D6.4
Future Dissemination & Exploitation Plans

Deliverable Report

NOTICE

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PU	Public
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RE	Restricted to a group specified by the consortium (including the Commission Services)
CO	Confidential, only for members of the consortium (including the Commission Services)

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SUNSEED project

SUNSEED proposes an evolutionary approach to utilisation of already present communication networks from both energy and telecom operators. These can be suitably connected to form a converged communication infrastructure for future smart energy grids offering open services. Life cycle of such communication network solutions consists of six steps: overlap, interconnect, interoperate, manage, plan and open. Joint communication networking operations steps start with analysis of regional overlap of energy and telecommunications operator infrastructures. Geographical overlap of energy and communications infrastructures identifies vital DSO energy and support grid locations (e.g. distributed energy generators, transformer substations, cabling, ducts) that are covered by both energy and telecom communication networks. Coverage can be realised with known wireline (e.g. copper, fiber) or wireless and mobile (e.g. WiFi, 4G) technologies. Interconnection assures end-2-end secure communication on the physical layer between energy and telecom, whereas interoperation provides network visibility and reach of smart grid nodes from both operator (utility) sides. Monitoring, control and management gathers measurement data from wide area of sensors and smart meters and assures stable distributed energy grid operation by using novel intelligent real time analytical knowledge discovery methods. For full utilisation of future network planning, we will integrate various public databases. Applications build on open standards (W3C) with exposed application programming interfaces (API) to 3rd parties enable creation of new businesses related to energy and communication sectors (e.g. virtual power plant operators, energy services providers for optimizing home energy use) or enable public wireless access points (e.g. WiFi nodes at distributed energy generator locations). SUNSEED life cycle steps promise much lower investments and total cost of ownership for future smart energy grids with dense distributed energy generation and prosumer involvement.

Project Partners

1. TELEKOM SLOVENIJE D.D.; TS; Slovenia
2. AALBORG UNIVERSITET; AAU; Denmark
3. ELEKTRO PRIMORSKA, PODJETJE ZA DISTRIBUCIJO ELEKTRICNE ENERGIJE D.D.; EP; Slovenia
4. ELEKTROSERVISI, ENERGETIKA, MERILNI LABORATORIJ IN NEPREMICNINE D.D.; ES; Slovenia
5. INSTITUT JOZEF STEFAN; JSI; Slovenia
6. GEMALTO SA; GTOSA; France
7. GEMALTO M2M GMBH; GTOM2M; Germany
8. NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO; TNO; The Netherlands
9. TOSHIBA RESEARCH EUROPE LIMITED; TREL; United Kingdom

Project webpage

http://www.sunseed-fp7.eu/

Executive Summary

This report highlights the plans of the project partners on the future exploitation and dissemination of the results achieved in the project. Exploitation and dissemination of the project results is a key goal that is essential for providing a successful project conclusion. The plans contained in this deliverable form the basis of how this can be achieved in a realistic and targeted manner, given the resources available. While some of the dissemination and exploitation activities will be executed during the lifetime of the project and other activities will continue beyond the project period.

The document is structured so that the high level rationale and goals (including the relevant existing industry groups) are introduced first followed by the exploitation methodology, which is split into exploitation routes and then exploitation opportunities (considering the different SUNSEED solution technologies). Then individual partner specific dissemination and exploitation plans are presented.

1. Introduction

This deliverable provides details of the SUNSEED dissemination and exploitation plans in order to achieve the goal of protecting IPR and knowhow generated within the project and to ensure the relevance and exploitation possibilities of SUNSEED developed solutions. The initial plans for exploitation were outlined within the SUNSEED description of work document WP6 task descriptions. These have been elaborated and refined during the project lifetime in order to ensure that focus and momentum is maintained. This is also essential for rapid reaction to advances within the market and other external factors which may have an impact on the project solutions.
The broad strategy used by the SUNSEED project is for all partners to:

1) Identify the exploitation opportunities within their relevant business sectors;
2) Identify the corresponding market opportunities;
3) Identify the prior art and the gaps (opportunities) to develop new IPR;
4) Secure the relevant IPR and perform technology development;
5) Determine the most promising exploitation routes for each exploitation opportunity (i.e. such as through standardisation or directly with product divisions);
6) Identify any barriers to exploitation (such as regulations etc.);
7) Refine the plans for achieving exploitation along the identified routes as technology is developed;
8) Monitor and adapt the plans as the technology is developed, and project and opportunities evolves.

2. Project Exploitation Plans

The first step towards careful design and evaluation of the exploitation activities for the project is to define the high level rationale and goals for the project, the exploitation routes and opportunities, the exploitation methodology, and potential business models.

2.1 Rationale

SUNSEED objective is to produce a set of guidelines on how to overlap, combine and interconnect, i.e. converge, DSO and telecom communication networks for dense DEG (distributed energy generation) smart energy grids as an evolutionary development from state covering end to end infrastructure (last mile to network operations centre, HAN, FAN/NAN, WAN). SUNSEED systematically addresses this with plan procedures, tools, long-term maintenance procedures and produces a set of guide books to shorten learning curve. It is part of SUNSEED investigation and field trial goals to assess and quantitatively determine viable networking possibilities on the physical, logical and topology layers viewed holistically from combined DSO-telecom perspective.

2.2 High Level Goals

1. Design, deploy and operate guidelines for DSO-telecom converged communication network for support of dense DEG smart energy grid.
2. Develop advanced measurement and control sensor node for DEG smart grid monitoring.
3. Use intelligent analytical and visual tools to manage, monitor and control these resources.
4. Produce guidebook for DSO-telecom converged communication network operations for dense smart grid energy networks, based on results of large scale field trial.

2.3 Identification of potential exploitation opportunities

Business model innovation either to create new services, optimise or improve efficiency of operations or reduce operating and or maintenance costs is a key driver to promote SUNSEED innovations. This also involves removing any barriers or creating new opportunities.

