Process for the 5th Union list of Projects of Common Interest (PCIs)

Description of the candidate projects in the thematic area of Smart grids[1]

1. Carmen (Romania, Hungary)

Project website: https://delgaz.ro/smart-grid/en

The major goal of the CARMEN (Carpathian Modernisation of Energy Network) Project is to improve the quality of the distribution service provided to the customers and to implement the mandatory performance standards for the electricity distribution operators via smartification aimed to achieve national and European requirements regarding decarbonisation, environmentally friendly digitization and streamlining of the energy system. The deployed Smart Grid technologies are based on modern ICT. Implementation of the Project will increase the efficiency of the network functioning, allow efficient integration of the behaviour and actions of all stakeholders connected to the electricity network (consumers, prosumers, battery operators, generators) and will create conditions allowing to increase proportion of electricity generated from renewable or distributed energy sources.

The project promoters are the Romanian DSO, DELGAZ GRID, with support of the Romanian TSO, Transelectrica and the Hungarian TSO, MAVIR. Partnerships will intensify cooperation between Romania and Hungary on data exchange and knowledge sharing. The Project will deliver several benefits to market participants in Romania and Hungary, as the partners will act as transmission channels enabling the spread of new technologies to other regions of Romania and Hungary. The Project will contribute to accelerated modernisation of the national distribution network and indirectly also the national transmission network, as well as the interface between transmission and distribution networks, improving grid security and flexibility in the region.

The Project covers the electricity grid in 6 counties in Romania's North-East region and overlap the central part of Romania near the Moldovian border and the Hungarian part, where there are increased requests for connections of new renewable sources (solar, wind).

The Project will improve the efficiency of the distribution network management while increasing the efficiency of the network and the quality of distribution service. Furthermore, the Project will improve interconnection with the transport network and will increase the network capacity to enable efficient connection of renewable energy sources to the distribution network. Deployment of bidirectional communication infrastructure and interactive real-time monitoring (through deployment of SCADA) will contribute to facilitation of effective consumption behaviour through smart metering exposure coverage. The Project will contribute to the reduction of the negative environmental impacts of some activities.

Consumers, producers and prosumers will benefit from the Project through improved supply quality.

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[1] *The order of the projects is random*

Implementation of the Project will significantly improve the security of the distribution system.

The Project consists of the following 5 major parts:

- smartification (modernization and increase of capacity) of 193,5 km HV Overhead Lines (HV-OHL) through modernization of the HV-OHL conductors with high-capacity wires and modernization of the HV isolators with silicone composite insulators;
- smartification of the electricity infrastructure via investment targeting 40 HV / MV transformer stations in 6 counties in the North-East Region of Romania;
- smartification of the electricity infrastructure via investment targeting 99 MV / LV transformer substations in 6 counties in the North-East Region of Romania;
- deployment of bidirectional digital communication system (supported by optical fibres on HV-OHL lines and PLC), ensuring real-time interactive monitoring of the grid leading to efficient integration of the behaviour of all users ensuring an economically efficient energy system with a high level of security and delivery quality and
- introduction of IT smart grids backbone with deployment of SCADA and smart metering (SMR).

The actions in the HV-OHL, 40 HV / MV transformer stations and 99 MV / LV substations will improve safety by reducing the environmental and operational risk. The number and duration of breakdowns and dips will be reduced, decrease the operational expenses by reducing the share of human operation and planned and unplanned maintenance through improved remote management and decommissioning of obsolete systems replaced by maintenance free ones, and decrease grid losses. Improved ability to connect and transport electricity by renewable sources, together with deployment of bidirectional digital communication system, SCADA and SMR will improve decision-making support for the operational command by the dispatcher by ensuring real time information regarding the distribution grid condition, and the supply of necessary high quality operation data implementing DSM concept. The measures will increase the ability to integrate additional RES and deployment of digital communication system, which positive impacts / benefits will contribute to decarbonisation of energy within the project's impact area.

From the interface between transmission and distributions grids point of view, Carmen Project implementation will lead to the improvement of this interface in respect of regional European grid security and flexibility.

The Project covers the following investments:

1. Modernization and capacity increase of HV OHL lines through

- modernization of the existing HV-OHL conductors with high capacity wires
- modernization of HV isolators with silicone composite insulators

2. Modernization of transformer stations – primary (40 HV 110/20/6 kV transformer stations)

The following activities are envisaged within this Project activity:

- Modernisation and digitalisation of the 110 kV transformer bays consisting of the replacement of the primary and secondary equipment and concrete pillars;
- Modernisation and digitalisation of medium voltage bays (primary and secondary circuits);
- Modernisation and digitalisation of neutral grounding systems (Petersen coils and resistors),

which covers replacement of neutral grounding systems, automation, protection and oil leakage-proof tanks greening;

- Replacement of 110/20 kV power transformers and greening of leakage-proof tanks with automated voltage regulation for all transformers;
- Installation of automatic adjustable condenser batteries in 40 power stations implementing reactive power automation;
- Internal services modernization including AC / DC secondary circuits' cables and cabinet connections;
- Modernisation of power station buildings and outside lightning system.

3. Transformer substations modernization – secondary (99 LV/MV transformer substations)

The following activities are envisaged within this Activity:

- Modernisation and digitalisation of the MV bays (primary and secondary equipment) of transformer substations in concrete envelope;
- Modernisation of the pole mounted transformer substations;
- Replacement of the classical distribution MV / LV transformers with automatically on load adjusted voltage distribution transformers;
- Modernisation of the LV power distribution panel;
- Modernisation of the low voltage grid (replacement of the classical conductor by a bunched cable and replacement of customer connections).

4. Communication devices and optical fibres

Within this part of the Project the following activities are envisaged:

- Interconnection of HV/MV stations with 387,47 km of optical fibre cable mounted on 20 sections of HV-OHL with potential of integration of EMS/DMS SCADA;
- Installation of 65 Longitudinal Differential Protection (LDP) in HV/MV transformer stations of Delgaz and Transelectrica critical for transmission and distribution grid stability;
- Interconnection of MV/LV substations through PLC and GPRS system.

5. IT smart grids backbone and smart metering (SCADA and smart metering)

The following activities are envisaged within this part of the Project:

- Integration into the EMS/DMS SCADA (modernisation of 5 transformer stations and 35 existing EMS/DMS SCADA);
- Integration of transformer substations in concrete envelope into EMS/DMS SCADA;
- Replacement of the existing metering with smart metering ones and their integration in SMR system.

Factors such as growing population, increase in C&I and residential consumption, increase in usage of smart technologies, growing people's dependency on technology and growth of electro-mobility will lead to significant increase of energy consumption and quality in the long-term. In order to eliminate potential negative impact of the growing energy consumption the project improves the ability of the distribution network to integrate connections of renewable energy sources and balancing of the load profile. New smart applications in the grid will lead to reduction of network losses in distribution grid and to reduction of the overall electricity demand in comparison to the situation without Carmen project, which means a huge positive environmental impact.

