

D6.4

Future Dissemination & Exploitation

Plans

Deliverable Report



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RE	Restricted to a group specified by 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 NEPREMISLILNE 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, including the marketing for the SunGIS platform, as well as the promotion WAMS device and data analytics tools to potential customers are presented.

1. Introduction

This deliverable provides details of the SUNSEED dissemination and exploitation related activities during the project lifetime and corresponding plans after the end of the project 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 in WP6 task descriptions. These have been further elaborated and refined during the project lifetime in order to ensure that focus and momentum were maintained. This was also essential for rapid reaction to advances within the market and other external factors which may have had an impact on the project solutions.

The broad strategy used by the SUNSEED project with respect to dissemination and exploitation plans was 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 the project and opportunities evolve.

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 the current state covering end to end infrastructure (last mile to network operations centre, HAN, FAN/NAN, WAN). SUNSEED systematically addresses this with planning procedures, tools, and long-term maintenance procedures and produces a set of guide books to shorten the 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 is a key driver to promote SUNSEED innovations either to create new services, optimise or improve efficiency of operations or reduce operating and or maintenance costs. 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 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.

After the end of the project, 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 or/and pertinent to other partners .

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 GIS layers.
 - 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).
 - Std. IEEE 802.11ah based WLAN technique for the 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 telco network infrastructure, used also for providing design and consultancy for other stakeholders in smart grid deployment process.
 - Enhancing curricula through the introduction of new energy management and communications subjects at MSc and PhD studies.
 - Developed software services on FPAI to extend the 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 on the 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 lead to more cost effective smart grid system as a result of future proof technical optimised model. Total costs of energy distribution, part of which make also costs related to communications, should decrease in the future. Deliverable D2.3.4 provides a detailed technoeconomic study elaborating on this.

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

<p>Partner Profile</p>
<p>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.</p>
<p>Individual Goals of Exploitation</p>
<p>TS is building a new generation of mobile networks with multi radio technologies, at the same time being aware 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, TS understands that today's technologies need to be supported for more than a decade to come.</p> <p>TS is also strategically pushing into greener infrastructure operations (energy efficient data center design) with the emphasis on PV installations (rooftop, base stations), where extensive custom designed sensor networks are deployed.</p> <p>The last mile and the smart real estate on one side of e2e chain will play a significant role in smart grid. TS is considering involving SUNSEED outcomes and solutions in its smart home portfolio mainly for the energy related services.</p> <p>Results of field trial energy and communications flow measurements obtained in SUNSEED are readily transferable and can be scaled up to whole mobile infrastructure (> 1000 base stations), for such nationwide solution to achieve energy and CO2 savings. The whole operations will be integrated within IT backend operations systems (OSS) e.g. GIS, Granite inventory, Oblicore SLA fulfilment. All this combined will bring about tangible operational cost savings, particularly exhibiting in the form of reduced energy consumption and CO2 footprint, given that TS as a large enterprise spends several million EUR per year on electrical energy alone.</p>

TS foresees three major long term exploitation pillars originating from SUNSEED: enhancing availability of communication network systems, new end user services combining telecommunications and energy markets, and significant new knowledge and IP gains.

Identified Exploitable Project Results and Strategic plans for exploitation

1. IaaS;

Infrastructure-as-a-service (IaaS) concept as sharing and reusing of existing networks including the following physical network segments:

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

2. Managed network services for smart grid communications

TS communication networks, which were used in the field trial, and in turn 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 a smart grid. Results of the field trial showed that mobile infrastructure meets the expectations and demands of smart grid needs. The whole operations can be integrated within the IT backend and business operations systems (OSS) e.g. GIS, Granite inventory, SLA fulfilment systems.

3. Security-as-a-service

TS can build information security level ISO 27001 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 the Internet networks and can be reused to a certain extent and added with new security functions according to grid security regulation. ISO 27001 architecture can and will be offered to grid operators.
- A TS dedicated secure element on a SIM card will be part of offer for grid operators in mobile networks.
- Subscription management platform for eSIM based smart grid devices and elements can 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

The TS data center in geo-redundancy mode is a secure and disaster proof data center. The 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 allows for dynamically growing according to needs.