Regulation and Policy drivers are also major factors in adoption of SUNSEED solutions. There are currently many regional variations in the regulations throughout Europe, which hamper the deployment of solutions. Hence, opportunities for exploitation will depend heavily on these factors. For instance, reliability targets and meter roll-out strategies are typically governed by national regulations although European targets are defined.

Standardisation and open interfaces are expected in exploitation of SUNSEED solutions, as no single vendor will support the complete overall solution. Also, it is evident that many existing standards and proprietary solutions exist to parts of the solution. Hence, it is necessary to adapt existing standards and also introduce new features (where necessary) in order for adoption in the market place. In fact, European and international standards are deemed to be essential for cost-effective solution deployment.

Enhancements to existing solutions are also essential and do not necessarily require new standards or regulation in order to facilitate adoption. However, in this case the key measure is the cost/benefit

evaluation, which must meet the requirements of the utilities and end customers in order to secure adoption.

2.4 Exploitation Methodology

In this section, we define the main exploitation routes for SUNSEED results and then define some potential opportunities related to different SUNSEED solution technologies. The exploitation methodology for SUNSEED involves four main exploitation routes:

- **Innovation (IPR) route** - Identify, prioritise and fill key Prior-Art gaps
- **New products / services route** - Exploitation through new products / business opportunities
- **Enhanced products / services route** - Exploitation through enhanced products
- **Standardisation route -** Exploitation through standardisation (i.e. common interfaces) to facilitate new integrated solutions and economies of scale

The first route involves identification of the key gaps in existing prior art that could be filled by the IP and technology development within the SUNSEED project. The second involves identification of new products/services and business models, which are enabled by the technologies under development within SUNSEED. The third and fourth routes consider the enhancement of existing business models, products and standards to facilitate a greater value proposition. For instance, this can include lowering costs by increasing the market (exploiting economies of scale) also by creating more competition and facilitating products and solutions that achieve optimised trade-offs between cost and performance.
Product opportunities will be refined further by consultation with the appropriate product divisions within the partner organisations. This information will also be shared amongst partners as far as is possible.

The different product / service technologies considered by SUNSEED are:

- Advanced Metering Infrastructure
    - Communications requirements for dense DEG smart grid used for planning power communication infrastructures.
    - Dense DEG smart grid planning process and development plan based on integrated power communications layers GIS.
    - The WAMS device which can provide secured GPS synchronised phasor measurements with lower production and installation costs for the distribution grid compared with current PMU deployments
    - Ultra-reliable communication via multiple access networks (GPRS, UMTS, LTE)
    - 802.11AH based WLAN technique for metering network
- Decision support system modules including the validation of models
    - Power measurements with accurate high resolution power system data and predictions within distributed prosumer oriented energy distribution grid.
    - LV losses measurements and continuous voltage profile measurement to assist planning for future DEG deployment and voltage regulations in distribution power system.
    - Geographical requirements within unified GIS presentation system and backend integration with SLA Oblicore system.
- New services, training and support for education

- Methods and tools for dimensioning, planning and optimization of the combined DSO and telecom network infrastructure, used also for providing design and consultancy for any stakeholder in smart grid deployment process.
- Enhancing curricula through introduction of new energy management and communications subjects at PhD studies.
- Developed software services on FPAI to extend portfolio of smart grid management tools and consultancy services.

- New Solutions
  - New business models for lowering overall costs using free and open source solutions
  - Service platforms that enable efficient, reliable and scalable smart grid operations used for centralised or distributed operations of VPP, microgrids and hybrid solutions.

  An embedded eUICC based end-to-end security platform for M2M communication.

2.5 Business Models

Six potential business models applicable to the integrated approach developed within the SUNSEED Project are identified in Deliverable D2.3.1. The main focus is on communications networks and who can take business roles associated with ICT in general to bring the best value to smart grid market place and society at large. In particular, we foresee that communication network convergence will not only have better technical properties, but will result in more cost effective smart grid system as result of future proof technical optimised model. Total costs of distribution of energy which part of them are also costs of communication should decrease in the future. Deliverable D2.3.4 provides a detailed technoeconomic study.

3. Per Partner Exploitation Plans

This section provides a summary of the exploitation plans of each partner. There are some details of individual partner exploitation plans that will not be shared within this document due to the sensitivity of the information. However, the aim is to establish a transparent process for identifying and permitting the most promising exploitation paths for the maximum benefit of the project.

3.1 Telekom Slovenije

Partner Profile
Telekom Slovenije is a comprehensive communications service provider in Slovenia. It is recognised as the leader in the introduction and connection of new generations of mobile and fixed communication services, system integration and cloud computing services and multimedia content. The Telekom Slovenije Group is among the most comprehensive communication service providers in South-Eastern Europe. In addition to being the national telecommunications operator in Slovenia, it also operates through its subsidiaries on the markets of South-Eastern Europe in Kosovo, Macedonia, Bosnia and Herzegovina, Croatia, Montenegro and in Germany. The Group activities include fixed and mobile communications services, digital content and services, multimedia services and digital advertising, system integration and cloud computing services, construction and maintenance of telecommunications networks.
Individual Goals of Exploitation
TS is building a new generation of mobile networks with multi radio technologies while at the same time we understand that support for legacy 2G/3G/4G services must be extended for a much longer period of time. On one side, new high speed communications solutions are cornerstones of future reliable smart grid communication subsystems offering many redundant pathways to assure highly available smart grid operation while on the other side all mature technologies will become legacy much faster than in the past. Regarding this we understand that today's technologies need to be supported for more than a decade. TS is also strategically pushing into greener infrastructure operations (energy efficient data center design) with emphasis on PV installations (rooftop, base stations), where extensive custom designed sensor network is deployed. The last mile and the smart real estate on one side of e2e chain will play a significant role in smart grid. We are considering involving SUNSEED outcomes and solutions in our smart home portfolio mainly for energy services. Results of field trial energy and communications flow measurements are readily transferable and scaled up to our whole mobile infrastructure (> 1000 base stations), for such nationwide solution to achieve energy, CO2 savings. The whole operations will be integrated within our IT backend operations systems (OSS) e.g. GIS, Granite inventory, Oblicore SLA fulfilment. All this combined will bring about tangible operational cost savings, especially in energy consumption and CO2 footprint, since we as a large enterprise spend several million EUR per year on electrical energy alone. We foresee three major long term pillars originating from SUNSEED: enhancing availability of communication network systems, new end user services combining telecommunications and

energy markets, significant new knowledge and IP gains.