The Project will lead to the development of the infrastructure able to generate a series of major benefits for the distribution, as well as transmission infrastructure, with a significant impact on the targeted geographical area, including other regions as well. The main benefits are following:

- Economic and social benefits - efficient smart grid leading to
    - reduction of operation and maintenance costs;
    - reduction of electricity losses;
    - increased efficiency of the distribution service through deployment of smart grids technologies;
    - increased interconnectivity across the national and European infrastructure through improved security, availability and flexibility.

- Consumer benefits - a smart grid oriented towards the quality of the service leading to
    - improved quality indicators of the electricity grid;
    - implementation of demand side management technology allowing electricity consumption analysis and optimisation;
    - increased capability to take over renewable energy including the energy generated by low voltage grid consumers;
    - automation of the distribution grid through SCADA integration and implementation of the primary voltage and reactive control.

- Environmental benefits –sustainable low carbon emission smart grid due to
    - Reduction of emissions through modernisation and digitalisation of the electricity distribution infrastructure;
    - Ability of the grid to take over the energy produced from renewable sources;
    - Deployment of cutting-edge, non-polluting technologies from the category of Best Available Technologies;
    - Improved long-term grid sustainability achieved by decommissioning of the technically obsolete primary equipment.
    - Oil leakage-proof tanks greening

Status: Planning phase
Date of commissioning: 31.12.2028

2. ACON Smart Grids (Czech Republic, Slovakia)

Project website: www.acon-smartgrids.eu (eng), www.acon-smartgrids.sk (Slovak), www.acon-smartgrids.cz (Czech)

The key intention of the ACON SG project (hereinafter referred to as the ACON SG project) stems already from its name – Again COnnected Networks. More precisely, main goal is to modernise and significantly improve the efficiency as well as cross-border cooperation of the distribution networks in Czechia and Slovakia. This modernisation will in turn serve as a base for the implementation of

Smart Grids (hereinafter referred to as SG) pilot projects. Consequently, the synergy between the Czechia and Slovakia at the Distribution system operator (hereinafter referred to as DSO) as well as Transmission system operator (hereinafter referred to as TSO) levels will be deepened. In addition, the project realisation can bring benefits for both Member States, as this cooperation will improve the already existing base of cross-border connection at DSO level.

The project is formed by two main segments; a massive implementation of innovative smart elements and to the support of conventional networks, where smart components will be installed. This auxiliary part will serve not only needs of Czechia and Slovakia, but also for other countries located in Central or Eastern Europe. Furthermore, the ACON SG project intends to deliver benefits to the broader territorial cohesion as it can provide a standard model for other countries demonstrating potential realisation of SG concepts.

The realisation of the ACON SG project aims at achieving the following goals:
• Efficiency and safety improvement of the Czech and Slovak distribution network
• Increase in the synergy between CZ and SK at both TSO and DSO levels
• Incorporation of SG elements into conventional parts of CZ and SK distribution systems
• Improved monitoring of the grid

In order to successfully achieving defined goals, relevant information will be collected from various studies, analyses and operational experience. This will also serve as a foundation for further evaluation of the project itself.

The ACON project will connect previously separated regions by using:

- Comprehensive smart technologies;
- Automated metering management (AMM) technology;
- Remote control devices;
- Looping of the MV power lines;
- Installation of the smart switchers (reclosers), locators on the MV power line;
- Installation of the voltage-regulated transformers;
- Implementation of the intelligent algorithms for automation of the grid steering, preparation of the compensation measures for local capacity of the power lines;
- Implementation of Broadband over power lines (BPL) technology to ensure rapid and reliable transmission of information.

With respect to the smart concepts introduced above, new communication elements will lead to overall advancement of the grid. This measure ensures better connection and future use of both distribution networks for easier deployment of Internet, including the availability of high-speed broadband internet and access to digital service infrastructure, i.e. so-called Internet of Things.

ACON SG project realisation will also cause an increase in the cross-border capacity at DSO level. Moreover, it will strengthen the existing cross-border interconnection by construction of another 22 kV line and 110 kV line. These measures should lead to a lower need for possible non-standard operational activities during the management of the grid. The advancement of the cross-border interconnection also fulfils the technical requirement implied by the article 4 (1.) paragraph c) point i) of Regulation No 347/2013. The compliance with this criterion is guaranteed also for the update ACON SG project on the PCI (Projects of Common Interest) list.

ACON SG project brings together four entities, who are interested in the development of SG activities in the Czech and Slovak area. Two of the four participants are DSOs in the selected location, E.ON Distribuce (CZ, hereinafter referred to as ECD) and Západoslovenská distribučná (SK, hereinafter referred to as ZSD). These two take the primary responsibility for prepared activities and act as project promoters. The other two are the related TSOs, ČEPS, a.s. (CZ, hereinafter referred to as ČEPS) and Slovenská elektrizačná prenosová sústava, a.s. (SK, hereinafter referred to as SEPS), who will play an important role in the matter of far-reaching use of the information flow.

This may enhance not only the operating of the transmission system but also the knowledge sharing process in the particular area for further development in other regions of the impacted countries.
Border area of the Czech Republic and Slovakia has been evaluated as a strategic locality for the cross-border part of the ACON SG project because this area already has existing connections of the voltage levels 400 kV and 220 kV between transmission operators, as well as 22 kV and 110 kV voltage level connections between the distribution system operators.

Southern and Eastern part of the Czech Republic and western part of Slovakia were selected as possible locations as well. The plan is to deploy innovative SG elements on the HV, MV, and partially LV levels, and to also build a new remotely controlled transformation station with installed capacity of 2 x40 MW on the Slovak side and to modernise transformation stations (using remote controllers, voltage regulation) n the Czech and Slovak side in order to improve the 22 kV cross-border connection.

ACON SG project aims to create smart solutions for the whole impact area by implementing of new smart technologies. Interconnection of borderline area systems is expected to deliver an increase in costumer's comfort, as it will be the customer, who will profit from the synergy of uniting regions and bigger market. Moreover, the project provides an incentive for greater competition within the region. Next intention of this project is to guarantee adequate supply quality, safety and reliability of the distribution system. The incorporation of smart technologies (for example, smart metering devices, remote control transformation stations, further installation of concentrators, implementation of intelligent algorithms for automation) will allow better monitoring of the system as a whole. It will also enable faster detection of potential problems. Furthermore, it will have positive influence on SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index) indicators. Enhanced international cooperation also represents a solution for potential crisis situations, e.g. outage. Another expected benefit of installation of smart elements is easier future management of the system in new conditions, especially during the expected increase in penetration of the distributed sources to the system. Overall, the ACON SG project should lead to an increased spread of additional sources due to better management of the power flow.

Furthermore, project activities are expected to increase potential energy input, which will allow the connection of a greater number of customers. This measure should ultimately improve the quality of life in the impacted regions. Impact of the project can be considered as beneficiary for the environment, due to the lower need for power, which depends on balancing the load profile. Another positive impact on the environment is wider use of underground cable lines, higher use of renewable energy sources or better consumption management. Utilisation of all new elements up to their full potential will be ensured by incorporating new modern communication elements and creating communication infrastructure.