5. Operational cost savings

All the data collected from smart grid will be thoroughly investigated and analysed for the potential in operational cost savings, especially in energy consumption and CO2 footprint, since TS as a large enterprise spends several million EUR per year on electrical energy alone and any improvement in this respect can bring around notable savings.

<p>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 the beginning for predictions optimization and net metering services and later for future energy services like balancing demand for EV, sub-metering, dynamic pricing etc.</p> <ul style="list-style-type: none"> - 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 improves 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). <p>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).</p> <p>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:</p> <ul style="list-style-type: none"> - Energy efficiency - Electricity cost optimization - Alarming based on events (grid outages) through base station SMS broadcast - Visualization of energy data on various screens (PC, smart phone, IPTV sets,...) - Electricity consumption benchmarking of local communities (student campus, local urban areas, suburban areas, mountains, costal buildings, ...)
<p>Project results to be disseminated (mainly through publications)</p>
<p>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.</p>
<p>Indicative relevant activities performed this period</p>
<p>There have been activities on SunGIS platform marketing, with the goal 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 has been also recognized as a platform candidate in recent activities within a project of Slovenian smart specialization.</p>

3.2 AAU

<p>Partner Profile</p>
<p>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 belong to the MASSM2M group which focuses on M2M radio</p>

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 are benefiting from the interdisciplinary and cross sector nature of the consortium and mix of the theoretical background with real life challenges, and having 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 functional prototypes and final products. The developed skills in power and ICT engineering and entrepreneurship within smart grid framework represent an important asset for the future. Project also fostered cross-sector cooperation at AAU, involving communication, control and engineering departments and thus increasing individual AAU department's 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. One among company divisions is Metering laboratory, the first meter maintenance laboratory in Slovenia which is granted 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

Through the SUNSEED project researchers and engineers were able to broaden their knowledge of future communication technologies not just for the use with smart meters but also beyond telecommunications used in energy sector, supporting new business models and auxiliary services to DSO. Also, the project helped developing deeper understanding of the importance of smart meters and WAMS units in the near future according to the trends in the field of power transmission (energy) and sustainability.

Therefore the company Elektroservisi d.d., as a member of commission under the supervision of Metrology Institute of the Republic of Slovenia, is able to contribute greatly the idea of making fast development and future integration. ES is able to create or optimize techno-economic model regarding verification of meters and metering equipment. ES is also considering the development of new services that Laboratory would 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. ES 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 the accreditation expansion of Lab and as independent service provider of VPP, ES will be able to employ new qualified engineers.

Company has focused on communication channels maintenance from a meter to a concentrator and ensuring high reliability for billing data readings. It includes remote maintenance, detection and elimination of interference on the network and control of specific parameters of long time 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 are giving 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 allows the implementation of standardized measurement method for disturbances detection and useful signal power measurement. All measurements are done in accordance with EU harmonized standards. As accredited 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 obtained access for testing new generation of smart measurement equipment which is not yet 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 meters in field, parameterization of smart meters, PLC communication establishment, maintenance and disturbances cleaning.
- By participating in the project we learned about new technologies, so we expect that the transition from PLC-FSK on PLC-3G technology is going to be much smoother for us.
- We upgraded our work and knowledge to the next level – i.e. covering complete HES data acquisition. The goal is to use a data base for the development of new maintenance tools, which will enable preliminary identification of source and type of disturbances based on experiences, practical field disturbances cleaning and data base processing. This approach will help optimizing our work, shorten the response time, and raise productivity, because our maintenance groups will have all the necessary data on where and what exactly is the problem that needs 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 8,000 km of MV and LV network, 16 HV/MV substations and 2,300 MV/LV transformer stations in the western part of Slovenia. The distribution network was supplying 130,000 consumers in 2012,

consuming 1,541,681 GWh/year. In 2012 the peak power reached was 263.9 MW. Total number of currently connected distributed energy sources (DER) is 438 with total installed power of 94.4 MW. The majority of DER-s are PV solar (54.8 MW), hydro (27 MW) and CHP (9 MW). Wind power is currently providing 2 MW, but more wind generators are expected. SCADA with OMS module is used for network control and management. Currently there are 18,000 consumers connected for remote consumption data analysis.