Identified Exploitable Project Results and Strategic plans for exploitation

1. IaaS;

Infrastructure as a service as sharing and reusing of existing networks including next physical network segments:

- Ducts; sharing existing ducts and planning a new investments in ducts infrastructure besides telco also for smartgrid needs
- Fiber optics; sharing and reusing optic for telco and smart grid, sharing WDM wavelengths
- Co-locations; utilization of existing locations and co-locations for smart grid
- Radio spectrum and mobile planning according to real-time and non-real time applications for smart grid

2. Managed network services for smart grid communications

TS communication networks which were used in field trial and its scaled impact on wireless (WiFi, LTE) networks will lead to optimal configuration of a network which supports all demands of a present and future needs of smart grid. Results of field trial showed that mobile infrastructure reach expectation and demands of smart grid needs. The whole operations can be integrated within our IT backend and business operations systems (OSS) e.g. GIS, Granite inventory, SLA fulfilment systems.

3. Security as a service

TS can build security level ISO 270001 to securing the smart grid on fixed communication networks and offer secure SIM elements on SIM cards and SM platform.

- Security as a service is a part of TS offer for internet networks and can be reused to a certain extent and added with new security functions according to grid security regulation. ISO27001 architecture can be and will be offered to grid operators.
- A TS dedicated secure element on a SIM card will be a part of our offer for grid operators in mobile networks
- Subscription management platform for eSIM based smart grid devices and element scan also be used on one hand as a security and on the other hand as a radio coverage optimization in multi SM interoperability ecosystem.

4. Hosting and data center sharing

TS data center in geo-redundancy mode is a secure and disaster proof data center. Data center can be reused for storage of vital and important grid data. TS can offer to grid operators a full data center solution in a pay-as-you-grow model which eliminates huge investments in data centers in the beginning and dynamically growing according to needs.

5. Operational cost savings

All the data collected from smart grid will be research and mined can show operational cost savings, especially in energy consumption and CO2 footprint, since we as a large enterprise spend several million EUR per year on electrical energy alone.

6. Energy supply and energy services

TS will exploit SUNSEED project to enter smart grid services and energy market.

TS entered into energy supply market in 2016. Sunseed deliverables will be exploited also for

electricity supply at a beginning for predictions optimization and net metering services and later for future energy services like balancing demand for EV, sub-metering, dynamic pricing etc.. - Smart grid Quality control Service: big data exploitation for SAIFI, SAIDI and MAIFI indexing - Error detection and alarming service: enables better network management operation and improving quality of error detection and problem solving error solving and detection improving with additional measurement devices (phase detection, unbalance of voltage, different network disturbances, etc.) - Error and outage predictions service (history data mining and correlation with public environment data) 7. GIS and maps services TS will exploit GIS system which is now used for radio network planning and physical network optimization of routes for DSOs. GIS system enables DSOs better network planning, route selection and physical network cost optimization (network reusing and investment sharing). 8. Services for end users Smart Life service for household and buildings of TS will reuse data from SUNSEED project for several use cases like: - Energy efficiency - Electricity cost optimization - Alarming based on events (grid outages) through base station SMS broadcast - Visualization of energy data on all screens (PC, smart phone, IPTV sets,...) - Electricity consumption benchmarking of local communities (student campus, local urban areas, suburban areas, mountains, costal buildings, …)
Project results to be disseminated (mainly through publications)
Project results, particularly those verified through field test, improve basis of understanding how such kind of (sub)networks might impact the carrier network when M2M and IoT is massively deployed. The topic covers network architecture, topology, protocol stacks and also planning costs of licensing fees. Those results will be disseminated mainly through presentations at various domestic and international conferences, seminars and symposiums.
Indicative relevant activities performed this period
There have been activities on SunGIS platform marketing, the goal is to position it as a network monitoring support tool for DSOs, either as a solution deployed within DSO's infrastructure or as a service residing in TS's cloud infrastructure. TS's GIS solution have been also recognized as a platform candidate in recent activities within project of Slovenian smart specialization lead by Slovenian government.

3.2 AAU

Partner Profile
The Department of Electronic Systems is one of the largest departments at Aalborg University (AAU) with a total of more than 300 employees. The department is internationally recognized in particular for its contributions within Information and Communication Technology (ICT). The staff members involved in the project belongs to the MASSM2M group which focuses on M2M radio technologies and with the Antennas, Propagation and Radio Networking (APNet) section which focuses on antennas and propagation transceiver solutions and networking concepts for emerging

radio communication systems.

The MASSM2M group has been very active within the M2M scope and has pioneered several novel approaches such as coded random access, multi-flow communication schemes, wireless network coding, and has been active in the area of relaying and multi-hop communications. The group has several publications, patents and several funded projects in these same topics.

Individual Goals of Exploitation

Involved researchers, especially PhD students will benefit from the interdisciplinary and cross sector nature of the consortium and mix of the theoretical background with real life challenges, and have access to the entire propagation path of engineering ideas and solutions: from their initial formulation and analysis in academia, over algorithmic solutions and software/hardware implementations, all the way to final products. The developed skills in power and ICT engineering and entrepreneurship within smart grid framework will be an important asset in future. Project will also foster cross-sector cooperation at AAU, involving communication, control and engineering departments and thus increasing AAU competences. The potential exploitation of the collaboration is through creation of improved/enhanced curricula at AAU regarding the multifaceted nature of smart grid, joint application for future smart grid projects and creation of related research positions. Other benefits are: opportunities to apply the designed solutions in the experimental facilities of the AAU (existing smart grid laboratories), potential exploitation of the results through spin-off companies that offer reliable communication solutions for business/industrial use, and patenting of the results.

