Interreg
Danube Transnational Programme
STRIDE

ANALYSING THE DANUBE REGIONAL SITUATION

GOOD PRACTICE GUIDE

Final Version

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1 Executive Summary

This document was prepared by ConPlusUltra based on the collected good practices by each project partner from its region. The Good Practice Guide is a main output of the work package "Analyzing the Danube regional situation on smart grids", within the STRIDE project. The main objective of the STRIDE project is to improve regional and local energy planning in terms of the integration of smart grid concepts. To back up the concept of smart grids, good practice examples in the Danube region have been investigated, and a Good Practice Guide was elaborated.

The research and elaboration of the good practice guide has included detailed information about the situation of successfully implemented smart grid projects in various regions. Each region offers a different development environment for smart grids due to its specific government policies and other market factors in place. The regions included in this study are: Podravje (Slovenia); Dorfen (Bavaria, Germany); Vienna (Austria); 10 districts in Western Bulgaria; Zenica-Doboj Canton and Central Bosnia Canton in the Federation of Bosnia and Herzegovina; Zlín Region (Czech Republic); Hungary; Istria County and Primorje-Gorski kotar County (Croatia). In case that relevant projects could not be identified in the participating regions, the analysis and research was extended to the national level. With the identification of good practices from these regions, the integration and deployment of smart grids will be facilitated. Focus on the research of the project partners was on innovative smart grid technologies, comprehensive solutions and concepts that could be identified on real-life examples and implemented projects.

Project partners have researched and selected 29 good practices in their regions that cover implemented smart grid projects, implemented technology solutions, initiatives, policies, and innovative strategies and concepts. All the collected good practices have been compiled in a collection of good practices (see Annex 2). Selected good practice cases include solutions for renewable energy solutions (RES) integration, development of micro grids, smart metering systems, e-vehicle, implementation of innovative smart grid technologies at local level but also in large-scale smart grid deployment projects.

Out of the 29 projects 12 relevant good practices were selected and compiled in this document. The presentation has been made in a concise form, by listing project identification data and key elements of success such as aim of the project, achievements, potential knowledge transfer and future perspectives. In the collection document, the selected projects were grouped according to the location where they were implemented. In this guide, to make the presentation more suggestive, the selected good practice cases have been assigned to the smart grid domains they belong to. Thus, according to this document, relevant projects which have been implemented in the regions or countries of the partners in the STRIDE project, were identified in the domains such smart grid management, integration of RES, policies and funding for smart grids, cybersecurity solutions.

The development of smart grids is a long-term process that binds capital over many years. It therefore requires strong commitment from all stakeholders and a viable business model. Given that the development of smart grids is a cross sectoral effort, it is of the utmost importance that policymakers, industry (including IT companies), and network operators should work closely together. In addition, they must jointly educate the public about the benefits of smart grids.

In this respect, to help in creating regional strategies and action plans to facilitate the deployment of smart grids, the good practice guide shed light on the status of smart grids, of innovative smart grids implemented solutions and the financing mechanisms needed for their development.

This report identifies the main drivers for smart grid technologies and major challenges for the implementation of smart grids by looking at the different countries of the partners that participate in the STRIDE project. The study also surveys the best practice projects in those countries or regions, and analyses their evidence of success, potential knowledge transfer and future perspectives. In the Annex 2, more detailed information is offered for each of the selected projects in the surveyed countries and regions.

2 Introduction

Smart grids are an essential element to facilitate the transition towards a CO_2 free economy. To achieve this goal, the power generation will be based on renewable sources and the way it is consumed will faced major transformations. The main challenge will be the integration of decentralized renewable energy resources. In this consideration, smart grids can help reduce transmission and distribution losses, optimize the use of existing infrastructure by helping to regulate power flows and meet peak demand, accommodate significant volumes of decentralized and renewable energy into the grid, and improve energy efficiency by managing the consumption patterns of new and existing users connected to the grid. Smart grids are essential for achieving energy security, affordable energy and climate change mitigation. Deployment of smart grid solutions can benefit both energy consumers and producers. Smart grid technologies provide predictive information and recommendations to utilities, their suppliers, and their customers on how best to manage power.

It is a clear consensus that the grids of today will not be able to meet the energy demands of the future and it is essential that well-designed plans be developed to ensure the successful materialization of smart grid goals and objectives.

Regardless of the country context or overall level of development, grid modernization promises to offer benefits to the environment, consumers, utilities, grid operators, and other stakeholders. Especially electric distribution utilities achieve many categories of benefits and solutions to core business problems. Such benefits include improved efficiency by reducing electrical losses (technical and nontechnical) and promoting energy conservation, reduced electrical demand during peak load periods, improved reliability, better utilization of existing assets, and more effective integration of a high penetration of distributed generation with variable output. With a smart grid in place, customers could benefit of innovative smart solution, so that their awareness will increase to voluntarily modify their energy consumption patterns as needed to improve the energy efficiency of the energy supply from the demand side. Stakeholders, especially electric distribution utilities started to modernize their grid and some of the core benefits have been achieved. Successful implemented smart grid solutions must be documented, to help facilitate the deployment of smart grids.

This report identifies, in the context of the regional analysis on smart grids in the STRIDE project, the main drivers for smart technologies and major challenges for the implementation of smart grids. Looking to the potential of smart grids development in the participating regions in the STRIDE project, the elaborated guide aims to serve as a compendium of best practice cases and the factors contributing to their success.

The main goal of the good practice process is not only to publish and share good practices, but to generate change through the adoption, adaptation and scaling up of these good practices. Therefore, it is important to plan, from the beginning of the process, how the impact of sharing the good practice will be monitored and evaluated.

3 Method of collection of good practices

3.1 Definition of good practice for smart grids

To ensure that renewable energy sources are reliably and efficiently integrated, the power grid will need to be "smarter" as the share of these sources grows in the grid. That means, that a traditional one-directional power grid must be converted into a fully interconnected network. Integration of larger shares of renewables requires better grids, new technologies, and regulations such as interconnection performance requirements. Without these transformations the grid will be a barrier to achieving strategic economic and environmental.