Individual Goals of Exploitation

By participating in the SUNSEED project 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 for any DSO, the main goal of EP is to assure quality of power supply to all users of power system. The main quality indicators include: 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 this field, in particular concerned with unification of communications in substations and AMI – PLC communication testing. In the SUNSEED project EP offered support in research and development of energy and communication infrastructures, services and business models based on SUNSEED goals, and provided testing facilities in real operating environment with high penetration of DER (PV solar, hydro, wind, CHP).

As a beneficiary directly involved in the project EP will fully exploit SUNSEED equipment, developed technologies and services. We see the WAMS SPM nodes as an indispensable measuring element in future distribution network, as it is a basis for advanced services like unbalance state estimator, protection pattern recognition and phase detection. With state estimator we intend to 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 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 advanced multipurpose measurement system which significantly improves power network management and solves operation problems relating to phase detection, voltage unbalances, disturbances recognition, protection management, state estimations, power system balancing, etc. For that reason EP is highly interested in further research in the 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 staff participating 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 development 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 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 environment, 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 is planning 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 use, adaptation and/or enhancement of CP-SPM and CP-PMC device prototypes in several H2020 projects, some of them recently accepted for funding (i.e., DEFENDER, NRG-5 and SAAM) and some proposals still 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, in particular in the postgraduate courses Future Communication Networks, Modelling and Simulations in Telecommunication Networks, Sensor Data Analysis, Heterogeneous Telecommunication Networks, Internet Connected Embedded Devices and Sensor Networks, 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) 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. The deployment at JSI campus is aimed at monitoring of power quality, control of individual loads and evaluation of energy management strategies for office and data center environments. With respect to office environment, the aims are to quantify and minimize standby power consumption, explore measures for personal energy footprint, and research methods for individuals' presence and activity detection. The deployment in data center is on the other hand aimed at the assesment of Power Usage Effectiveness (PUE) on the level of individual devices, examination of weighted PUE measures that take into account CPU load and/or computing platform type to perform specific tasks, and benchmarking to COTS power metering solution. Additionally to these local deployments integrated with the SUNSEED backend infrastructure, several CP-PMC devices have been adapted for the use with other energy management systems and deployed in relevant environment. These include (i) heat pump monitoring and control via Modbus RTU at one potential commercial and productivization partner from Slovenia and (ii) the support of client framework for prosumer flexibility management developed within the H2020 Flex4Grid project. After the demonstration and testing period, currently underway, agreements needs to be made with respective partners on the conditions of IPR transfer and the timeframe for the preparation of final design ready for certification and productivization. Further developments and enhancements of the CP-PMC device are also planned to take place in future projects (e.g. H2020 SAAM), in particular related to non-intrusive load monitoring and energy disaggregation).

- **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. Moreover, a few CP-SPM devices have been (i) adapted to support the standardised data exchange protocols (i.e. as defined by IEEE C37.118.1a-2014 and IEC 61850 standards) and deployed in relevant environment in parallel to a commercial PMU device for the purpose of benchmarking and interoperability testing 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. The demonstration and testing period is expected to run until June/July 2017, and if meeting the requirements of the industrial partner from Slovenia an agreement will be made on the conditions of IPR transfer and the timeframe for the preparation of final design ready for certification and productivization. In its current form, the CP-SPM device is also considered for (i) supporting [secure communications between virtual power plant locations and aggregators](#) in the ongoing H2020 project FutureFlow by the support of Gemalto, and (ii) using together with real-time power system simulator (RTDS) provided by a partner interested in joint research and development of grid

fault detection principles. Further development and enhancements of the CP-SPM device are planned to take place within future projects (i.e. H2020 DEFENDER, H2020 NRG-5) and through commercial collaboration.