Identified Exploitable Project Results and Strategic plans for exploitation

- **LTE performance models of limitations in the access reservation procedure**: The developed models are used in our own current and future works to characterize the performance of legacy LTE systems, but can also be readily used by other students, researchers, or network planners, since the models are fully described through journal and conference paper publications, as seen in D6.2.2. This model is the first to comprehensively model the different limitations of the LTE access reservation procedure in a joint framework.
- **Multi-interface communications**: The proposed transmission strategies allow to first and foremost increase reliability by transmitting simultaneously via several communication interfaces. Thereby, the latency for a given reliability level is lowered. Secondly, the proposed optimization of strategies enable trading off latency and reliability through flexible packet splitting approaches. Thereby, the different available interfaces' properties are optimally exploited. The ideas for multi-interface transmissions that were matured during the SUNSEED project, will be further developed in future research.
- **M.Sc. and Ph.D. course**: The knowledge and experience acquired within the SUNSEED project will be integrated in the relevant teaching curricula, especially in courses that cover the topics of communication in machine-to-machine systems, such as smart grids.

Project results to be disseminated (mainly through publications)

During the course of the SUNSEED project, AAU has disseminated its research results in publications to the following conferences and journals. The topics of the disseminated research covers project overviews, enhancement to cellular access protocols for improved reliability, multi-

interface transmissions, and field trial measurement analysis.
Conferences:

- IEEE Global Communications Conference (Globecom)
- IEEE International Conference on Communications (ICC)
- IEEE International Conference on Smart Grid Communications (SmartGridComm)
- IEEE Signal Processing Advances in Wireless Communications (SPAWC)
- Global Wireless Summit

Journals:

- IEEE Journal on Selected Areas in Communications
- IEEE Communications Magazine
- IEEE Wireless Communications Magazine
- IEEE Wireless Communications Letters
- IEEE Transactions on Communications

3.3 ES

Partner Profile
The company Elektroservisi d.d. has been present on the electrical construction market for numerous years meeting the needs of the infrastructure companies mostly concerning the devices for transmitting and distributing electric power. Among company divisions is Metering laboratory, the first Meter Maintenance Laboratory in Slovenia which is granted eith accreditation and a decree sheet of nomination as a control body in the area of electricity meters and metering. transformers and switching clocks.
Individual Goals of Exploitation
Researchers and engineers will be able to broaden their knowledge of future communication technologies not just among Smart Meters but also beyond telecommunications used in energy sector developing of new business models and auxiliary services to DSO. Project will show the importance of smart meters in the near future according the trends in the field of power transmission (energy) and sustainability. Therefore company Elektroservisi d.d. as member of commission, under the supervision of Metrology Institute of the Republic of Slovenia is able to contribute greatly the idea of making fast developement and future integration. We are able to create or optimize techno-economic model regarding verification of meters and metering equipment. We have the vision within development of new services that Laboratory will offer to DSO and others stakeholders (aging and life expectancy test of smart meters, new field test, power quality test, PLC/DLC troubleshooting, etc). DSM (for example Dynamic Pricing Programs) requires skilled approaches towards end-user who are demanding transparent explanation of the technology choices. We will develop various presentations and create supporting documentation for all involved end users (bridging the gap between environmental and financial benefits of DR). On the other hand, with accreditation expansion of Lab and as independent service provider of VPP, we will be able to employ new qualified engineers.

Company has focused on communication channels maintenance from meter to concentrator and ensuring high reliability for billing data reading. It includes remote maintenance, detection and elimination of interference on the network and control of specific parameters of long operating meters based on field requirements.
Identified Exploitable Project Results and Strategic plans for exploitation
- Development of basic procedures and tools for communication channel cleaning. Distribution companies give us access to individual locations, based on this project. We have learned disturbances cleaning, using specially designed tools and we have achieved positive results. In the process we get trust from distribution companies. Together we developed new service and design new business model for providing it. - Equipment developed under this project provides us implementation of standardized measurement method for disturbances detection and useful signal power measurement. All measurements are done in accordance with EU harmonized standards. As notify independent laboratory we can determinate level of disturbances or useful signal power in case of legal disputes between the distribution company and individual consumers. - Based on this project we have access for testing new generation of smart measurement equipment which in not jet in general use. We also strengthened our position as a competent partner of electrical distribution companies for consulting and providing services for implementation and maintenance of measuring equipment. We have achieved next level of cooperation with distribution companies. In addition for providing metrological accuracy and maintenance we can provide implementation of smart maters in field, parameterization of smart meters, PLC communication establishment, maintenance and disturbances cleaning. - We learned about new technologies based on involvement in the project. Based on that fact we expect transfer from PLC-FSK on PLC-3G technology is going to be much smoother for us. - We upgrade our work and knowledge on to the next level – complete HES data acquisition. The goal is use of the data base for development of new maintenance tools, which is going to enable us preliminary identification of source and type of disturbances based on experiences, practical field disturbances cleaning and data base processing. That fact is going to help us optimizing our work, shortened the response time, and raise productivity, because our maintenances groups is will have all the necessary data where and what is the problem need to be solved for PLC communication reestablishment.