A smart grid is a very complex arrangement of infrastructure, and its functioning depends on many interconnected elements (monitoring, control, protection, telecommunications). A simplified way to visualize a smart grid is to think of it having four major layers:

- "Hard" infrastructure - components of the grid, such as the generation, transmission, and distribution assets that produce, transport, and deliver energy to consumers.
- Telecommunications - communications services that enable applications to monitor, protect, and control the grid.
- Data - data and data management techniques to facilitate smart grid applications.
- Applications - the tools and software technologies that use and process information collected from the grid to monitor it, protect and control the hard infrastructure layer, and reinforce the grid to allow the participation of all forms of renewable energy.

Main goals are to promote more efficient energy use among consumers and to make more efficient use of grid infrastructure. Better monitoring, protection, and control of the grid will in turn enable the delivery of electricity services in a more efficient, reliable, and sustainable manner.

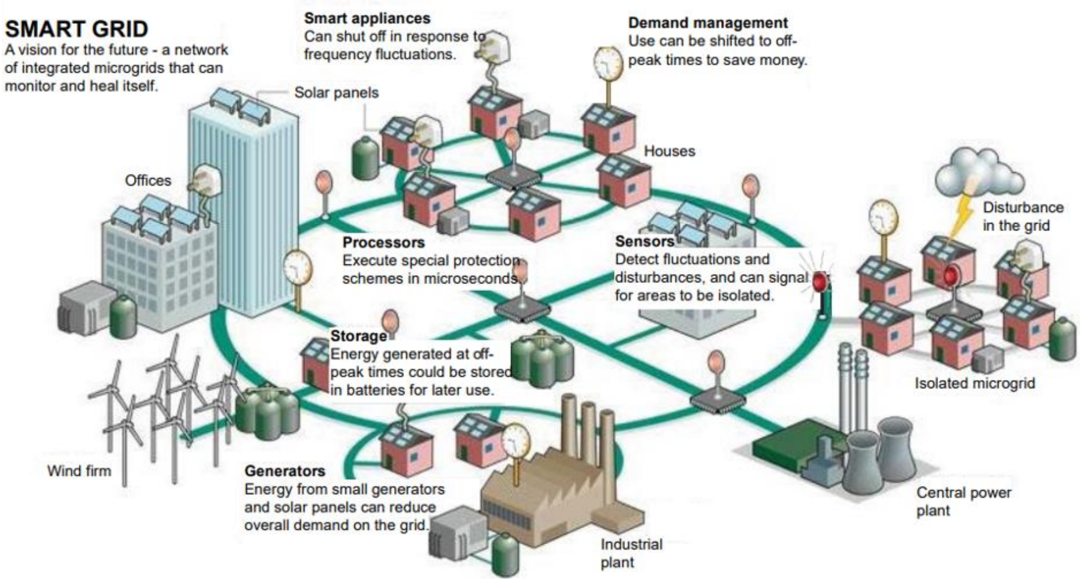


Figure 1 - Smart grid power system[1]

Therefore, a smart power grid is a conceptual goal whose achievement for the future will require continuous grid modernization using conventional and advanced digital technologies.

A good practice in field of smart power grids is a successful project for the implementation of an innovative solution that has been tested and replicated in different contexts and can therefore be recommended as a model. It deserves to be shared, so that a great number of stakeholders can adapt and use it.

Knowledge sharing and capitalization of good practices have a key role in the deployment on large-scale of smart grid solutions and achieving energy supply security for all consumers. Considerable knowledge is continuously gained by stakeholders through all their experiences, projects and programs. If practices are systematically analyzed, documented and shared, relevant actors in the energy sector can adapt what works well and deploy innovative solutions. Thus, they can replicate and scale-up identified good practices to elaborate policies, new necessary regulations and implement programs effectively. By engaging in this continuous capitalization process, key actors are strengthening their capacities for better results and impact.

3.2 Good practice selection tool

To ensure that all projects could be compared on a fair basis and to support later analysis, a data collection template (see Annex 1) was prepared and distributed. The data collection template has been structured in two parts: one for qualitative assessment and one for quantitative assessment. The qualitative assessment section of the template included a brief description of the project and a summary of goals and outcomes. Other information requested included the location and duration of the project, the budget, the participating organizations and their budget share and the financing

[1] Source: Smart Grid 2030 Associates, SG2030™ Smart Grid Portfolios

mechanism used. Quantitative assessment included only financial key figures and KPIs because of the lack of available information.

The research and identification work of examples of good practices was based on criteria such as:

- Success and effectiveness
- Improving security of supply
- Technical feasibility
- Replicability and adaptability
- Positive impact on consumers (individuals / communities)
- Economic, social and environmental sustainability

The template includes background information on good practices as well as a form to fill in, that help to structure the collected data. Also, the elaborated template can be used as a checklist to verify that the research has covered as much as possible when documenting a practice and identifying good practices. This template is based on the elaborated methodology for the regional analysis and project partner approaches to good practices collection.

4 Identification of regional projects for good practices

4.1 Domain: Smart network management

Project Acronym / Name:	**NEDO**
Start / End:	Nov. 2016 / 2021
Organization in charge:	Japanese agency NEDO; Hitachi; ELES; +large number of stakeholders from Slovenia
Implementation Region:	Slovenia, NUTS1
EU Contribution:	-
Project website:	https://www.eles.si/en/nedo-project

Move consumption logo (NEDO demo project)

Aim of the project

NEDO is a Slovenian Japanese smart grid project that stated in 2016 and ended in 2019. NEDO project focused on the implementation of smart grid on the national level by means of integrated and centrally managed cloud solutions. The project has been managed and coordinated by ELES, but activities were carried out on infrastructure of all owners of the electricity grid (6 electricity distribution companies).

The main purpose of the project was to use of advance solutions that can respond to the challenges of modern electricity systems while considering the sustainable development and environmental-friendly solutions. The goal of the project is to use advance secondary equipment, information and communication technologies and cloud solutions that can enable better exploitation of existing grids. In this respect investing in grid expansion will not be needed.