To be more precise, the ACON SG project will cover the following activities to increase system stability and enhance innovation process by using smart technologies:

- modernization of current cross-border MV and HV power lines and construction of new cross-border MV power line;
  o increase in capacities for connection of grid users
  o installation of optic wires for delivering, e.g. IoT
  o security reasons – resolving critical security circumstances

- construction of new substation near Borský Svätý Jur (SK) and new substation Brno-sever (CZ), as well as the modernisation and automation of the distribution grid within the Action area;

- modernization of TS 110/22 kV and construction of new TS 110/22 kV; o installation of new local advanced SCADA (Supervisory Control and Data Acquisition) within integration with GIS, voltage regulation, remote control,

  - o installation of new local advanced SCADA (Supervisory Control and Data Acquisition) within integration with GIS, voltage regulation, remote control, IT hub
  - o continues with the process of the implementation of smart technologies
  - o enables to connect more consumers / producers / prosumers
  - o lowers the peak of consumption – balance of the peak / diagram of consumption

- AMM technology for innovative steering grid purposes, that will use smart meters, concentrators and additional communications devices;
- enhanced platform for demand side management
- installation of remote-control devices;
- installation of the smart switchers (reclosers) on the MV power line;
- installation of the Fault detectors for MV covered conductors;
- installation of the voltage regulated transformers MV/LV (VRDT);
- preparation of the compensation measures for local capacity of the power lines;
- construction of a communication network, including a number of different elements (e.g. optical networks, development of 5G network etc.), to ensure rapid and reliable transmission of information;
- the construction of the optical network which may include the renewal of the problematic parts of the MV power overhead and strengthening of the existing power lines;
  o increase in capacities for connection of grid users
  o improvement of SAIDI and SAIFI, decrease of malfunctions – better quality of supply
  o preparation of the new type of the grid connection – cross grid

- updating the energy dispatching centre according to the SG project;
- PIT/CIT (Process IT/ Communication IT);

  - constructing or detaching the parts of existing data networks in order to separate critical systems
  - separating the communication access points into network segments based on their categorization
  - ensuring the voice services through the communication infrastructure
  - implementation of the WDM (Wavelength Division Multiplexing) technology

- Ensuring the cyber and physical security of SG infrastructure (critical infrastructure of the state);

    - security of substations 110/22 kV, construction of the technical monitoring centre with respect to technologies, e.g. both electronic as well as emergency systems, CCTV (Closed Circuit Television), chip cards.

- implementation of the intelligent algorithms for grid steering automation.

Status: Started 2019
Date of commissioning: 31.12.2027

3. Danube InGrid (Slovakia, Hungary)
Project Website: www.danubeingrid.eu

The main goal of the Danube InGrid project (hereinafter referred to as Project) is to strengthen the interaction of the Slovak and Hungarian electricity markets and to deepen cross-border cooperation between the distribution and transmission system operators. The Project will focus on the modernization of the distribution grid and development of modern energy infrastructure by using Information and Communication technologies (ICT) to adopt Smart Grid technologies. It will efficiently affect the behaviour and actions of all market participants (consumers, producers, prosumers, operators, generators, etc.) in order to focus on energy efficiency and to integrate great amounts of electricity generated from renewable or distributed energy sources.
Altogether there are seven entities engaging in the Danube InGrid project. On the Slovak side Project promoters are two largest distribution system operators (hereinafter referred to as DSOs) Východoslovenská distribučná, a.s. (hereinafter referred to as VSD) and Západoslovenská distribučná, a.s. (hereinafter referred to as ZSD), as well as the Slovak transmission system operator (hereinafter referred to as TSO) - Slovenská elektrizačná prenosová sústava, a.s. (hereinafter referred to as SEPS). On the Hungarian side, Project promoters include DSOs E.ON Észak-dunántúli Áramhálózati Zrt. (hereinafter referred to as EED), ELMŰ Hálózati Kft. (hereinafter referred to as ELMŰ) and ÉMÁSZ Hálózati Kft. (hereinafter referred to as ÉMÁSZ). Moreover, the Project is supported by Hungarian TSO MAVIR Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zrt. (hereinafter referred to as MAVIR). Participation of DSOs and TSOs will result in more efficient cooperation between the Slovak Republic and Hungary. The Project will develop virtual cross-border cooperation on the distribution level, which will be realized by the establishment of data exchange platform and know-how sharing.
The addition of a new Slovak DSO (VSD) and two new Hungarian DSOs (ELMŰ and ÉMÁSZ) into

the Project is significantly beneficial in terms of focusing on a territory twice the size of the initial Project area intervening eastern part of both Slovakia and Hungary. These operators will contribute to the development of the infrastructure in the eastern, less developed region along the border with Ukraine, which might lay ground for prospective smart solutions and lead to the following cross-border cooperation in one of the most undeveloped part of Schengen Area. The deeper interaction between the countries will result into more affordable, more secure and sustainable energy, increased comfort and life quality of the consumers, job creations and new employment opportunities through suppliers of Smart Grid technology.

The region, where there is physical interconnection between ÉMÁSZ and VSD, is the secondary power supply of the 26km-long Domica-Baradla Cave system, which is the largest subterranean hydrological system of the Gömör-Torna karst plateau in Hungary and the Slovak Republic. Baradla, as a part of the Aggtelek National Park in Hungary and Slovensky kras National Park in Slovakia, was declared as a UNESCO World Heritage Site and a Ramsar site. This area contains large number of ponds, dripstone formations, a subterranean stream and rich fauna, providing habitat for a great number of species, and serves as a tourist attraction. Medium voltage line coming from Slovakia was built as a backup line because of the security of supply of the Baradla cave due to the necessary regulations ensuring operation safety of highly touristic venues. Deepening Hungarian-Slovak network connection will lead to creation of long-term sustainable energy system in a highly protected nature conservation area.

The Project aims at the modernization of the national transmission and distribution networks leading to more efficient cooperation between the operators. That will lead to increased quality and security of electricity supply, potential for increased share of renewable or distributed energy sources, reduced negative environmental impact of DSOs' activities and predicted decrease of network losses and deferred investments in conventional power plants in the eastern, less developed regions of Hungary and Slovak Republic. Modernization and digitalization of the energy infrastructure in the Project area will not only benefit the key Project promoters, but also market users, energy suppliers, consumers, producers, and prosumers in other regions of the Slovak Republic and Hungary. The Project will enhance cooperation between TSO and DSOs in the field of smart grids, particularly preparing the grid for increased integration of distributed energy resources including storage systems and data sharing among all of partners for smooth operation of the grid as a whole. Strengthening the backbone of the grid by creating more capacity for new connections and integrating weather forecast data to the energy loadflow in grid planning and grid operation will help balancing the cross-border extremities due to the rapidly increasing weather dependent intermittent energy sources.