3.4 EP

Partner Profile
Elektro Primorska d.d. is electrical distribution power system operator in Slovenia, managing 8000 km of MV and LV network, 16 HV/MV substations and 2300 MV/LV transformer stations in western part of Slovenia. Distribution network is supplying 130000 consumers in 2012, consuming 1541681 GWh / year. In 2012 our peak power was 263.9 MW. Total number of currently

connected distributed energy sources (DER) is 438 with total installed power 94.4 MW. Majority of DER-s is PV solar (54.8 MW), hydro (27 MW) and CHP (9 MW). Wind power is currently 2 MW, more wind generators are expected. SCADA with OMS module is used for network control and management. Currently there are 18000 consumers connected for remote consumption data analysis.
Individual Goals of Exploitation
By participating in the project SUNSEED EP expects positive effects on the primary field of business as well as in new opportunities, based on smart grid technologies. EP is managing power system distribution network. As DSO main goal is to assure quality of power supply to all users of power system. This are: continuity of supply, as measured by the index SAIFI, SAIDI and MAIFI; voltage Characteristics of Public Distribution networks based on standard EN50116, commercial quality. New technologies and customer requirements need strong integration between DSO and telecommunications operators with modern data management. EP is already involved in regional pilot projects in field: unification of communications in substations; AMI – PLC communication testing. EP will offer support in research and development of energy and communication infrastructures, services and shape new requirements based on SUNSEED goals and provide testing in real environment with high penetration of DER (PV solar, hydro, wind, CHP). Elektro Primorska will fully exploit SUNSEED equipment, developed technology and services. We see the WAMS SPM nodes as an indispensable measuring element in future distribution network as it is a basis for some advance services like unbalance state estimator, protection pattern recognition, phase detection. With state estimator we will achieve the complete observability especially in low voltage network.
Identified Exploitable Project Results and Strategic plans for exploitation
- Performing further research on using mobile cellular communication network for operational measurement devices connection. - Gradually spreading FTTH communication network owned by DSO. - Further development of business models between DSO and telco operators regarding usage of coverage networks. - Sunseed results identify a state estimation as a key management function in distribution power network control ensuring power network fully observable. For this reason it has the highest priority in short-term future plans for improving network management systems. - Synchro phasor measurements with WAMS is advance multipurpose measurement system which significantly improves power network management and solves operation problems relating phase detection, voltage unbalances, disturbances recognition, protection management, state estimations, power system balancing, etc. For that reason EP is fully interested for further research in field of phasor measurements for WAMS and even WAMPAC systems.

3.5 JSI

Partner Profile
JSI is the central research institution for natural sciences and technology in Slovenia. The research stuff paticipating in the SUNSEED project belongs to two departments, the Department of Communication Systems and the Artificial Intelligence Laboratory, thus combining the expertise in

wireless communications, networked embedded systems, web services, machine learning, and data mining and analytics. The Department of Communication Systems is responsible for the development of integrated hardware and embedded software solution, i.e. measurement and control devices, for the deployment in field trial and evaluation of use cases covered by the project; for precise measurement of load/grid operational data and its transmission to the data storage and processing server; for modeling of the energy grid; and for the developement of the state estimation software tool. The Artificial Intelligence Laboratory is concerned with the development and implementation of advanced load/grid data analytics, anomaly detection and event prediction modules supporting the state estimation software tool. The work in the SUNSEED project largely builds on the previously developed hardware platform VESNA and software tools for multimodal data analysis.

Individual Goals of Exploitation

JSI as a research institute is involved in many different basic and applied national and international projects through which it exploits and extends the existing and newly acquired and/or enhanced knowledge, competences and experience. In these projects the activities of JSI typically extend from investigation of basic principles up to prototyping of developed solutions for integration, validation and demonstration in relevant environment, i.e. TRL levels 1 to 6, whereas for higher TRL levels generally carried out by an interested industry partner it only provides support upon request.

New knowledge, experiences and lower TRL technologies are typically exploited and further enhanced in subsequent projects and used in the higher education process at the Jozef Stefan International Postgraduate School, where it gets integrated in existing curricula. Validated technology as well as hardware and software prototypes are made available for further development or transfer to the final operational environemnt, typically by way of industry partners. Industry partners may be identified among the partners of existing projects or via the institute's own Center for Technology Transfer and Innovations, responsible for (i) protection and/or transfer of IPR, (ii) support in establishing spin-off companies and (iii) search for additional funding / investors.

With respect to the results obtained in the SUNSEED project JSI will strive to reuse, adapt and further develop hardware and software components in various national and international projects and pilot deployments, ultimately looking for interesting final beneficiary/ies or commercial investors. Initial steps in this direction have been already made by planning adaptation and enhancement of CP-SPM and CP-PMC device prototypes in several H2020 project proposals currently under evaluation. As public non-for-profit institution JSI also strongly supports open data initiative and aims at preparing representative data sets from CP-SPM and CP-PMC devices ready for use by other research groups and projects. Part of results will be integrated into education curricula and taken further within the experimental part of PhD research work of selected students.

Identified Exploitable Project Results and Strategic plans for exploitation

Among the identified exploitable results we can in general distinguish among (i) two variants of prototype devices (combining PMC or SPM module with a common CP module) that comprise dedicated hardware and software solutions for the operation in trial environment and to support the project use cases, (ii) a modular metering and control devices management platform binding, (iii) monitoring/visualization module, (iv) distribution grid state estimation module, (v) advanced real-time analytics and short-term generation/consumption prediction module, and (vi) and recommendation and decision support module.