Achievements

The key equipment being provided by Japanese partner included: electricity storage systems, advance distribution management, advance tools for optimization of electricity consumption (EMS-energy management system), platform for the inclusion of consumption in system service., with additional missing passive and active elements (e.g., circular-breakers, regulation transformers).

In the participating households a Direct Load Control device were placed, that automatically switched off electric loads at the time of power reserve high network tariffs thus helping householders to adjust their electricity consumption and reduce electricity bills. Average reach demand response of all included active users was in wintertime - 30 % of average demand power and in summertime - 17 % of average demand power.

Potential for knowledge transfer

NEDO is the project of Slovenian Japanese cooperation and in addition ELES, many stakeholders from Slovenia are included, which is why it can rightfully be called a national project and the only one of its kind in Europe. Similar projects in Europe are focused on narrower areas and communities, whereas in this case we can speak of the implementation of a smart grid on the national level.

Future perspectives

Within NEDO project advanced functionalities are established which provides better coordination between stakeholders in the electricity system and more efficient operation of the system. In the project many stakeholders from all Slovenia are participating which is why it can rightfully be called a national project and the only one of its kind in Europe. Meaning, we can say that within NEDO the implementation of smart grid is taking place on the nation level and therefore it is and will be used as a showcase for replication across EU and beyond.

Project Acronym / Name:	**Implementation of SCADA/DMS/OMS system in the electricity distribution system of PE EP**
Start / End:	2020, year of completion.
Organization in charge:	PE Elektroprivreda BiH d.d. Sarajevo
Implementation Region:	Federation of Bosnia and Herzegovina
EU Contribution:	-
Project website:	SCADA/DMS/OMS EPBiH distributivne električne mreže na distribucijskom nivou EPBiH (integracija malih hidroelektrana u SCADA sistem) – Cet Energy d.o.o. (cet-energy.com)

Interfaces with existing technical information systems within EP BiH

Aim of the project

Upgrading the existing optical network and building a digital radio network will enable connection to the central computer system in the dispatch center of EP BiH and distribution branches (Sarajevo, Zenica, Travnik, Tuzla, Bihać, Mostar), which will enable an automated system for monitoring and managing energy distribution facilities. The implementation of the SCADA/DMS/OMS system implies the introduction of a system for remote monitoring and management of power distribution facilities. The distribution SCADA system includes all 35/x kV substations and 20/10/x kV central substations through which the switching conditions on the network can be changed, as well as switchyards, fault indicators. The introduction of the SCADA system will enable at any time remote monitoring and control of the medium voltage network (MV) and power distribution system facilities.

Achievements

Installation of SCADA/DMS/OMS for the main and backup control center in the infrastructure of the Data Center (CISCO blades, Hyper-V) in the branches in Sarajevo and Zenica. SCADA - Spectrum Power 7 technology is introduced, which will provide versatile tools to optimize power flows, change switching states, helping operating staff to ensure reliable supply, efficient use of production resources and reduced losses in the distribution network in real-time planning and operation phases. DMS integration is performed as part of applications in the distribution network, which include analysis of power flows in the distribution network (DSPF - Distribution System Power Flow), assessment of the state of the distribution system (DSSE - Distribution System State Estimator), STLS - Short Term Load Scheduler, Fault Management, Optimal Feeder Reconfiguration (OFR). Also, the project includes integration with software tools and databases on electricity distribution facilities

(GIS/DEEO), customer relationship management system (CRM) and metering data management system (MDM).

Potential for knowledge transfer

Integration of individual (small) SCADA systems for managing parts of the distribution network into the global SCADA system for managing the complete ED network and integration of own software solutions (non-purchase and ordering of others), especially integration of EEE database (DEEO) on distribution networks.

Future perspectives

In the future, the Spectrum Power 7 SCADA system will include new EEOs to be built, EM chargers, especially in public areas, and DC chargers, as well as storage batteries. Also, the integration of the asset management software tool with the SCADA system will be performed and in the future the electricity quality monitoring system will be integrated, which will be subsequently developed.

Project Acronym / Name:	**GAP Elektroistra (GAP - Grid Automation Planning) - GAP_EI**
Start / End:	
Organization in charge:	Croatian Distribution System Operator – HEP ODS
Implementation Region:	Croatia, NUTS3 (HR036)
EU Contribution:	
Project website:	https://www.hep.hr/UserDocsImages/dokumenti/vjesnik/2020/3_2020.pdf

Aim of the project

The key actor of the project is HEP Distribution system operator. (Siemens Energy and Energy Institute “Hrvoje Požar” have been also involved in the project). The project covers the region of Istria County, and the beneficiaries are the users of the network and HEP DSO.

- Development of new protection and automation concepts using “smart” equipment, and
- Comparison of the concepts in terms of supply reliability and costs.

Achievements

The project defines a new methodology for site selection and equipment for automation of medium voltage networks to achieve the desired reliability indicators. The project consists of a GAP study and the installation of equipment in the medium voltage network of Elektroistra Pula.

Steps taken: The study developed a new approach to medium voltage network automation planning.

The research and feasibility study have been finished. The second part of project – installation of equipment will start next year (2021).

Potential for knowledge transfer

The implemented tool will be used in HEP DSO in other Croatian regions to achieve the targeted reliability.

Future perspectives

First, after the construction of a high level of automation of the distribution network, preconditions will be created for the acceptance of a significantly larger number and strength of distributed sources, but also the visibility of the network from the user's point of view. Network visibility is a key activity for involving the end users of the distribution network in energy transition processes.

Second, self-healing is essential to improving reliability and assuring grid stability amid these 21st century challenges. The solutions feature software, switching, and communications products that leverage distributed intelligence to provide unmatched advanced automation capabilities.

Project Acronym / Name:	Siemens Campus Microgrid
Start / End:	Operational 2020
Organization in charge:	Siemens AG, Austria
Implementation Region:	Vienna (AT 130), Austria
EU Contribution:	-
Project website:	Siemens Campus Microgrid | Topic Areas | Siemens Österreich

Aim of the project

The Siemens Campus Microgrid is an intelligent system for optimizing electricity and heat demand at the company's premises in Vienna Floridsdorf, consisting of PV systems, e-charging infrastructure, electricity storage and microgrid controller. It enables safe, reliable provision of electrical energy while reducing the CO_2 footprint and peak loads.