The main objective of the Project is implementation of new smart technologies, which will positively affect all involved regions in both the Slovak Republic and Hungary. To fulfill this objective the Project will include a wide range of activities: new transformation stations will be constructed, existing transformation stations will be modernized by implementation of smart elements, the distribution system will be better monitored and remote controlled and IT based system for the smart management of the grid and smart metering system at medium voltage level will be implemented along with the integration of weather forecast data to grid planning and operation.

Taking into account the rise in GDP (Gross Domestic Product), the consumption of whole industry, increased use of smart technologies, the reliance of people on technology and the deployment of electromobility, spread of heat pumps and solar panels, these developments would contribute to a long-term increase in energy consumption. New smart applications within the grid will lead to the efficiency of the distribution grid. By using new smart elements to their full extent the Project will have a positive impact on the economy as well as on the environment.

Subsidizing of a wide range of grid developments helps equalize the differences between the DSO supply areas, to achieve a modern and environmentally friendly energy supply for the economically less developed regions (e.g. ÉMÁSZ and VSD), attract more international investments, establish infrastructure for more enterprises and give solutions for the highly developed areas' (e.g. in Budapest) overconsumption with optimized grid management.

The Project consists of several Activities focusing on the construction and modernization of grid elements, which will increase reliability of power supply and network stability, installation of smart elements and implementation of IT solutions supporting smart grids. The overview of major Activities is as follows:

Smart installations and devices

1) Installation of voltage and current metering devices with communication function to MV/LV transformer stations
- measuring devices and sensors installed in MV/LV transformer stations have a central processing and communication unit, and use real-time communication in order to reduce the reaction time in case of failure
- devices use real-time communication so that in case of failure the reaction time will be reduced considerably
- metered data (current and voltage values) considerably help to maintain a careful, optimized schedule of operation and maintenance tasks and establish the planning methods and operation of decentralised network areas

2) Installation of automatic tap changer MV/LV (OLTC) transformers and Inline Voltage Regulators (IVR) on LV to tackle voltage challenges caused by high PV penetration
- the OLTC (on load tap changer) MV/LV transformer is able to continuously change its transmission even when it is loaded to achieve standard LV level, saving the cost of complete network expansion
- with this technology it is possible to avoid switching of transformation areas due to break-down or maintenance-caused voltage problems. It increases service quality
- in cases where the penetration of PVs on LV is uneven, OLTC transformers cannot cope with opposite regulation needs. In such cases Inline Voltage Regulators (IVR) are needed to keep voltage in the required level and retain the flexibility of the grid.

3) Remote controlled switching machines to medium voltage lines, ring main unit switchgears and fault indicators
- provide better quality of the service thanks to the improvement of the recovering process of distribution grids
- remote control and switching of lines and cables
- immediate fault detection which leads to faster network repair and better services quality

- reduced CO_2 emissions as the operators knows exactly where to send the linemen

4) Cabling of lines due to environmental issues
- the protection will be installed to lower the level of bird mortality caused by collisions of birds with wires, cabling is done in non-hatching periods (i.e. end of year)
- it will improve the protection of migratory, wintering and certain breeding bird species by reducing the negative impacts of high voltage power lines on their populations

5) Capacity increase technology (energy storage systems)
- optimization of the use of primary infrastructure in a form of "load shifting" to achieve compliance with voltage quality requirements. In nature protected areas where standard solutions are not feasible.
- the peak load and backup demands are covered with smart technology, where mutual cooperation of modern storage system and distribution grid brings the benefit
- result will be reduced system losses, optimized capital operational costs when meeting supply and voltage quality standards (SQ and VQ) that leads to improvement of the system efficiency, power quality and reliability
- decrease of necessity to build “classical” lines or cables and using innovative solution that can be integrated to the grid

6) Implementation of smart technologies and metering devices to MV/LV transformer stations
- better detection, localization and response to operating faults, and non-standard disturbances
- improved monitoring of the grid
- metering the voltage quality
- reaction to planned and unplanned interruptions in the system (improvement of local and global quality indicators)
- central control system (SCADA) level upgrade
- establishment of metering functionalities in MV/LV transformers will lead to improvement of LV monitoring and optimization for the development of customer requirements
- implementation of smart technologies might lead to integration of communication devices to the networks, realization of cross border data exchange platform and improvement of IT system
- modernization of transformer stations will also result in SAIDI and SAIFI in the action area and decrease the number of malfunctions within the system
- it is possible to achieve full MV level automatization with respect to areas with highest population density
- online monitoring of load conditions and its distribution along the MV line leading to optimal configuration of MV grid and reduction of electrical losses
- metering will ensure the subsequent possibility of power optimization of MV / LV transformation and the general MV grid configuration with the potential for the reduction of electrical losses in the distribution system (and leads to CO_2 reduction)
- analysis of the metered data will allow to determine the critical points in the network, which is crucial in terms of customer service quality

7) Modernization of 11 HV/MV transformers and 1 000 MV/LV transformers (150 per year)
- increased capacity and stability of distribution system, and new possibilities for connecting end-users and renewable energy resources
- capacity optimization for the expected development of electromobility

- full alignment with present ecodesign standard
- installation of OLTC technology in HV/MV transformers and online monitoring
- reduction of losses, i.e. CO_2 emissions

Construction and modernization of substations

8) New substation 400 kV in Vajnory (SK) with a loop line
- construction of this substation will have the key role regarding the stability of the electricity system in the InGrid area of ZSD, together with safety and reliability of the electricity supply
- will increase the capacity for DSO's customers and increase benefits for possible RES and distributed generation connection into distribution system

9) Extension and modernization of substations Stupava (SK) and Podunajské Biskupice (SK)
- increased capacity for DSO's customers, improved business environment and employment in the region through connection of new customers and energy generation in the region

10) Reconstruction of existing substation/new substation in southern parts of Danube InGrid region
- better flexibility under both expected and unexpected interruptions of distribution
- enhanced distribution capacity and stability of the grid

11) New substation near Šamorín (SK)
- connection of more RES
- support of e-mobility
- lower GHG (Greenhouse gas) emissions and electricity losses

12) Realization of 110/22 kV substation Lučivná (SK), substation Levoča (SK), 2 more substations in ÉMÁSZ and 3 more substations in ELMŰ including related lines used for the connection and power output
- development and more efficient integration of renewable energy sources (RES) in the action area
- provision of the development of a „super-charger" for the needs of electromobility on the rest areas of D1 motorway, where the necessary infrastructure is currently absent (Levoča and Štrba rest areas)
- provision and significant expansion of electromobility with environmental protection in national nature protected area (national park) the High Tatras with regard to the zoning of the area
- increase of the reliability of distribution for the system users in the High Tatras area
- elimination of inefficient assets
- ensured network reliability because of improved voltage conditions, enabling connecting new customers and renewable energy sources, and ensured ability to meet the requirement in case of unpredictable events
- by substation realization the voltage conditions in the area will be improved providing greater opportunity to connect the other customers and production sources
- realization and modernization of substations will increase reliability of power supply and network stability