- **CP – Communication and Processing module**

CP-PMC and SP-SPM devices have been designed in fully modular fashion, making possible also partial exploitation 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. As an example the CP module has already been used with external partner to prototype generic meter data acquisition and transfer to the cloud for post-processing purposes. The CP module is also used as a baseline for the new nodes in LOG-a-TEC 3.0 testbed, being part of the H2020 project Fed4FIRE+ and are planned for the use and further enhancement in recently accepted H2020 project SAAM. Finally, in collaboration with Gemalto and Engie, a French DSO, further exploitation opportunities are investigated related to the transmission of trusted power measurements associated to Energy Distributed Generation scenarios as a continuity of a joint demo at EUW16.

- **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 clustering, (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 the above mentioned 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 underlying 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, demonstrated in SUNSEED on the grid of Elektro Primorska, is 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 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 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 solution, JSI can provide to interested parties also the experience and know-how in grid modeling as well as the algorithm used for determining the 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 directly 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.

3.6 GTOSA

Partner Profile

Gemalto SA (GTOSA) 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,

<p>epassports and tokens. GTOSA 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).</p>
<p>Individual Goals of Exploitation</p>
<p>GTOSA is deeply committed to the deployment of managed services for its customers. The primary interest in the SUNSEED project is related to the definition of security solutions for smart grid appliances. GTOSA security contributions in the project are revolving around two main value propositions:</p> <ul style="list-style-type: none"> - 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. <p>In the M2M domain the GTOSA ambition stated in the three year plan is to be positioned to provide security solutions on three vertical domains:</p> <ul style="list-style-type: none"> - Smart health - Energy - Personal life and wearable <p>Our action in the SUNSEED project is therefore perfectly in line with the corporate strategy. SUNSEED pilot project acts as a showcase of Gemalto Security solutions and helps promoting our security solution and generating business opportunities. These business opportunities will be generated along 2 lines:</p> <ul style="list-style-type: none"> - Commercialization of embedded security solutions, primarily to smart grid equipment manufacturers. - Commercialization of platform and services solutions to energy service providers: DSO, TSO, aggregators...
<p>Identified Exploitable Project Results and Strategic plans for exploitation</p>
<p>The technical work performed in SUNSEED resulted in the development of 3 component solutions:</p> <ul style="list-style-type: none"> - An embedded solution for smart grid appliances including »solder and play« secure elements to be embedded in a smart grid appliance, along with the embedded software stack and demonstration software. One of the main design goals was to simplify the implementation of security for application developers, 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. <p>Those three components will constitute the core of Gemalto smart grid solution.</p>
<p>Project results to be disseminated (mainly through publications)</p>
<p>The security architecture used in SUNSEED is well suited to smart grids application; it has been described in a paper which has been accepted for publication in IEEE wireless communications magazine.</p>
<p>Indicative relevant activities performed this period</p>

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 European Utility Week (Barcelona, November 2016) of a crowd funded solar panel deployment use case. The demo was successfully carried out at the Engie booth and raised significant interest. In order to set up 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 were leveraged to assemble the demonstration setup. This effort is currently being followed up, 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	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
Based on the participation in the SUNSEED project GTOM2M expects to expand in the M2M market and unlock new targets in the area of security related market. GTOM2M recognized a high demand for M2M solutions at both sectors, DSO and telecommunication operator. Secure communication and securing of data itself will be even more important in the future.
Identified Exploitable Project Results and Strategic plans for exploitation
<ul style="list-style-type: none"> - 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 trend 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 is developing tools and methodologies for designing communication networks, re-engineering existing communication network solutions, estimating 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 (FPAI) 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, in 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 gained 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 continue with active dissemination of 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 as 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 bringing together three different systems, smart meter infrastructure, 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 intellectual property 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 requirements from the stakeholder'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 participates) 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.

- Commercial 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 a 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 introduced 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 trial 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