Achievements

The project combines the components photovoltaics, battery storage, microgrid controller, load control and optimized charging solutions for electromobility. Together, these form an intelligent system for optimizing the energy and heat supply management of the company premises. In addition, the Siemens building management system Desigo is integrated into the microgrid so that, for example, the heat supply in the main building can be adjusted in the event of load peaks to optimize the power consumption of the property.

Potential for knowledge transfer

Thanks to its many years of expertise and experience, that Siemens has accumulated in the areas of building management and power grids, the Microgrid Campus demonstrates the performance and benefits of microgrid solutions in real-life operation. The showcase presented solutions for optimizing the footprint and energy balance, for facilitating electromobility without further grid expansion. Also, future-oriented charging management and how microgrids will leverage the benefits of 5G technology in the future have been demonstrated on site. The project also includes the prospect of making flexibility on the electricity market via aggregators.

Future perspectives

Microgrids have become an important factor in the energy transition. They are electric area networks that are controlled separately for geographical, technical, political, strategic or economic reasons. They can operate with or without connection to the public grid. However, Siemens Microgrid Campus, in conjunction with the infrastructure of an existing industrial plant, is unique to date - and offers plenty of scope for innovative research and concrete new solutions. This new project points the way to the future of smart energy management solutions.

Project Acronym / Name:	Viertel Zwei
Start / End:	5 years, still in progress
Organization in charge:	Wien Energie GmbH; Value One Holding AG.
Implementation Region:	Vienna (AT 130), Austria
EU Contribution:	-
Project website:	https://positionen.wienenergie.at/projekte/strom/viertel-zwei/

Aim of the project

In the VIERTEL ZWEI urban development area, Wien Energie is researching and developing what will make up urban life in the smart future. Innovative mobility, energy and living concepts are being used. Among other things, the residents generate their own electricity with a PV system and trade it among themselves using blockchain. As part of this innovation project, Austria's first energy community is being created in Viertel Zwei.

Achievements

Within the project management of electricity consumption in households has been implemented. The innovative approach is the implementation of blockchain technology for energy trading among households. It enables end consumers of electricity to actively manage their consumption and reduce their electricity bills. On the other hand, the initiative has been beneficial also for Wien Energie, the electric power operator, through preparing advance infrastructure framework to improve their services.

Potential for knowledge transfer

Energy communities represent a new milestone for the Austrian energy industry. The population now gets the opportunity to join forces to share energy. The advantages are clear: proactive participation in the energy transition, expansion of decentralized energy systems, enjoyment of economic incentives and strengthening of the regional value chain. The flexible composition of energy communities allows members to produce, store, sell and consume energy across property boundaries for the first time.

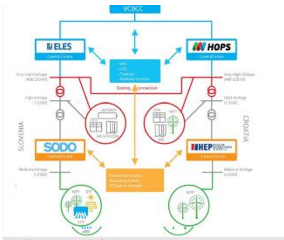
The project is a real demo-case that could be replicate in any other location.

Future perspectives

What has become legally possible in multi-family housing in Austria by the adoption of the Renewable Expansion Act, with the Green Electricity Act will be extended even further with the EU's Clean Energy Package. In the future, it will be a great opportunity here for energy providers. They can support local communities and neighborhoods with their expertise if they want to join forces in energy production from renewable energies. Also, through energy communities, consumers can receive lower electricity prices in this way and the energy can be used more efficiently.

4.2 Domain: Integration of RES

Project Acronym / Name:	**SINCOgrid Project**
Start / End:	2016 / 2021
Organization in charge:	ELES, Ltd., Electricity Transmission System Operator – coordinator of Phase 1 Croatian Transmission System Operator Ltd. (HOPS) SODO electricity distribution system operator, d. o. o. (SODO) HEP-Operator distribucijskog sustava d.o.o. (HEP ODS)
Implementation Region:	Slovenia / Croatia, NUTS 1
EU Contribution:	Co-financed by the Connecting Europe Facility of the European Union
Project website:	https://www.sincrogrid.eu/



https://www.sincrogrid.eu/en/

Aim of the project

Project is providing solutions to the lack of flexibility resources needed to regulate the electric system due to increasing integration of decentralized renewable energy sources both in the regions of Slovenia and Croatia.

Overview of the goals:

- Effectively integrating dispersed units for electricity generation from RES into transmission and distribution systems in Slovenia and Croatia
- Improving voltage quality in the electricity systems of Slovenia and Croatia
- Increasing possibilities for the inclusion of ancillary services
- Increasing capacities of existing transmission lines
- Improving the observability of transmission and distribution grids.

Achievements

In Slovenia: installation of a stationary compensation device with an SVC (Static Var Compensation)/STATCOM technology of +/- 150 Mvar at the Beričevo substation, the installation of variable shunt reactor of -150 Mvar at the Cirkovce substation, the installation of variable shunt reactor of -150 Mvar and the installation of a capacitor of +100 Mvar at the Divača substation and two battery storage units with a capacity of 5 MW will be installed at the existing substations of Okroglo and Pekre. At the same time the system for the assessment of power grid operating limits will be implemented, whereby is planned: the installation of hardware and software in control centers and atmospheric measuring instruments on transmission lines. Within the project also the upgrade of the system SUMO (the system for real-time and short-term forecast assessment of power grid operating limits) will take place, which will enable better utilization of existing transmission lines and transformers.

POTENTIAL FOR KNOWLEDGE TRANSFER

Project provides technological innovation with a replication potential, as it solves issue of voltage profiles, provides more ancillary service and increases transmission line capacities.

FUTURE PERSPECTIVES

Relieving the growing network overvoltage issues, not only in Slovenia and Croatia, but also in adjacent countries, thus unlocking the renewable potential in these countries: thanks to technical control of dedicated and non-dedicated voltage and power sources with optimization based on national and international cooperation between TSOs and DSOs, overvoltage caused by high generation and low consumption at specific times will be completely removed, though low voltage problems, which could also occur in future will be prevented.