Reactive power overflows

13) Implementation of technical solution for elimination of reactive power overflows
- optimization of energy flows, while helping to relieve the pressure on primary infrastructure equipment (reduction of current load)
- improving voltage regulation and stability in AC transmission and distribution systems with the help of compensation systems (as shunt reactors)
- relieving the distribution system to improve the quality of supply by constructing SMART (automated and regulated OLTC) compensation systems such as coils, shunters, capacitors etc.

reducing the risk of overvoltage in transmission and distribution system and overloading of the system equipment/elements
- reduction of electrical losses
- higher active utilization of distribution system equipment

Optical fibre network

14) Optical fibre network on HV and MV network
- optical cables will be installed on HV and MV overhead lines, or where necessary (urban areas), underground optical cables will be used
- optical fibre network will be feasible for all communication between HV/MV substations in both control and protection
- building and development of the optical connections create the foundation of an intelligent network at HV and MV level
- development of optical infrastructure ensures greater reliability and security of the transmission and distribution networks with a positive environmental impact
- opportunity to cover “white maps” of the regions access to the internet, which wouldn’t be feasible for “commercial” entities
- Implementing system control (automated “reclosers” and DTS)
- Improvement of available power demand and resources (DER)
- Improving data collections (IMS, etc.)

IT management for Smart Grids
- IT infrastructure is one of the key elements of a modern network needed to support all other activities
- IT for smart grid is focused on smart management of losses and failures, asset management system, digital platform for customer data publishing and network security system, which will enhance the grid management
- The aim of the IT data platform is to exchange weather data between the DSOs which does not depend on national borders but on weather conditions of regions (i.e. wind, icing)

15) Installation of a new modern SCADA system with smart functionalities
- introducing a modern, forward-looking SCADA system both on the Slovak and the Hungarian side with sensors allowing the implementation of optimum measures on the distribution network, thereby increasing security of supply
- maintaining monitoring and operational control functionality, and extending the use of advanced applications

- functional expansion: introducing less used functions to meet new challenges and expectations based on customer expectations and regulatory requirements (based on the Clean Energy Package), like demand side management, flexibility, forecasting, network computing, real-time data services
- development and unification of SCADA-NET: Closer connection to INIS (which is a program of network topology based on GIS); extending remote monitoring to all SCADA-NET devices
- the intelligent system allows less classic network investments to provide greater flexibility, thus enabling renewable energy to capture capacity on the distribution network
- the system provides useful online information to customers that allows to manage injection and consumption of producers and consumers for energy management
- by installing a communication module, it is possible to continuously share and exchange system information between Project partners, providing useful predictions of system behaviour

16) Installation of a new modern GIS system (INIS) on the Hungarian side with large capacity and smart functionalities
- the introduction of a modern, high-capacity, wide-functionality GIS system opens up the possibility of extensive data storage, which provides the basis of all DSO IT platforms and solution for better operation and for introducing new services

17) Grid processes digitalization
- the integration and implementation of IT solutions supporting smart grids will enable to gather, share and analyse greater volumes of data directly affecting the asset management process and optimization of distribution system operation
- implementation of the Ewita customer interface (E-digitalization, Workflow, IT Administration) will lead to easier online communication, paperless identification of customer requirements and subsequent digital workflow
- digitalization of distribution grid processes will lead to implementation of higher share of automation in interaction with customers
- these new digital solutions will improve customer experience, minimize the paperwork and reduce time of the procedure on the other side of the system

18) Cybersecurity
- this activity is focused on system usage reliability, cybersecurity of distribution network and data management improvement
- integration of new ICT components (e.g. Event/ privileged access/ identity management systems, firewalls) to implement measurements to mitigate risks of cyber-attacks, ensuring safety of the distribution network

19) Meteorology
- collecting the meteorological data will help to secure the stability and safety of the grid by integrating these data to network operation and planning,
- it helps grid operation for faster planning, preparation for black-out (extreme weather conditions) and reaction to faults by the data exchange of meteorological data on international level thus it will improve security and quality of supply in both Slovakia and Hungary.

Status: Started 2020
Date of commissioning: 31.12.2029

4. GreenSwitch (Slovenia, Croatia and Austria)

Project website: N/A

Distributed renewable sources, increased peak consumption from electric vehicles and heating (heat pumps) have recently challenged us with increasing power flows on both distribution and transmission grid. Power flows related to renewable energy sources are becoming more and more volatile. Operators are facing increasing investment demands due to new generation and loads but also due to incompatibility of the existing grid for solving new patterns of flows, increased demands for quality of supply even in most remote areas while facing limited resources, allowing just the most needed investments in critical network areas. In this circle, it is very challenging to meet the always moving target. The situation urgently calls for a more holistic, systematic and multi voltage level system wide approach with a stronger coordination among TSOs, DSOs and network users with a clear focus on a longer term grid development perspective and optimizing investments in primary equipment with various techniques, also by using advanced network control functionalities. Partners from Austria, Croatia and Slovenia have balanced the opportunities and risks associated with such a modern approach of grid development and decided that due to extraordinary challenge and limited resources, they could do it only by solving the problems together in a strong international cross border collaboration. Hence the project GreenSwitch presented in this proposal was born.

The basic approach in the GreenSwitch project is to optimize the utilization of existing infrastructure and efficiently incorporate new technologies and advanced functionalities allowing higher hosting capacity, efficient integration of new loads, optimizing future investments and improve the security and the quality of operation and supply. Besides investments in primary infrastructure a smart grid toolbox of different technologies, platforms and functionalities is needed to achieve the maximal output. Cross-border and cross-sector solutions are explored and implemented in the most advanced directions. They are combined with storage, consumer engagement and highly digitalized information systems.

Remarkable synergies within and among partners have been achieved through a dedicated siting and sizing of infrastructure and operational solutions. As an example, the complex management of power flows on the 220 kV network, which today represents one of the biggest challenges on the transmission network in N or N-1 system states, would require 2 power control units to be invested in Slovenia, 5 units in Croatia and eventually an additional unit in Austria. By introduction of the GreenSwitch project the number of such units will be reduced from 8 to 5, which represents between 29-37% reduction of costs. Additional flexibility of power control can be further achieved by allowing for the construction of the latest modular power control units (SSSC), which will be commonly analysed by the partners and determined in the design phase of the GreenSwitch project. The remarkable 46 MW of battery energy storage systems on the GreenSwitch project will be installed with the view of a wider network congestion and stability issues and will also improve the compliance to N-1 criteria, which will allow a postponement of some very complex and expensive DSO and TSO investments in the grid. Regarding the installation of high temperature line equipment on the 110 kV cross-border lines, two system operators will interconnect some areas with seasonally variable loads or variable generation that would in the absence of the GreenSwitch project and if taking a more protectionist approach require that each of them strongly reconstructs and secures their bordering substations with additional internal 110 kV or 220 kV lines (up to 4 new lines in total). These new lines would need to be put into a completely new environmental corridor. The GreenSwitch project will achieve savings of more than 60% on this particular issue.