- PMC - Power Measurement and Control module
  This module in combination with CP module and FPAI or similar software solution represents functional prototype ready for demonstration in operational environment. Additionally to the deployment in JSI campus, aimed at monitoring of power quality and evaluation of energy management strategis for office and data center environments, a few CP-PMC devices are within the extended project lifetime going to be adapted for the use with commercial energy management software system and deployed in relevant environment of potential future commercial and productivization partner. If meeting the requirements, an agreement needs to be made on the conditions of IPR transfer and the timeframe for the preparation of final design ready for certification and productivization. The demonstration and testing period is expected to run from February until May 2017. Further development and enhancements of the CP-PMC device may be also part of future project proposals.
- SPM - Synchro-Phasor Measurement module
  This module in combination with CP module and the synchrophasor estimation algorithm developed by the project represents a functional prototype for the demonstration in the SUNSEED project trial at Elektro Primorska DSO. Within the extended lifetime of the project a few CP-SPM devices will be (i) adapted to support the standardised data exchange protocols (i.e. as defined by IEEE C37.118.1a-2014 and IEC 61850 standards), deployed in relevant environment in parallel to a commercial PMU device, and tested with commercial situational awareness software system (i.e. WAMS), and (ii) used as a baseline solution in prototyping the agent based system based on blockchain technology. If meeting the requirements, an agreement needs to be made on the conditions of IPR transfer and the timeframe for the preparation of final design ready for certification and productivization. The demonstration and testing period is expected to run from March until June 2017. Further development and enhancements of the CP-SPM device are planned also within future projects (already envisaged in submitted proposals).
- CP – Communication and Processing module
  CP-PMC and SP-SPM devices have been designed in fully modular fashion, making possible also partial explitation of individual or combined modules. To this end the CP module can be also used independently, i.e. as a processing and communication module in other applications requiring Linux environment, RS-485 (ModBus), Ethernet, Wi-Fi or LTE connectivity, and GPS/GNSS bases time synchronization. Similarly PMC and SPM modules mentioned above can be taken into exploitation as standalone advanced metering devices depending on external provision of data processing and communication link. The CP module is ready for integration in third party devices with the exploitation conditions depending on the agreement with interested parties. Within the extended project lifetime the CP module will be used with external partner to prototype generic meter data acquisition and transer to the cloud for post-processing purposes. The CP module is also used in some other existing and proposed research projects.

- Metering and control devices management platform
  This software solution is used as an independent tool to support (i) the process of devices deployment and registration to application server, (ii) devices remote configuration and logical clustring, (iii) the set-up of the communication paths, data formats and protocols, and (iv) remote software management on individual devices or clusters. Such tool is useful as a baseline for adaptation to IoT solutions in future research and commercial projects addressing different application domains. In its current form, combined with the modules and functionalities developed in the SUNSEED project and outlined below, it already provides a decision support solution for the selected use cases at the project partner Elektro Primorska, while it would require some adaptation for the use by other DSOs as well as for covering further use cases. Modules are thus primarily exploitable as a bundle and not planned for individual exploitation, but will be offered for demonstration and further development in future research projects.
- Monitoring/visualization module
  This software module is used for displaying measurements obtained by CP-SPM devices and can be used for monitoring their correct deployment and operation. It is planned to be provided as part of trial deployment along with CP-SPMs. No further development or enhancement is planned on this module beyond the requirements of the SUNSEED project, but already in its current version it has practical value for the distribution grid operator involved in the project. As part of grid state estimation module it is not planned for individual exploitation.
- State estimation module for the distribution grid
  State estimation module is independent of the underlaying topology of the grid and as such directly applicable to any DSO as long as appropriate model of the grid is provided along with CP-SPM and smart meter measurements. Functional prototype, to be demonstrated in SUNSEED on the grid of Elektro Primorska, will be ready for adaptation and pilot use by other interested DSOs. In addition to state estimation in points of interest without own measurement data it also provides power flow analysis per grid branch. Individual exploitation is not planned at this stage.
- Advanced real-time analytics and short-term generation/consumption forecasting module
  This module is based on some previously developed core modules and tools and has been supplemented and adapted for the use on big data from smart grids. As such the core is already part of other running and proposed projects where it is complemented with other domain specific submodules and adapted to other use cases with rich real-time data flows. The functional prototype, to be demonstrated in SUNSEED on the grid of Elektro Primorska, is planned to be further developed in follow-up projects.
- Recommendation and decision support module
  The functional prototype of recommendation and decision support module, to be demonstrated in SUNSEED on the grid of Elektro Primorska, is designed to provide recommendations to the grid operator and not to act on its own. As such it is not planned for individual exploitation.
- Methodology for grid modeling and determination of optimal positions of CP-SPM devices
  State estimation, advanced analytics and recommendation modules require excellent knowledge about the grid, provided in the form of an appropriate model. Along with the particular modules of the overall sulution, JSI will provide to interested parties also the experiences and know-how in grid modeling as well as the algorithm used for

determining optimal number and positions of CP-SPM devices. - Postgraduate courses The newly acquired knowledge and experience will be integrated in the education process at the Jozef Stefan International Postgraduate School, in particular in courses concerned with (i) modeling and simulations in telecommunications, (ii) sensor technologies, (iii) wireless sensor networks, and (iv) wireless communications.
Project results to be disseminated (mainly through publications)
As an academic institution JSI regularly disseminates newly acquired knowledge and insights through scientific publications in renowned international journals and at leading conferences. In addition to already published results JSI foresees further publications related to the state estimation and sensitivity analysis, accuracy of synchrophasor estimation algorithm and consequently the impact on the grid state estimation, the implementation of embedded measurement and devices, etc. We envisage also two PhD theses direclty related to the research work in part conducted within the SUNSEED project, one concerned with state estimation and the other with short term load forecasting. In addition to the dissemination of research results and trial experiences via publications, JSI and Gemalto together with ENGIE, a French utility company that expressed clear interest in the project results, prepared a demo based on CP-SPM device for the Utility Week 2016.

3.6 GTOSA

Partner Profile
Gemalto SA is the world leader in end to end digital security solutions and has the vision to simplify day to day object or personal digital interactions. Our activities range from the development of software applications to the design and production of secure personal devices (with a world-market position), such as smart cards, SIM/USIMs, epassports and tokens. Gemalto SA is also a strong leader in the development and production of M2M devices for various sectors such as Automotive, Energy or Industrial Applications (#1 one world-wide in volume and #2 in $ value).
Individual Goals of Exploitation
Gemalto SA is deeply committed in the deployment of managed services for our customers. The primary interest in the SUNSEED project is related to the definition of security solutions for smart grid appliances. Gemalto security contributions in the project are revolving around two main values propositions: - Plug and play security in the smart grid devices (WAMS) Thanks to the use of an embedded secure element in the WAMS. - Fine grain access control capabilities for smart grid applications based upon the use of Oauth2 authorization protocol.