Project Acronym / Name:	Wind power plant Podveležje
Start / End:	In progress. 2012 EPBiH launched a wind potential measurement campaign.
Organization in charge:	PE Elektroprivreda BIH d.d. Sarajevo
Implementation Region:	Federation of Bosnia and Herzegovina
EU Contribution:	-
Project website:	https://www.siemensgamesa.com/en-int/explore/journal/2021/01/siemens-gamesa-bosnia-podvelezje-pwp


Wind power plant Podveležje in operation at the beginning of 2021

AIM OF THE PROJECT

Wind power plant Podveležje is the first power plant in the generation portfolio of JP Elektroprivreda BiH d.d. – Sarajevo. 15 wind turbines are placed at a plateau above the city of Mostar having the total installed capacity of 48 MW. These wind turbines are the largest available within the country using a direct drive technology. Besides the wind turbines, the project consists of a 30/110 kV substation which places the produced energy into the transmission system and a SCADA system which allows remote monitoring and control of the power plant and prompt reactions in case a problem occurs.

ACHIEVEMENTS

Expected annual electricity generation is above 130 GWh which will provide clean energy to cover more than 40.000 consumers to and within the region of Mostar city. Wind power plant Podveležje produces CO2 emission free electricity to consumers and thus contributes to climate change mitigation measures. The available wind potential at the location is used, whereby most of the land is still available, primarily for grazing livestock

Potential for knowledge transfer

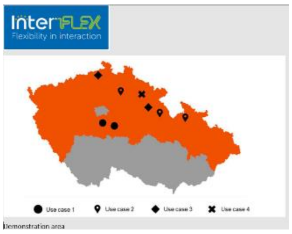
This project, since being the first one in the generation portfolio of JP Elektroprivreda BiH d.d. – Sarajevo, and amongst first ones in the country in general, will serve as a showcase for implementing further large-scale RES projects.

- Use of gained knowledge for further implementation of similar projects
- Presentation of project activities at conferences and round tables
- Visit tours organization and cooperation with universities and schools
- Organization of student practices at the WPP for gaining practical knowledge

Future perspectives

As a future perspective it is important to state that another project is planned to be developed within the same project area, namely a large-scale photovoltaic power plant. This will form a hybrid system, first of such a kind in the country and the broader region, which will provide clean electricity to consumers, reduce CO2 and pollutant emissions in the future, contribute to energy transition and sustainable development and reduce the need for balancing power.

Project Acronym / Name:	**InterFlex – The Czech Demonstrator**
Start / End:	Nov. 2017 / 2019
Organization in charge:	ČEZ Distribuce
Implementation Region:	Czech Republic (CZ0)
EU Contribution:	Co-funded by Horizon 2020 research and innovation programme
Project website:	https://interflex-h2020.com/interflex /project-demonstrators/czech-republic-demonstrator/



Aim of the project

To find a cost-effective solution for renewable energy integration, reliable power supply and high-power quality for customers, ČEZ Distribuce focused on testing innovative smart solutions with a strong potential for large scale development under the InterFlex project. The Czech demonstration project was in several areas in the Czech Republic where ČEZ Distribuce operates its distribution grids. The demonstration was focused not only on one area to prove replicability and interoperability of designed solutions and was divided into 4 use cases: Increase the DER hosting capacity of LV distribution networks by smart PV inverters; Increase the DER hosting capacity in MV networks by Volt/VAr control; Smart EV charging; Smart energy storage.

Achievements

Power quality was monitored in the LV grid in detail at many places through DSO power quality measurement devices Meg38 (with online remote data download using GPRS/LTE). The main tested function was the permanent feed-in limitation of active power into the grid which was se to 50 % of the installed PV capacity. The systems were furthermore designed to support the grid by discharging the battery in case of under-voltage, under-frequency (autonomous control) or based on a ripple control signal sent by the DSO through one-way simple PLC.

Project demonstration confirmed that the operation of a higher share of renewables than baseline is possible by using autonomous Q(U) and P(U) functions implemented in PV inverters and Volt/Var control system at DER installations as a tool for voltage stabilization.

A theoretical analysis showed the general potential of increasing DER HC by means of control functions. The minimal general expected rise is 20 to 60 % for CEZ Distribuce grids depending on feeder electrical parameters and DER placement along the feeder.

The expected rise by means of Volt/Var control is 25 to app. 90 % for CEZ Distribuce MV grids depending on feeder electrical parameters and DER placement along the feeder.

Potential for knowledge transfer

All project solutions were investigated in terms of possible barriers for scalability and replicability. The result is that all solutions are technically scalable and replicable without any significant barriers. All solutions could be easily replicated worldwide (if not yet done, with some modification depending on local conditions).

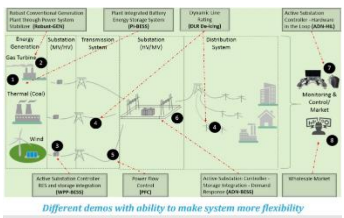
It's expected that smart EV charging concept (if replicated in large scale and customized for local conditions in other countries) could significantly contribute to increase the flexibility of distribution network in case of congestion or under-voltage and case of emergency.

After the evaluation of project, CEZ Distribuce is going to propose to update grid codes to allow DSOs to calculate hosting capacity with different generation power than 100 % of installed capacity of DER to respect feed-in power limitation in chase it is commissioned during installations of PV systems with batteries and with this gain additional hosting capacity in existing LV grids. This approach could be replicated not only in other EU member states but also worldwide considering local customs and existing hosting capacity calculation guidelines.

Future perspectives

CEZ Distribuce decided to use or promote project solutions to mitigate risks which are related to the expected future increased share of DER and EV charging stations in distribution grids. CBA analysis for project proved that in case of large-scale implementation, project solutions are a cost-effective approach for DER and EV charging stations implementation, however some grid capacity investments will be still needed in the future.