Distribution companies in all three countries are facing the challenge of not being able to keep up with the grid upgrades to follow all the applications of new loads and distributed generation. New, smart functionalities are commonly seen as the only way out for a timely and sufficient increase of the hosting capacity of existing grid and improving the security and quality of supply while reducing the need for costly and lengthy investments in primary equipment. However, by fulfilling the needs on the distribution level, these large amounts of new loads and generation will shift the problem with an aggregated effect on the high voltage level that will also reflect in the increased volatility of cross-border flows that need to be managed by the TSOs.

Distribution grid problems cannot always be solved locally, especially in the rural areas where distributed generation often surpasses the total consumption. With the increasing share of distributed sources and new loads that require larger and larger needs for flexibility, distribution systems are directly influencing the national and cross national TSO networks. This relation needs to improve with smart solutions that will be able to effectively deploy various kinds of supply and flexibility flows on the locational basis for the distribution and the transmission services being provided by the conventional flexibility like gas fired power plants, pumped storage or more advanced like demand response and battery storage in a more orchestrated way. Without such approach the partners of the project would require larger flexibility needs in each individual area or an increasing cross border capacity by building new transmission lines which as we know is an extremely complex and lengthy from the timing perspective. Many new technologies and techniques will be deployed on this project including locational use of battery storage, power flow prediction and control systems, an optimal supply of physical islands, and an advanced approach on providing distribution grid resilience by a cross border connection, securing the supply to the customers on the bordering territories in the emergency conditions. Cross sector integration on the field of mobility and heating also represents a rarely seen examples of smart technology implementation into the Power System.

Transmission and distribution system and network operators in the GreenSwitch project have a long history of cooperation both at cross border level between TSO-TSO and DSO-DSO as well as within each country as a TSO-DSO cooperation. Slovenian and Croatian partners are finishing the very successful PCI project SINCRO.GRID, where focus was on a common approach to solve the voltage issues on transmission level and enable massive deployment of renewable sources, mainly connected at the transmission level. The GreenSwitch project will upgrade the SINCRO.GRID results with additional cross border capacity and optimization of grid operation while expanding to lower voltage levels. New technologies will be introduced and the grid will be better prepared for expected large amounts of new loads and RES.

One of the technologies utilized by transmission system operators in the GreenSwitch project is the Wide Area Measuring System (WAMS), which provides valuable information through real-time measurement-based analytics and combines them with model-based predictive visibility. In the GreenSwitch project this technology will be used by network operators to gather an accurate estimation of the current grid status for near to real time parameterization of Power Control Systems in order to mitigate the potential cascading events.

There are more examples on how the GreenSwitch project is building on the experience from different pilot, demonstration, or small-scale application projects at the DSO level. In Slovenia, the TSO and selected distribution companies gained experience in a large international demonstration project called NEDO, where advanced functionalities such as coordinated voltage control, FLISR and closed loop operation (at 20 kV level) were demonstrated on a limited scale. GreenSwitch project is leveraging on the findings and experience of the NEDO project with a full-scale implementation, including also other complementary technologies. Several projects dealing with local flexibility implementation and market were also conducted. DTR (Dynamic Thermal Rating) systems are already established at selected transmission lines of Slovenian and Croatian TSO's. Moreover a pilot project testing an indirect DTR method at MV/LV transformer was conducted with great success in Slovenia. GreenSwitch project will build on this experience by further developing DTR system on cross-border lines between Slovenia and Croatia as well as on power transformers on 400 kV and MV level.

In Austria, project ProAktivNetz aimed at analysing how distributed RES can be optimally integrated in real network operation, considering planned shutdowns or unforeseen disturbances within the distribution grid. The findings will be mainly used for the effective implementation of an automated outage management system, which is becoming an important part of the GreenSwitch project.

Furthermore, in the scope of the VirtueGrid project it was analysed how virtualisation techniques can support system operators with the integration of large numbers of new communication nodes, can increase dependability, situational awareness in energy and communication systems and, most prominently, reduce manual configuration and engineering effort.

New loads such as electric vehicles and heat pumps as well as distributed generation are a driver for investment needs first at distribution level and as aggregated at transmission level too. Increased cooperation, coordination and data exchange are needed at TSO-DSO level. Operators also aim at using flexibility potential, which requires a common marketplace allowing cooperation and optimization of distributed flexibility sources. This is a subject of several projects in the area like the FutureFlow, Crossbow or the recent OneNet project where local flexibility markets will be regionally connected.

GreenSwitch enables prosumers get into the frontline of power system operation, as flexible load and generation are crucial for future grid development and coordinated optimization at TSO-DSO level. Fully automated MV/LV substations developed in the GreenSwitch project will in the future represent the main information and power hub between MV grid and energy communities.

Main goals of the project are:

- Increase hosting capacity for distributed renewable sources,
- Allow efficient integration of new loads,
- Optimize grid investments,
- Improve quality of supply,
- Improving observability of the distribution network,
- Coordinated flexibility procurement and supply,
- Increase cross border capacity,
- Optimal use of infrastructure.

In Slovenia, a numerous group of partners involving the TSO, retailer GEN-I and three distribution companies Elektro Celje, Elektro Ljubljana and Elektro Gorenjska decided to work on this project together. From Croatia the TSO HOPS, DSO HEP ODS and generation/retail company HEP joined their forces. DSO KAERNTEN NETZ is a distribution company from Austria who is also strongly committed to the project. Each company is responsible for the implementation of the envisioned technologies in their respective grids. GEN-I and HEP will invest in battery storage helping the grid needs.

Project establishes a cross border dimension both on TSO-TSO level as well as DSO-DSO one. TSOs from Slovenia and Croatia will increase capacity of existing cross border lines by installing high temperature wire technology (HTLS), expand DTR systems on other cross border lines and install Power Control Systems to better control the cross-border flows. All these will result in safer and more reliable operation of power systems as well as have a positive effect on neighbouring systems. The GreenSwitch project will remove up to 3300 hours per year of stressful state of transmission grid operation by removing critical N-1 situations in these periods for Slovenian and Croatian and Austrian grid. By this, the partners will also be able to avoid very critical alternative measures taken today on 220 kV level, which are leaning on topological redirection of flows, therefore reducing the grid availability and also putting the grid security in jeopardy. These advanced system states will also positively impact the power system of Italy. KAERNTEN NETZ will in coordination with Elektro Gorenjska also establish a cross-border emergency electrical connection via the Loiblpass (Ljubelj). In case of the disturbance the connection will ensure increased security of power supply in the bordering areas of both DSOs in the Loibl (Ljubelj) area. Furthermore, the existing cross-border electrical connection via the Seebergsattel (Jezersko) will also be upgraded in the scope of the project. This connection was built in the time of sleet and storm period that hit Slovenia in 2014. The table below shows the number of cross-border power-supply activations for last 3 years. In 2020 this emergency line served the customers on one or other side of the border for more than 200 hours, predominantly preventing an outage of 300 users and 240 kW of renewable sources.