In the M2M domain Gemalto ambition stated in the three year plan is to be positioned to provide security solutions on three vertical domains:

- Smart health
- Energy
- Personal life and wearable

Our action in the SUNSEED project is therefore perfectly in line with Gemalto corporate strategy. SUNSEED pilot project will act as a showcase of Gemalto Security solutions and help promote our security solution and generate business. This business will be generated along 2 lines:

- Commercialization of embedded security solutions, primarily to smart grid equipment manufacturers.
- Commercialization of platform and services solutions to energy service providers: DSO, TSO, aggregators…

Identified Exploitable Project Results and Strategic plans for exploitation

The technical work performed in SUNSEED has resulted in the developpement of a 3 component solutions:

- An embedded soution for smart grid appliances including »solder and play« secure elements to be embedded in smart grid appliance, along with the embedded software stack and demosntration software. One of the main design goals was to simplify the implementation of security for application developpers, and a particular focus has been put on this aspect
- An authorization server platform, enabling to manage access control in an IOT ecosystem
- A template of a proxy server to be used along with non auth compliant IOT platforms.

Those three components will constitute the core of Gemalto smart grid solution.

Project results to be disseminated (mainly through publications)

The security architecture used in SUNSEED is well suited to smart grids application; It has been described in a paper which been submitted and accepted in IEEE wireless communications.

Indicative relevant activities performed this period

During this reporting period, the Sunseed project and particularly Gemalto and JSI had the opportunity to collaborate with Engie to perform a joint demonstration at the Utility week (Amsterdam, November) of a crowd funded solar panel deployment used case. The demo was done successfully on the engie booth and raised significant interest. In order to setup this demonstration, building blocks from the SUNSEED projects were reused and adapted to the use case demonstrated. In particular, the WAMS and associated security solution where leveraged to assemble the demonstration setup. This effort is curently being pursued, and may lead to the identification of commercial opportunities.

Result/Outcome	**Goals**	**Success Indicators**	**Timeline**
Trust solar panel measurement	Proof of concept prototype	Functional demonstrator	April 2017

3.7 GTOM2M

Partner Profile
GTOM2M is a Machine-to-Machine (M2M) industry pioneer and market leader for more than 15 years, Gemalto M2M GmbH (until 2nd May 2013: Cinterion wireless modules GmbH) gives customers the confidence to excel in a complex M2M ecosystem through the foundations of expertise, security, simplicity and partnership.
Individual Goals of Exploitation
We expect from the project that we will expand in the M2M market and unlock new targets in the area of security related. We recognized that there is a high demand at both sectors DSO and telecommunication operator. Secure communication and securing of data itself will be more important in the future.
Identified Exploitable Project Results and Strategic plans for exploitation
- Preparation and deployment of IPv4 and IPv6 support for our M2M module with main emphasis in the area of Iot in the M2M market - Development of products which support direct access to Secure Elements and preparation of products with Secure Elements on board. This allows increased security in data transmission and opens up new business areas in the M2M market.

3.8 TNO

Partner Profile
The Netherlands Organisation for Applied Scientific Research (TNO) is a non-profit research organisation, with a mission to create innovations that boost the sustainable competitive strength of industry and well-being of society. TNO has about 3500 employees, who are organised into a matrix organisation of seven themes, each with a prominent place in the national and European innovation agenda, including the 'Information Society' and 'Energy' theme. The involved departments, 'Access Technology' and 'Service Enabling and Management', have strong knowledge and broad experience in both, wireless, wired, home etc. networking, at one side and on the other hand service enabling platforms, and electricity distribution control software for matching electricity supply and demand. TNO is involved in standardisation in a number of bodies such as ETSI and 3GPP.
Individual Goals of Exploitation
TNO is an independent research organisation whose expertise and research make an important contribution to the transition of the traditional top-down power flow of electricity to a future smart grid for a variety of customers: governments, the SME sector, large companies, service providers and non-governmental organisations. The real-time operations of smart grids, including encompassing distributed electricity generators (DEGs), is seen as important trends in the domain of electricity distribution systems. The realtime, reliable, affordable and scalable operation of these future smart grids form a challenging environment from a communication networks,

interoperability and business point of view.

TNO has a strong knowledge and expertise, including a recognized market position in providing technology and business solutions for communication networks of current telecommunication network operators. The SUNSEED results will enable TNO to expand its knowledge and expertise to support the communication requirements for electricity distribution operators (DSOs) of future smart grids and VPP entities. Further, as current telecommunication operators are expected to cooperate with DSOs and VPP entities it is crucial that within the SUNSEED project TNO develops the relevant knowledge and skills needed for such a cooperative approach. For example, TNO will develop tools and methodologies for designing communication networks, re-engineer existing communication network solutions, estimate the impact on existing (last-mile) communication network for support of the reliable and scalable smart-grid real-time operation. The SUNSEED methods and tools can be re-used for providing customized solutions for current and future TNO clients such as telecom operators, DSOs and VPP parties for deployment of future smart grids. These assets will further strengthen TNO's knowledge and market position in the combined telecommunication and electricity distribution work area. TNO is playing an important role in standardising the infrastructure interoperability in a uniform and open manner. For that, TNO provides the Flexible Power Application Infrastructure in SUNSEED. This infrastructure is developed within the Flexible power Alliance Network (FAN), which is an open industry alliance for the development and promotion of semantic (de facto) standards, with respect to communication of and communication with energy consuming and producing devices for end users. These standards will facilitate the emergence and use of energy services, on a uniform, accessible and cost-effective manner. The experiences and results of SUNSEED will be exploited within the FAN to improve the application infrastructure. The FAN standards are available free of charge which leverages the use of these standards.
TNO will develop and refine its current and future business models for the smart grid, based on the experiences within SUNSEED. It will allow and assist governments and industrial companies to make smart choices in which areas of the smart grid to subsidize and/or invest. TNO will also actively disseminate the SUNSEED research results in scientific and standardization forums in order to influence the ICT technology development towards the future smart grid support and to establish its bridging position between the industry and the academia in this work area.