Project Acronym / Name:	**FLEXITRANSTORE H2020 project and platform for Flexible Energy Grid Architecture (FEG)**
Start / End:	01 Nov.2017 / 30 Apr. 2022
Organization in charge:	Consortium of 30 partners coordinated by European Dynamics LTD Belgium; Hungarian Partner: Budapest University of Technology and Economics (BME)



The system integration model for the FLEXITRANSTORE project planning

Implementation Region:	Hungary and EU
EU Contribution:	Funded under H2020-EU.3.3.4. Grant agreement ID: 774407
Project website:	http://www.flexitranstore.eu/The-project

Aim of the project

The **FLEXITRANSTORE** project is aiming to implement innovative technologies of battery storage solutions, smart grid technologies and market platforms in the SEE region. The project takes both a national and regional approach acknowledging the need to seamlessly integrate national markets, particularly in the SEE region. The project will contribute to solutions, relieving internal congestion issues via e.g., market-based demand response mechanisms and the integration of storage, among other problems that are currently being faced.

Achievements

The original aim of the FLEXITRANSTORE project was planned in complexity to overarch the aspects of the EU Grid development: 1. A range of state-of-the-art ICT technologies / control improvements was to be exploited to enhance the flexibility of this novel energy grid while increasing the utility of the existing infrastructure by integrating storage and demand response management. 2. From a market perspective, state-of-the-art ICT technologies / control improvements was to be applied to develop an enhanced market model on an integrated platform, for flexibility services and to support cross border auctioning and trading of energy. 3. Demonstrations: The FEG components and the digital market infrastructure was to be tested- deployed in **8 Demonstrations which is taking place in 6 countries (Greece, Bulgaria, Cyprus, Slovenia, Belgium, Spain),** focusing on illustrating specific functions and serving real needs and existing challenges.

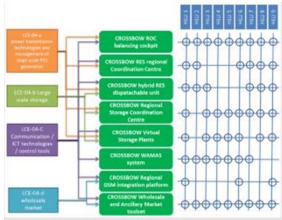
Potential for knowledge transfer

Flexible Energy Grid Architecture (FEG) platform, an IT platform/toolbox with all functionalities that could fulfil all needs and requirements of the market and participants. The open architecture of the FEG Platform provides ease of integration within the operators' software environments and facilitates bi-directional communication with external systems, thus adding a high degree of flexibility and adaptability even in extreme brownfield situations. http://www.flexitranstore.eu/content/feg-platform

Future perspectives

Innovations in FLEXITRANSTORE will replace conventional, time-consuming and capital-intensive grid reinforcements thus, limiting the network charges in the electricity bills for the end consumers. Furthermore, they promote RES integration and market coupling thus reduce even more the cost of electricity.

Project Acronym / Name:	**KONCAR-KET CROSSBOW**
Start / End:	11.2017 / 04.2022
Organization in charge:	
Implementation Region:	Croatia, Bosnia and Herzegovina, Serbia, Montenegro, North Macedonia
EU Contribution:	IA Horizon 2020 project, financed via Grant agreement ID: 773430
Project website:	www.crossbowproject.eu https://cordis.europa.eu/project/id/773430



Aim of the project

The objective is to demonstrate a number of different, though complementary, technologies, offering Transmission System Operators higher flexibility and robustness through: 1) A better control of exchange power at interconnection points; 2) new storage solutions – distributed and centralized-, offering ancillary services to operate Virtual Storage Plants (VSP); 3) better ICT and Communications - e.g. better network observability, enabling flexible generation and Demand Response schemas; 4) the definition of a transnational wholesale market, proposing fair and sustainable remuneration for clean energies though the definition of new business models supporting the participation of new players – i.e. aggregators - and the reduction of costs.

Achievements

The main developments of CROSSBOW are software solutions for the transmission system operators that work in a collaborative fashion and manage the system with a much-increased RES integration as well as storage integration. The CROSSBOW results are being evaluated by 8 TSOs in Easter Europe, grouped to form clusters that will validate each of the project's outcomes in at least three different countries, demonstrating in all cases how CROSSBOW tackles the transnational challenges faced by these TSOs. The project includes a storage management solution as well as virtual storage plant composed of smaller scale storages – quite uncommon in todays practice. The project architecture is also able to utilize the data from wide area measuring systems relying on phasor measurement units. Finally, the solutions are expected to coexist with current information systems already in the control centres of the TSO. The project solutions described above are currently being implemented and actively evaluated across the South-Eastern Europe region in the live TSO systems.

Potential for knowledge transfer

Through the TSO collaboration, and in H2020 cross cutting activities such as BRIDGE we have already initiated the process of knowledge transfer.

Future perspectives

Expected the CROSSBOW solutions to proliferate across the region and the derivatives of the technology to live in many other TSOs beyond the SEE region.

4.3 Domain: Cybersecurity solution for smart grids

Project Acronym / Name:	**EnergyShield: Integrated Cybersecurity Solution for the Vulnerability Assessment, Monitoring and Protection of Critical Energy Infrastructures**
Start / End:	Still pending implementation.
Organization in charge:	Electricity System Operator EAD (ESO)
Implementation Region:	Bulgaria, all Regions
EU Contribution:	70% from Horizon 2020, grant agreement No. 832907.
Project website:	https://energy-shield.eu/

Aim of the project

The EnergyShield project addresses the following objectives:

- Adapt and improve available building tools (assessment, monitoring & protection, remediation) to support the needs of the EPES sector
- Integrate the improved cyber security tools in a holistic solution with assessment, monitoring/protection and learning/sharing capabilities that work synergistically.
- Validate the practical value of the EnergyShield toolkit in demonstrations involving EPES stakeholders
- Develop best practices, guidelines and methodologies supporting the deployment of the solution and encourage widespread adoption of the project results in the EPES sector.