Table 1: Table of cross-border power supply for last 3 years.

	Start of cross-border power-supply		End of cross-border power supply		Direction	
Year	Date	Time	Date	Time	From	To
2021	20.02.2021	09:59:02	20.02.2021	15:15:37	KNG	EL GOR
2020	05.02.2020	15:02:00	06.02.2020	12:18:19	EL GOR	KNG
	14.02.2020	15:59:00	14.02.2020	19:14:00	EL GOR	KNG
	04.06.2020	08:42:28	04.06.2020	14:39:19	EL GOR	KNG
	14.09.2020	07:49:40	14.09.2020	15:33:22	EL GOR	KNG
	23.09.2020	10:35:21	23.09.2020	11:40:18	KNG	EL GOR
	29.09.2020	07:56:12	29.09.2020	15:52:42	KNG	EL GOR
	06.10.2020	07:03:07	06.10.2020	14:06:22	KNG	EL GOR
	11.10.2020	19:08:09	16.10.2020	13:24:57	EL GOR	KNG
	26.10.2020	10:18:47	26.10.2020	11:58:10	EL GOR	KNG
	06.12.2020	18:34:15	06.12.2020	19:51:27	EL GOR	KNG
	09.12.2020	11:17:00	09.12.2020	16:26:00	EL GOR	KNG
	29.12.2020	18:00:06	30.12.2020	13:40:04	EL GOR	KNG
2019	14.01.2019	08:45:02	14.01.2019	10:18:16	EL GOR	KNG
	16.01.2019	08:53:29	16.01.2019	09:24:14	EL GOR	KNG
	22.01.2019	08:47:15	29.01.2019	09:55:00	EL GOR	KNG
	07.02.2019	08:45:48	07.02.2019	09:54:35	KNG	EL GOR
	28.02.2019	07:30:00	28.02.2019	14:37:00	KNG	EL GOR
	27.03.2019	07:46:50	27:03:2019	13:35:06	KNG	EL GOR
	04.09.2019	11:03:25	04.09.2019	13:19:00	KNG	EL GOR
	19.09.2019	08:23:06	19.09.2019	14:21:56	EL GOR	KNG
	01.10.2019	08:05:00	01.10.2019	15:57:08	EL GOR	KNG
	24.10.2019	08:07:50	24.10.2019	13:55:37	KNG	EL GOR

Technologically the implementation of state-of-the-art smart grids is at the centre of the GreenSwitch project. In selected project areas these smart grids are also able to perform a DSO-DSO, TSO-TSO and DSO-TSO coordination. The GreenSwitch project is also looking for applications where advanced functionalities are established together with adequate primary infrastructure. This includes applications and functionalities at the control centre level as well as ICT infrastructure, controllability, and observability infrastructure in areas where the situation is the most critical. Field applications may vary from location to location based on specific needs.

The following advanced functionalities will be implemented in selected areas:

- Distribution level
    - Coordinated voltage control (Slovenia, Austria)
    - Fault Location, Isolation and Service Restoration (FLISR) in Slovenia, Austria and Croatia
    - Closed loop operation (Slovenia, Austria)
    - Data and function architecture prepared to enable and support the local flexibility market (Slovenia, Austria)
    - Dynamic thermal rating of MV/LV transformers (Slovenia)
    - Support to resilience power scheme (Slovenia, Austria)

- Transmission level will:
    - Upgrade the flexibility of grid operation to enable increased power loading with instalment of new technological equipment (high temperature lines, Power Control Systems, expansion of DTR) in Slovenia and Croatia.
    - Large scale connecting points for e-mobility (Slovenia).
    - Optimal use of infrastructure by extraction of heat from many high voltage power transformers and its use in the local and district heating system (Slovenia).
    - Support to resilience power schemes (Slovenia).

To enable the functionalities the following investments will be needed in specific areas:
- At distribution level:
    - Upgrade existing or install new ADMS system capable to support advanced functionalities,
    - ICT network to connect all observability and controllability network elements (depending on terrain optical fibre, LTE radio, other),
    - Upgrade existing secondary substations (MV/LV) or build new ones with automatization and control equipment in selected areas (several possibilities, where applicable: PMU, RMU, remote control load break switches, short circuit indicators with remote reading capability),
    - Additional measuring devices in selected areas,
    - Reclosers in selected areas,
    - Additional cable to close MV loops in selected areas and interconnect the bordering network users for emergency backup supply,
    - Smart primary substations (HV/MV), where applicable,
    - Battery energy storage servicing the local network operation processes including the physical islanding use case.
- At transmission level:
    - Power Control Systems,
    - HTLS technologies (High temperature line equipment),
    - Expansion of DTR system,
    - New grid connections for the future heavy duty hyper charging stations in the vicinity of the highways,
    - ICT infrastructure between the existing and new nodes,
    - Equipment for heat extraction from transformers

The overall project scheme is shown by the following illustration.

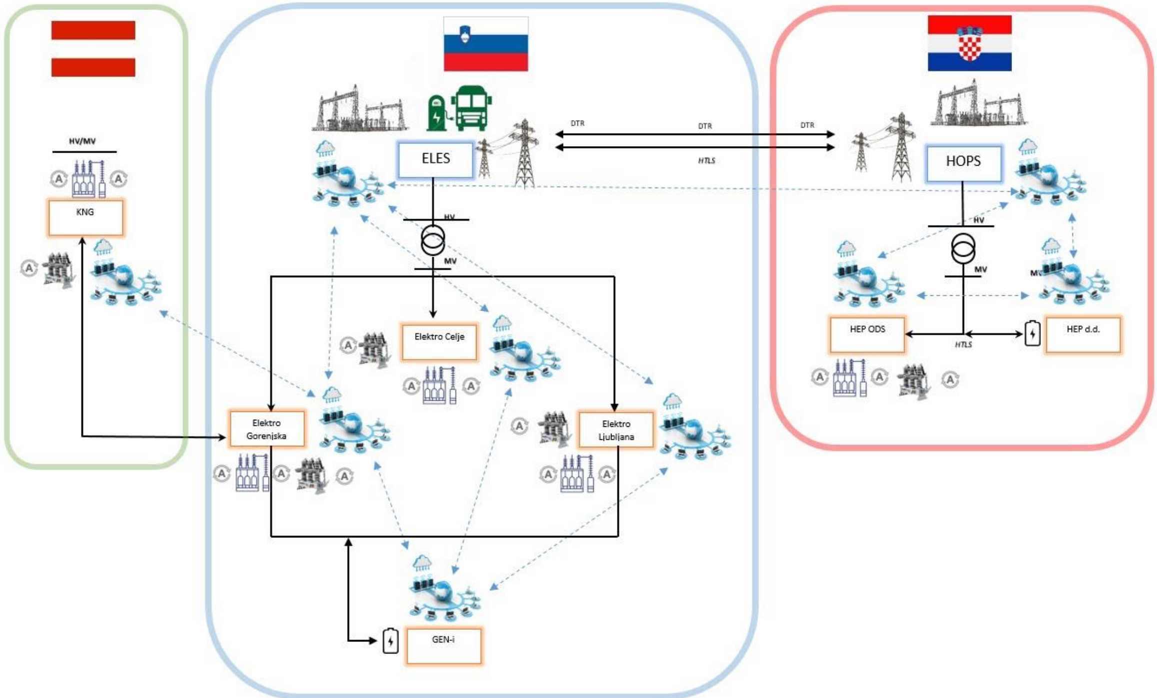

Figure 1: Project scheme

Expected impacts of the project:

- At least 20 % lower SAIDI index in selected MV feeders or secondary substations,
- Better utilization of existing MV/LV transformers – at least 15 % higher limit in wintertime,
- Increased hosting capacity of existing network – 550 MW of additional renewables can be installed in selected MV feeders and 1.350 MW at transmission level,
- Deferred transmission and distribution investments,
- 10 % lower peak demand using flexibility sources,
- Increased cross border capacity on borders between Slovenia-Croatia and increase the cross-border emergency capacity between Slovenia-Austria,
- Production of 30 GWh of heat from at least 20 power transformers per year,
- Provide commercially available high-power infrastructure on frequent traffic locations that enable simultaneous fast charging of at least 50 busses or heavy duty vehicles with the charging power of between 1-4 MW per vehicle.

Status: Planning phase

Date of commissioning: 2028

5. Gabreta (Czech Republic, Germany)

Project website: www.gabreta-smartgrids.eu

The Gabreta Smart Grids project (hereinafter referred to as the Gabreta SG or the Project) aims to digitalize and modernize the distribution grid of project promoters and foster the cross-border cooperation between Germany (Bavaria) and the Czech Republic. The projects name comes from

Gabreta Forest, which can be identified with today's Bohemian/Bavarian forest spreading across the border between Czech Republic and Bavaria. The name is believed to be Celtic, as the Celtic tribe Boii settled in this region.

Gabreta SG has altogether four entities who are participating in this Project. Project promoters taking primary responsibility for the Project are the German DSO Bayernwerk Netz GmbH (hereinafter referred to as BAG) and the Czech DSO EG.D, a.s. (hereinafter referred to as EGD). The Project is supported (project supporters) by two TSOs, TenneT TSO GmbH (hereinafter referred to as TenneT) in Germany and the Czech TSO ČEPS, a.s. (hereinafter referred to as ČEPS).

Gabreta SG introduces new cross-border interconnections between Germany and the Czech Republic on the MV level. The grid will be upgraded by smart elements accommodating it for further integration of renewable energy sources and the ongoing decentralization of the energy system. This will allow a better connection of grid users, providing them with higher security and quality of supply. Gabreta Smart Grids will prepare the electricity grid for a connected, resilient, and sustainable energy future in Europe.

Main goals of the Project are the modernization and digitalization of the energy infrastructure. Gabreta SG will foster the cross-border cooperation mainly on the distribution level through the construction of a cross-border interconnection. It will contribute to the further interconnection of European energy networks. The interconnection will be realized on the physical as well as on the non-physical level. The data exchange (data sharing platform, data processing) between EGD and BAG will be introduced in order to achieve higher level of coordination between both parties. The specific activities will accommodate the power grid infrastructure for a broader energy transition towards intermittent renewable sources. Moreover, Gabreta SG will contribute to the creation of a sustainable energy supply system and security of supply.

The Project consists of several streams of Activities focusing on: interconnection and strengthening of distribution grids, their modernization by smart elements, communication, and Smart Grid IT solutions. The overview of the major Project Activities is as follows:

1) Interconnection and Strengthening of Distribution Grids

- *Physical cross-border interconnection of BAG and EGD distribution grids on MV level* o It will provide more flexibility, possible cooperation in the case of the outages on one side of the border, long-term grid stability, flexibility of grid operations, improvements of SAIDI/SAIFI.
- New smart substations and renewal of primary substation o Modern substations with extensive smart elements will be able to integrate the most recent information and grid control systems. This will enhance the security of supply.

2) Modernization of Distribution Grid by Smart Elements

- *Modernization and construction of digital secondary substations* will increase grid observability in MV and LV grids.
- *Installation of remote-control devices*
- *Installation of universal monitors, reclosers and controlling cabinets* for higher grid observability and reduction of outage periods
- Installation of locators on the MV power lines
- *Installation of Voltage Regulated Distribution Transformers (VRDT) on the MV power lines*

- *Smart metering systems* for regional load management and data collection
- *Energy storage systems* for balancing power supply and demand
- *Replacement of conventional conductors with High Temperature Low Sag (HTLS) conductors or Thermal Resistant Aluminium Alloy (TAL) conductors*

3) Distribution Grid Communication

- *Power Line Communication and optical network development* will provide communication and data transfer technology, enable bidirectional communications.
- *Installation of Wavelength-Division Multiplexing (WDM)*
- *Implementation of GPRS (LTE), BPL communication technology, 5G networks or other alternative technologies*
- *Construction of reactive power compensation systems (e.g. coils, capacitors or static VAR compensators SVC) and the integration of voltage and reactive power management for high voltage grids.*

4) Smart Grids IT Solutions

- Implementation of data hub and data sharing platform
- Provide extensive data collection, improved data management and usage of all data also on the cross-border level.
- *Implementation of SCADA (Supervisory Control and Data Acquisition)* system for an effective distribution grid management
- *Implementation of Data storage system for Advanced Metering Management* for storage purposes
- *Installation of overhead line monitoring and grid control systems*
- *Installation of intelligent algorithms for grid steering automation (OT Analytics and SAM)*

Gabreta SG generates benefits in various areas. These benefits can be divided into three main categories – environmental benefits, economic and social benefits, as well as benefits for consumers.
Environmental benefits

- Emission reduction due to reduction of transmission losses and possibility of integrating variable energy sources
- Integration of renewable energy sources
- Reduction of negative environmental externalities
- Creation of long-term sustainable energy system
- Lower threat to animal species

Economic benefits

- Economically efficient electricity system
- Lower transmission losses
- Reduced operation and maintenance costs of assets
- Deferred distribution capacity investments and improved capacity utilization
- Electricity cost savings through smart grid technology
- Enhanced international cooperation and involvement of more market participants

Consumer benefits

- Enhanced quality and security of supply

- Increased grid users’ connection capacities
- Enabled connection of microgeneration at the consumers’ side
- Optimization of consumer consumption habits by implementation of Demand Side Management
- Reduced outage time

Gabreta SG will lead to an overall maximization of long-term economic efficiency, enhanced security of supply and positive environmental impact of the distribution grids in the Czech Republic and in Germany.

Status: Planning phase, start in 2023

Date of commissioning: 31.12.2030