TNO is investigating the possibility to use the FPAI developments of the SUNSEED project in a joint pilot project with one or more Dutch telecommunication providers to enable those telecommunications providers to offer smart grid services on the home boxes used to provide internet connections to their customers.

Identified Exploitable Project Results and Strategic plans for exploitation

- Extension of our expertise and performance analysis tools for providing consultancy to wireless network operators regarding dimensioning/configuration of their wireless networks for providing smart grid support.
- Extension of our commercial proposition towards utility companies and their communication networks department related to technology assessment and feasibility of communication performance targets.
- Exploiting the expertise and the performance analysis tools for further research in IoT enhancements in 4G and future 5G wireless cellular networks performed in future projects at TNO
- Extension of our IoT/Smart City proposition with respect to collecting large amounts of measurements from a large amount of sensors using XMPP, secure transmission of data and authorization of the data publishers and consumers

- Extension of our FPAI/EFI proposition by adding measurements to the EFI, generalizing the EFI interface to XML and adding XMPP functionality to FPAI clients as well as the ability to configure large groups of FPAI instances using the FPAI management center - Piloting the addition of energy services using EFI on home gateways in cooperation with a large Telecommunication Operator.

3.9 TREL

Partner Profile
Toshiba Research Europe Ltd (TREL) is one of four globalised corporate-level R&D organisations founded by Toshiba Corporation. TREL has its headquarters in Cambridge UK and incorporates two divisions, the Cambridge Research Laboratory (CRL) and Telecommunications Research Laboratory (TREL) which was founded in Bristol UK in 1998. TREL conducts research into software, protocol stack, physical layer and hardware design aspects of future mobile terminals and networks, as well M2M and smart grid.
Individual Goals of Exploitation
Toshiba is a global, world's leading provider of innovative ICT and energy solutions. In the SUNSEED project, Toshiba is interested in novel communication network architectures and service platforms that enable efficient, reliable, and scalable smart grid operations. In particular, we are interested in efficient and reliable infrastructures and data processing engines that support VPP and renewable integration. Further, as part of our smart community initiative, Toshiba will utilize knowledge and expertise gained through SUNSEED to further develop new applications and technologies for M2M type scenarios, such as smart cities, e-health, and ITS. TREL is hoping to pass on the consumption scheduling innovation to Toshiba Social Infrastructure Company and explore the possibility of new service offerings.
Identified Exploitable Project Results and Strategic plans for exploitation
- Innovation: By bringning together three different systems, smart meter infraastructure, electricity distribution network and telecommunications network, the SUNSEED project has created a unique set of know-hows and knowledge through trial data. Not only the innovation related to Wireless IoT optimisations, but also techniques specific to electricity network use cases will be continued after the project. It is envisaged that such research and development activities will result in intelectual propriety which will be used in products for more efficient infrastructures. - Standardisation: SUNSEED approach for utilising multiple metering devices over telecoms operators network will be presented to potential stakeholders to understand the standardisation requiremens from the stakehodler's viewpoint. Efforts will be directed towards contributing to standards development organisations such as International Electrotechnical Commission (IEC) to understand the agenda for standardization and where possible influencing the work in the standards committee through disseminating know-how gained from the SUNSEED project. The IEC SC3D WG2 (within which

Toshiba participate) develops standards related for defining common data dictionaries and interoperability between national and regional standards for defining product properties. This approach permits larger markets to be addressed with the same products, for instance global solutions that will conform to the needs of all Countries that participate within the IEC standards. The targeted exploitation within this group is to facilitate global interoperability for SUNSEED solution that make use of sensor and meter equipment (i.e. WAMS node, Smart meters and Communication Gateways (if applicable)). The size of this global market and other application domains offered by standardisation means that SUNSEED based solutions will present much more potential and interest if standardised.

- Commecial Exploitation:

Landis+Gyr, a Toshiba subsidiary (one of the largest European and Global smart meter manufacturers) has been already introduced to SUNSEED solution. Currently, active discussions are ongoing to determine the ways in which Toshiba and Landis+Gyr's future products in smart grid monitoring and control (http://eu.landisgyr.com/smart-grid-monitoring-controlling) can be differentiated and exploited via SUNSEED multi-sensor approaches. In addition Toshiba has a large transmission and distribution business which could exploit the new technologies developed within the SUNSEED in their future grid solutions. SUNSEED project results and technology has been already introduced to Toshiba T&D company and one of their biggest customers (TEPCO – Tokyo Electric Power company). Discussions are ongoing with Toshiba semiconductor business units and meetings have been arranged in the next six months.

Toshiba is a global corporation addressing various energy markets and conducting trials across the world to evaluate Low Carbon Technologies (such as Battery storages, PV, EV, and Hydrogen refuelling stations). TREL has proven track record to continue developing technologies from within EC projects in further smart energy regional pilot projects (such as the IoT platform from EC IceWater was continued in Levenmouth Community Energy Project (LCEP) in Scotland). SUNSEED solutions will also be introducted to future Toshiba trials in Europe and abroad in particular where a suitable requirement for monitoring and control is identified.

Finally, demonstrations of the SUNSEED approach for power network observability and operational optimisation will be proposed to the annual Research and Development Fair in Kawasaki (Japan) where over 3000 prospective Company representatives across the globe attend.

Indicative relevant activities performed this period

TREL introduced the WAMS proposed in SUNSEED as one of the potential business cases for the 5G network, in a consultant report by Vodafone. The SUNSEED system and results from the field trail have been presented to delegations of high level executives of Tokyo Electric Power Company, a Japanese electric utility, and Landis+Gyr, whose business is focused on metering and management of energy.

Result/Outcome	**Goals**	**Success Indicators**	**Timeline**
Accept SUNSEED technology? For evaluation by an in-house business division	Identify a use case and develop cost/benefit analysis for SUNSEED solution	Technology transfer of SUNSEED technology	2017