Achievements

The EnergyShield project develops an integrated toolkit covering the complete EPES value chain (generator, TSO, DSO, consumer). The toolkit combines novel security tools from leading European technology vendors and will be validated in large-scale demonstrations by end-users. The EnergyShield toolkit combines the latest technologies for vulnerability assessment (automated threat modelling and security behavior analysis), monitoring & protection (anomaly detection and DDoS mitigation) and learning & sharing (security information and event management). The integrative approach of the project is unique as insights produced by the various tools are combined to provide a unique level of visibility to the users.

Potential for knowledge transfer

Still pending implementation and refinement.

Future perspectives

The smart grid domain in Bulgaria holds a significant development potential across the entire EPES value chain, including generation, transmission, distribution, and end-users. The EnergyShild project is one example that illustrates the key role and importance of cybersecurity as an integral and indispensable part of smart grid evolution.

4.4 Domain: Policies and Funding for smart grids

Project Acronym / Name:	**E-energy – IT-based energy system of the future**
Start / End:	2007 / 2013
Organization in charge:	Federal Ministry of Economics and Technology (BMWi)
Implementation Region:	Germany, NUTS3
EU Contribution:	
Project website:	https://www.bmwi.de/Redaktion/EN/Publikationen/e-energy-ict-based-energy-system-of-the-future.pdf?__blob=publicationFile&v=1

Aim of the project

"E-Energy: ICT-based Energy System of the Future" is a support and funding priority undertaken by the Federal Ministry of Economics and Technology (BMWi) as part of the technology policy of the Federal Government. The primary goal of E-Energy is to create E-Energy model regions that demonstrate how the tremendous potential for optimization presented by information and communication technologies (ICT) can best be tapped to achieve greater efficiency, supply security and environmental compatibility (cornerstones of energy and climate policy) in power supply, and how, in turn, new jobs and markets can be developed. Integrative ICT system concepts, which optimize the efficiency, supply security and environmental compatibility of the entire electricity supply system all along the chain – from generation and transport to distribution and consumption – are developed and tested in real-time in regional E-Energy model projects, i.e., smart grid technologies.

Innovative about this project is that integrative ICT system concepts, which optimize the efficiency, supply security and environmental compatibility of the entire electricity supply system all along the chain – from generation and transport to distribution and consumption – are developed and tested in real-time in regional E-Energy model projects.

Achievements

The E-Energy programme served to develop new solutions for the Internet of Energy and to test these new approaches in real-life scenarios. This led to the development of new ICT products, processes and services which can help improve energy efficiency and security of supply, whilst also contributing to mitigating climate change. The "E-Energy" programme also demonstrated that there is potential for new markets and professions in an emerging field at the crossroads between the energy and ICT industries.

The new E-Energy systems that were developed as part of the individual projects funded under this programme were thoroughly tested in real-life scenarios across 6 selected pilot regions. This led to the development of concepts for integrated ICT systems designed to improve every aspect of the overall power supply system and thus deliver the best possible solutions for generating, transporting, distribution and consumption of electricity through smart grids.

Potential for knowledge transfer

Using sample solutions, it should be clearly demonstrated how such an innovative "Internet of Energy" can guarantee the utmost security and efficiency of electronic business and legal communication between marketers, and how the technical components and infrastructures of the overall electricity system can be intelligently monitored, controlled and regulated, and directly linked to electronic market activities.

Future perspectives

E-Energy solutions independently ensured that power is used (in households, machines, plants, commercial and industrial equipment etc.) when it is available at a low cost and in sufficient amounts (e.g., when winds are high or sunshine is intensive) without having to compromise on convenience, energy supply security or quality. Overall, this will lead to a wide variety of new service offerings, such as comprehensive advice on potential ways to save energy based on measured values recorded. Interesting business models could also take shape for new players, particularly providers that are independent of the energy industry.

5 Conclusions

Smart grid applications have many potential benefits, like reduction in operational costs, integration of renewable energy sources, reliability improvement, reduction in greenhouse gas emissions and many others. All these objectives are important, and stakeholders are looking for their prioritization, with focus on grid-side benefits but also to customer-oriented applications. Utilities and policy makers structure their strategy of a smart grid development around specific challenges. Targets for smart grid development strategies in the different participating regions could be identified by analyzing the most relevant projects implemented.

The main identified areas for developing power grid solutions were connected to integration of renewable energy demand (load) response & management, integration of distributed energy resource, increase in electric and hybrid vehicles, energy efficiency, environmental concerns, micro grids development, significant increases in energy demand, power quality improvement, reducing technical losses, reliability improvements, power system restoration, concerns with aging infrastructure, and energy supply security.

The regional research carried out shows that drivers for regions with advanced developed power grids (including policy and regulation) place higher emphasis on the integration of renewable energy, demand response management, environmental concerns, and enabling consumer participation and choices. In other regions, the focus is on improving reliability, restoring power, improving revenue collection, and reducing losses. Generally, drivers as reducing operating and maintenance costs and improving power quality, were equally important for the stakeholders in the analyzed regions, independent of their power grid development stage. Deployment and the replication of smart grid solutions present a major challenge.

The difficulties encountered during the data collection process suggest the need for improvements in data collection. These include a common structure for data collection in terms of definitions, terminology, categories, and benchmarks, and improving projects data base at regional and national level. Also, a major barrier faced was a lack of available information due to data confidentiality in terms of network security and economic competition between network operators. The lack of quantitative data led to the impossibility to perform cost-benefit assessments for the identified good practice projects. Because of this, most of the data obtained in the study came from internet research and not from data provided by local network operators or specialist local agencies.

Projects in the elaborated good practice collection are not evenly distributed across the analyzed regions or at national level. Smart Grids are deployed at different pace and not in a homogenous way across the regions, a fact that could lead to challenges for both, trade and cross-regions cooperation. In most of the regions, a significant number of investments has been allocated to projects which address the integration of different smart grid technologies and applications. Most of technologies are known, but their integration is the new challenge.

The results of the research of smart gird good practice, confirms the leading role DSOs play in coordinating the smart grid deployment across the analyzed regions and countries.

To facilitate the deployment of smart grids, the energy sector must develop a positive business case with a precise indication of how investments are paid for, reflecting the benefits for the wide range of stakeholders including consumers, utilities, information technology providers, manufacturers and the environment. The energy sector will need to overcome two main challenges. The first is at the level of implementation: issues of standardization and certification, operation, system testing, and consumer participation. The other is financial: large amounts of funding are needed throughout the lifecycle of smart grid development. Governmental support by funding schemes and innovative mechanisms to finance these investments are therefore an absolute necessity. As in Europe, the current tariff schemes in the analyzed regions allow the financing of line reinforcement but not necessarily the deployment of “smarter” solutions. However, many of the identified projects as good practice were financed under the EU Programs. Finding appropriate funding for the launch of all the necessary large-scale demonstration projects and the consequent deployment of smart grid technologies remains one of the key challenges.

In conclusion, of major importance is, that in all regions and countries regardless of whether their power grid system is developed, they face several challenges, and government and local authorities’ interventions can demonstrate and accelerate the deployment of smart grid technologies.

Annexes

Annex 1 – Good Practice Template

Project identification

Name of the good practice case:

Country | Region name (NUTS code)

Country	Region name (NUTS code)
…	**…. (…)**

Level at which the good practice is implemented (select one dominant level)

National ❑ Regional ❑ Local ❑

Visibility (photo, image, diagram, logo, etc. that visually represents the good practice)

Reference (website, press release, media article, documents)

Organization in charge of the good practice case

Name: ……	Public authority ❑ Economic and/or innovation agency ❑ Energy agency ❑ Intermediary ❑ Other ❑, please specify ……………………

Contact person: name, organization, email.

Smart grid domain (max. 2 choices)

Smart network management ❑ ; Demand-side management ❑ ; Integration of storage technologies ❑ ; Integration of distributed generation ❑ ; Integration of large-scale RES ❑ ; Electric mobility ❑ ; Energy efficiency measures ❑.

Other (e.g., cybersecurity, development of roadmaps, …) ……………… (specification) ❏

Smart grid segment (max. 3 choices)

Software
Smart Grid Distribution Management ❏; Smart Grid Network Management ❏.
Grid Asset Management ❏; Substation Automation ❏; Smart Grid Security ❏.
Billing and Customer Information System ❏; Advance Metering Infrastructure ❏.
Hardware
Smart meter ❏; Battery storage ❏; E-vehicle charging station ❏.
RES (e.g., PV systems, wind turbines, etc.) ❏; Power quality system ❏; SCADA system ❏.
Services
Consulting ❏; Deployment and Integration ❏; Support and maintenance ❏.
Other
………………………… (specification)❏

Description of the good practice

Short summary of the good practice

Briefly describe the identified project and argument how you consider it an innovative Best-Case practice.

Challenge addressed and targeted objective

Please provide shortly the main goals of the project and the addressed challenges.

Innovation

Multiple-choice and explanation

Technological ❏; Service❏; Commercial❏; Managerial❏; Social ❏; Environmental❏
Other❏: ……..
Explanation: ………

Technical characterization of the good practice

Included technical solution(s)

Multiple choices possible

New hardware component ☐;	New software component ☐;
Improved system integration ☐;	Optimized technologies/processes/procedures ☐;
New decision support system (DSS) ☐;	New data collection & analysis system ☐ ;
Other ☐, please specify:	

Applied technology/service providers

All the necessary products and services were supplied by a single solution provider or more than one provider were participated: Single provider ❑ ; Multiple provider ❑ ; not relevant ❑.
A system integrator (or general contractor) was applied for coordination or supervision of the participants' work: Yes ❑ ; No ❑; not relevant ❑.

Main competence field of the system integrator

System integrator company was applied with the following profile:
Software developer company ❑ ; Hardware supplier company ❑ ;
Research & development company ❑; Other (e.g., system operator) ❑; not relevant ❑.
In case of "other" please specify: ....

Alternatives regarding the technical solution

Decision was needed regarding the technical possibilities:
Multiple solution providers were available ❑; Multiple technical solution was on the market ❑;
Tailor made technical solution had to be developed ❑; not relevant ❑.

Brief description of the technical solution

e.g., main elements, new functions, interfaces towards other systems, R&D focus: e.g., Artificial Intelligence, AR/VR, Industry 4.0 etc.

Funding sources / Financing mechanism

Provide a brief description of the used financial mechanism and the funding sources

History: origin, definition phase, start and end

Please give a general overview about the roll-out and the timeframe of the project development.

Stakeholders involved in implementation

Please select the type of involved organizations, multiple choices allowed

Distribution System Operators (DSOs) ❑; Generation company ❑; ICT company & Telecom ❑; Technology manufacturer ❑; Industry association ❑; Engineering services ❑; Utility ❑; Research center ❑; Retail company ❑; Consultancy ❑; University ❑; Public Institution ❑; Policy makers ❑; Other ❑…………………… (specification)

Stakeholder involvement and target groups

Please describe briefly the key actors involved in the development of the project and their role.

Beneficiaries

Give a brief overview of the covered area by the project implementation and the beneficiaries.

Implementation

Implementation process

Please present the implementation process *of the project focusing on issues specific for new innovation, necessary steps and subsequent activities, resources and management effort for a successful development.*

Achieved results

Please give a brief description regarding the achieved results (indicate technological, environmental and social) after the project implementation.

Financial achievement

Key figures

Please summarize the main relevant financial key figures of the project (investment volume, financial objectives, financial status before project implementation, etc.), if they are publicly available

KPIs

Input the collected data from your research, using the template "KPIs Best Case" in the provided Excel-toolkit and please give a brief interpretation of the values regarding the analyzed project goals.

Innovative approach

Describe the innovative characteristics realized through the implementation of the project

Evidence of success

Most successful elements

Lessons learned

Difficulties encountered

Most important encountered difficulties

Potential for knowledge transfer

Ideas for transfer of good practice knowledge

Future perspectives

Please present what future perspectives you can expect, regarding development, functionality, synergies for development of new innovations in the field of smart grids.

Annex 2 – Good Practice Collection

See separate document on MS Teams folder: Documents>General>WP T1>Good practice examples>STRIDE-Good Practice Collection.pdf

Link: