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GreenSwitch

10.12-W-M-22-GreenSwitch

Energy Community

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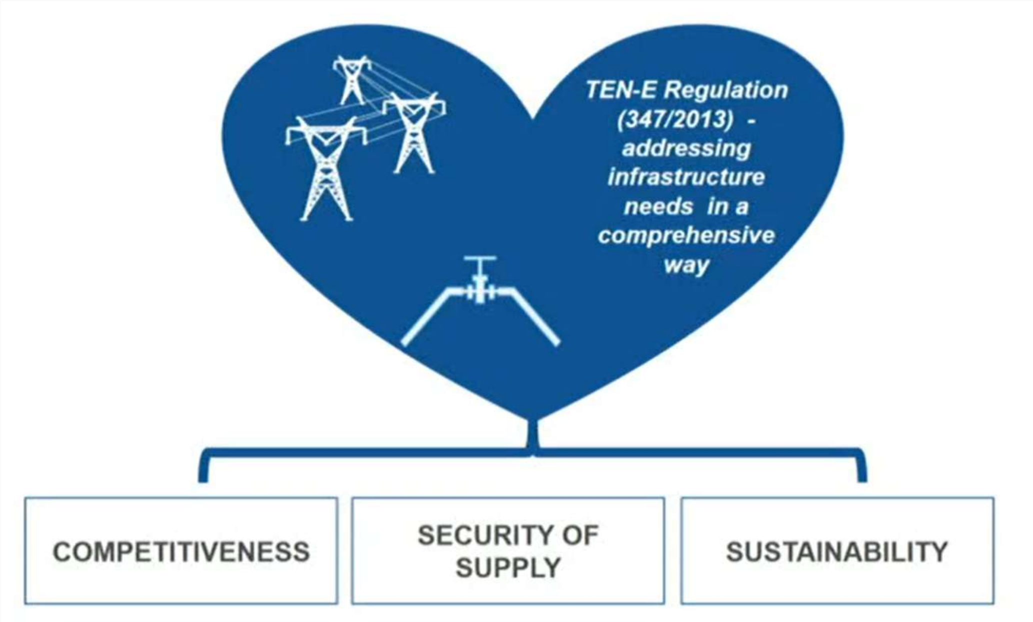
October 9, 2023

ELES HOPS Kärnten Netz elektro gorenjska Elektro Celje Elektro Ljubljana HEP OPERATOR DISTRIBUCIJSKOG SUSTAVA d.o.o.

Trans-European energy networks are the heart of the European energy policy



Projects of Common Interest (PCIs) are a category of projects launched in 2013, which the European Commission has identified as a key priority to interconnect the energy infrastructure in the European Union.

Since May 30, 2022, the list of Projects of Mutual Interest (PMIs) has also been established under the TEN-E Regulation (EU) 2022/869.

These projects are eligible to receive public funds.

Project of Common Interest (PCI) or Project of Mutual Interest (PMI)

PCI:

- Relevance for one of the priority corridors and areas (TEN – E regulation).
- Benefits outweighing costs.
- Involving at least two MS or located on the territory of one and significant cross-border impact for a second MS.

PMI:

- Contribution to the Union's and third countries' overall energy and climate objectives.
- Benefits outweighing costs at the Union level.
- Located on the territory of at least one MS and at least one-third country‘s & significant cross-border impact.
- Hight level of convergence of the third country‘s policy framework with that of the EU.

PMI eligibility: electricity transmission, offshore grids, hydrogen transport, and CO2 transport and storage.

Project contribution to specific criteria [TEN-E Reg. Art. 4(3)(b)]

- **Security of supply:** The GreenSwitch project contributes to the optimization of utilizing the existing infrastructure and efficiently incorporating new technologies and advanced functionalities, acceleration of RES integration, and increasing the security of supply and improving the quality of supply.
  - Security of supply will be greatly improved due to the implementation of different cross-border projects. The project will implement DTR, HTLS, power flow control devices, and new cross-border connections by digitizing and upgrading ICT computer solutions and communication with high-level advanced applications.
  - Establish a new or upgrade the existing MV loops (approx. 150 km) to increase hosting capacity and ensure better security of supply
  - Increase the security of supply, resolving the possibility of energy isolation on two islands.
  - The implementation of ADMS into a SCADA system will increase the security of supply due to the coordinated voltage control, FLISR, closed loop operation, DTR of secondary transformers, and resilience power scheme between Slovenia and Austria.
  - Implementing advanced FLISR and closed loop functionalities will significantly impact the SAIDI index, as loops or isolating of the fault can be performed, thus reducing the number of affected network users and the outage duration.

Project contribution to specific criteria [TEN-E Reg. Art. 4(3)(b)]

- **Market integration**
  - In contribution to market integration, the project will participate by removing network bottlenecks, optimizing the existing network infrastructure, and decreasing energy isolation by the power flow control devices, DTR system, and HTLS technologies.
- **Network security, flexibility, and quality of supply**
  - TSOs are planning to upgrade the existing grid to increase hosting capacity, security of supply, and utilization of cross-border capacity by implementing power control systems, DTR, and HTLS.
  - Shunt reactors will be installed to enable the operator to reduce the energy losses and voltage increase and stabilize the system within suitable values.
  - Network security will be increased by implementing the cross-border MV emergency power connections between AT and SI, consisting of a new and upgraded cross-border connection.
- **Smart sector integration:**
  - **Integrating electricity and transport**
    The project will provide infrastructure for heavy and fast charging stations and directly connect the energy and transport sectors.
  - **Integrating electricity and heating**
    The coupling between electricity and heating involves installing equipment for waste heat extraction from transformers at 110 kV, 220 kV, and 400 kV voltage levels.

The Union list of projects of common interest in 2023

(10) Priority Thematic Area Smart Grids Deployment:

10.4 ACON (CZ, SK) (Again COnnected Networks) fosters the integration of the Czech and the Slovak electricity markets by improving the efficiency of distribution networks while increasing cross-border capacity at the DSO level.

10.7 Danube InGrid (HU, SK) enhances cross-border coordination of electricity network management, with a focus on smartening data collection and exchange

10.10 CARMEN (HU, RO) improves distribution network operation efficiency and service quality and enables secure electricity flows from new renewable generation.

10.11 Gabreta (CZ, DE) enhances system optimization by retrieving and exchanging information in Real-time, improving metering and monitoring of the grid and more flexibility and hosting capacity for renewable generation.

10.12 Green Switch (AT, HR, SI) optimizes the utilization of existing infrastructure and efficiently integrates new technologies to increase hosting capacity, efficient integration of new loads, and improve quality and security of supply.

CINEA's key contribution to the European Green Deal

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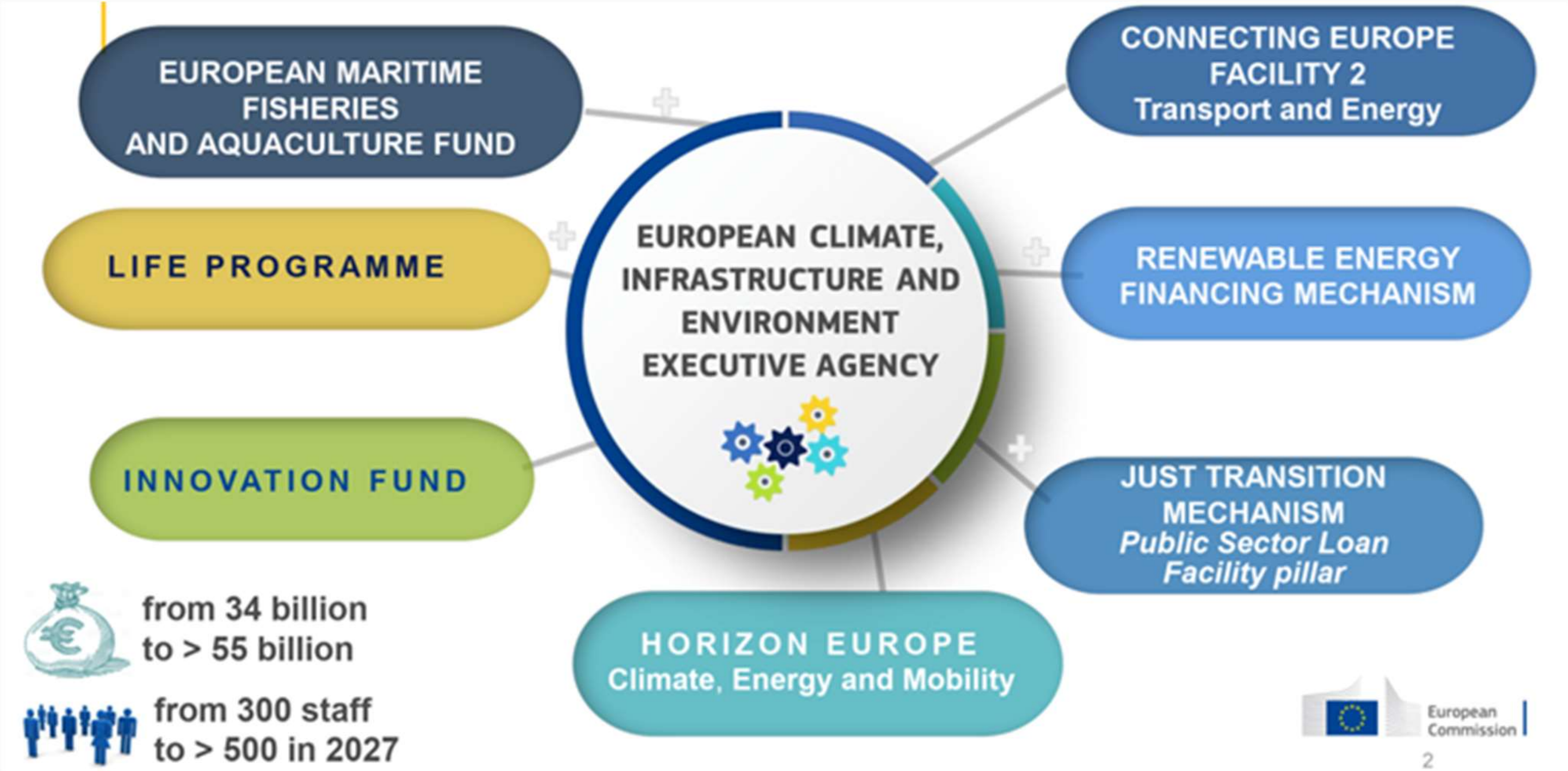


CEF funding - Grant Agreement

GreenSwitch

- Annex 1: **Description of the Action (Part A & B)**
- Annex 2: **Estimated budget for the Action**
- Annex 2a: **Additional information on unit costs and contributions (if applicable)**
- Annex 3: **Accession forms (for multi-beneficiary)**
- Annex 4: **Model for the financial statements**
- Annex 5: **Specific rules**

Description of Actions

The following main elements should be reflected:

- The link between the Action and PCI/corridor/region, including technical parameters of the infrastructure (i.e., electricity line in km, smart grid, pipeline in km, gas capacity, etc.).
- The scope of the proposed Action, which refers to the extent of the coverage of the Action, including the geographic one.
- The aims of the proposed Action include deliverables and outputs (e.g., documents, infrastructure).

Compliance with EU environmental policy

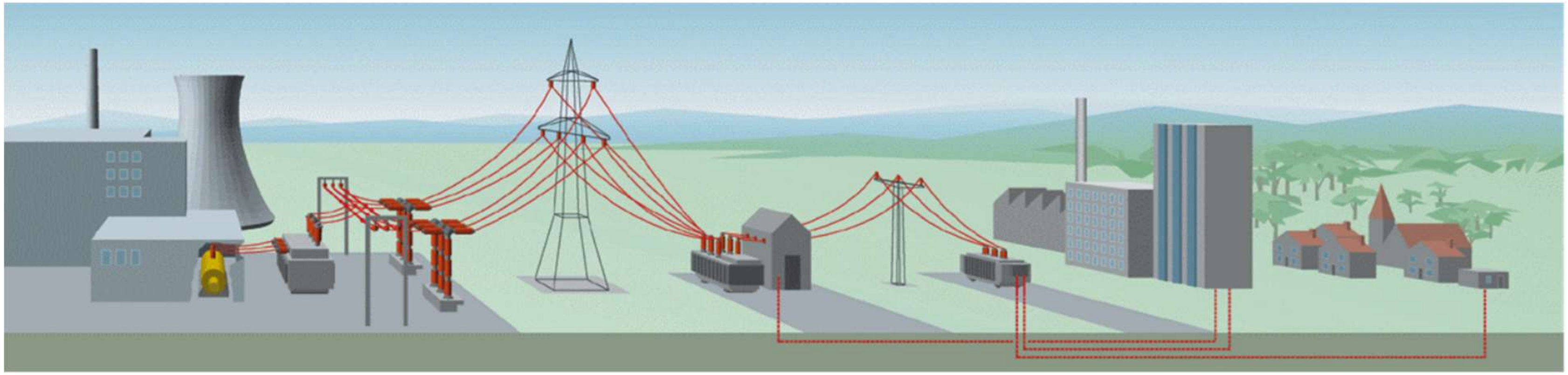
The following guidelines should be taken into account:

- The consistency of the project with environmental policy.
- Environmental Impact Assessment

Public Acceptance of Project of Common Interest

- Communication, dissemination, and visibility
- How to engage with your local communities?

System transition from centralized to decentralized



Consumers of electricity are becoming producers

Renewable energy sources increasing

E-mobility

Pumps heating

Abandoning fossil fuel resources

Innovation and development of new technologies

It is necessary to provide more Ancillary services

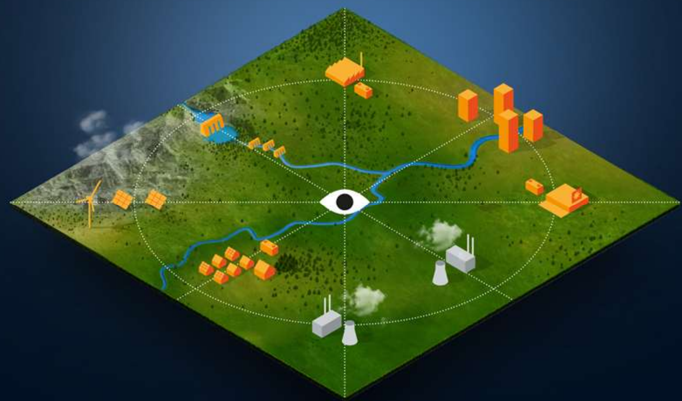
Three key elements supporting RES integration

Market integration

Strengthening of corridors

Grid controllability

- Active and reactive power control devices
- Dynamic line/thermal rating
- Power flow control devices
- Transformation of AC HV OHL into DC OHL
- New optimization and control tools, algorithms, technologies, organization etc.



SINCRO.GRID GreenSwitch

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Goals

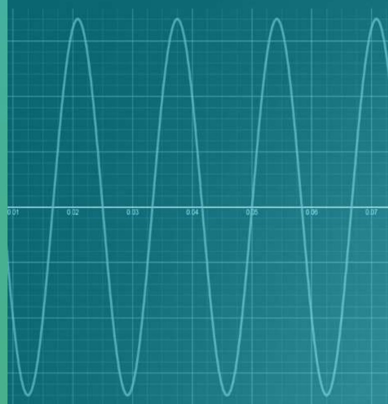
- ✓ **Solved issue of voltage profiles**
- ✓ Providing additional ancillary services
- ✓ Better utilization and observability of the transmission network
- ✓ Higher potential penetration of RES

Goals

Make optimal use of the infrastructure

Improve observability of the distribution network.

Improving the quality and security of supply.



Enable the integration of an increasing quantity of dispersed RES and new loads.

ELES | HOPS | Kärnten Netz | elektro gorenjska | Elektro Celje | Elektro Ljubljana | HEP OPERATOR DISTRIBUCIJSKOG SUSTAVA d.o.o.

GreenSwitch PCI - Smart Electricity Grids

TEN-E Regional Group/Thematic area:
Priority Thematic Area Smart Grids Deployment

Member States: **Austria, Croatia, Slovenia**

PCI Number: **10.12-W-M-22-GreenSwitch**

Project Promoters:

ELES d.o.o. (TSO SI), HOPS d.d. (TSO HR);

KNG (DSO, AT), HEP ODS d.o.o. (DSO, HR), Elektro Gorenjska, Elektro Celje, Elektro Ljubljana (DSOs, SI);

HEP d.d. (generation, HR), GEN-I (generation, SI);

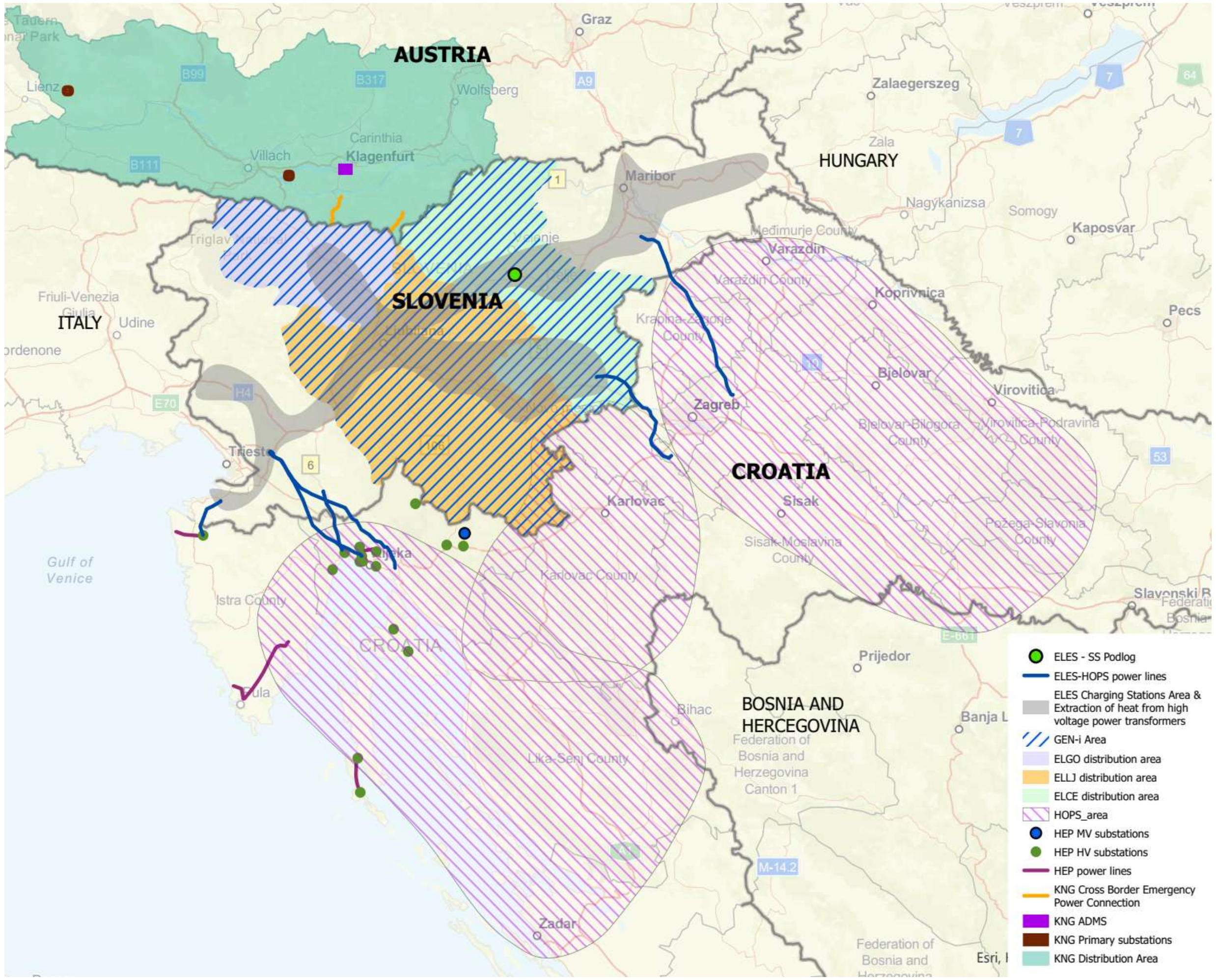
CAPEX [PCI]: 207.000.000 €

Grand Total [CEF]: 146.204.508 €

EU contribution: 73.102.254 €

Expected date of commissioning: 31/12/2028

Project website: www.greenswitchproject.eu



Main objectives of the GreenSwitch Project

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Increased controllability
of the transmission grid

- Increased the hosting capacity of the existing network.
- Increase cross-border capacity

up to 10%

lower peak demand
using flexibility sources.

up to 6 GWh

heat production from
at 11 power transformers per year.

Better utilization of existing
MV/LV transformers.

Grid connection for heavy duty and fast charging stations.

List of Work Packages

GreenSwitch

WP 1 - Project management and coordination

4.230.104 €

WP 2 - Increasing operational efficiency and transmission grid controllability in HR and SI

34.486.900 €

WP 3 - Sector coupling integration (power, heat, mobility) in SI

13.010.000 €

WP 4 - Increasing distribution grid efficiency, security of supply, cross-border and RES hosting capacity in AT, HR, and SI

94.477.504 €

GreenSwitch

Duration: 6 years

Budget: 146.204.508 €

WP and related Activities

GreenSwitch

WP1	WP1 - Project management and coordination
WP2	WP2 - Increasing operational efficiency and transmission grid controllability in HR and SI
	A2.1 Power control systems in HR and SI A2.2 The HTLS conductors in HV overhead line (OHL) in Croatia, A2.3 The upgrade of DTR systems at transmission level in Slovenia, A2.4 The upgrade of transmission system applications in Croatia
WP3	WP3 - Sector coupling integration (power, heat, mobility) in SI
	A3.1 The grid connections for heavy-duty and fast-charging stations in Slovenia A3.2 Implementation of waste heat extraction systems from power transformers in SI
WP4	WP4 - Increasing distribution grid efficiency, security of supply, cross-border and RES hosting capacity in AT, HR and SI
	A4.1 Automation of seven HV/MV primary substations in Austria, Slovenia and Croatia A4.2 Automation of approx. 390 MV/LV secondary substations in Austria and Slovenia A4.3 Upgrade of Advanced Distribution Management Systems (ADMS) in Austria and Slovenia A4.4 The HTLS conductors on MV OHL in Croatia A4.5 Modernization of ICT networks in the distribution grids in Austria and Slovenia A4.6 Closing of MV loops in Austria and Slovenia A4.7 The cross-border MV emergency power connections enhancement between Austria and Slovenia A4.8 Four MV shunt reactors in Croatia

WP 1 - Overview

Project management and coordination are of horizontal nature and include effective management and coordination of the project to ensure quality and timely implementation of the activities, including technical and financial supervision, communication, and stakeholder's engagement.

It includes, among other things:

- Set and maintain program schedule for the project, ensure quality technical design principles and quality financial and budget control;
- Legal support for tendering and contracting ;
- Internal communication, including coordination and technical meetings between beneficiaries and the contractors;
- External communication and dissemination, including public consultations, engagement of competent authorities, and workshops with a direct link to the project's scope.
- Preparation of the project's graphic design, audio-visuals, videos, press releases, social media posts, translations, proofreading services, construction of billboards, and organization of the events.

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WP 2 - Overview

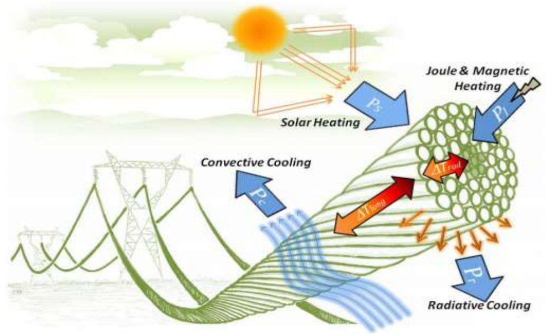
Increasing operational efficiency and transmission grid controllability in HR and SI includes:

- Installation of new technologies at the SI and HR transmission grids such as power control systems,
- Installation of HTLS (high-temperature low sage conductors),
- Upgrade of DTR (dynamic thermal rate),
- Integration of all new components in the SCADA/EMS (Supervisory control and data acquisition / Energy management system). The Wide Area Monitoring System (WAMS) in HR will be upgraded to improve the security of supply and quality of service, including new transmission system applications and ICT infrastructure.

WP 2 - Overview

ICT

DTR system on TSO level in SI



Power Control Systems in SI and HR

HTLS (High Temperature Low Sag Conductors) on TSO level in HR

SSSC
Static Synchronous Series Compensator

PST
Phase shifting transformer

Battery storage (not part of CEF)

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WP 2 - Implemented technologies

Power flow control Systems in SI and HR

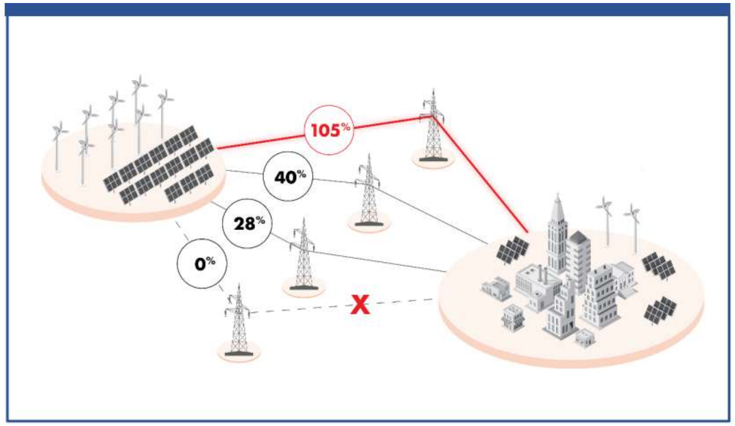
ELES:

✓ Implementation of the Power Control Systems (Static Synchronous Series Compensator) - the Project involves installing technological equipment on the 220 kV voltage level in substation Podlog and accompanying primary, protection, and control equipment, which will continuously regulate the Power Control System.

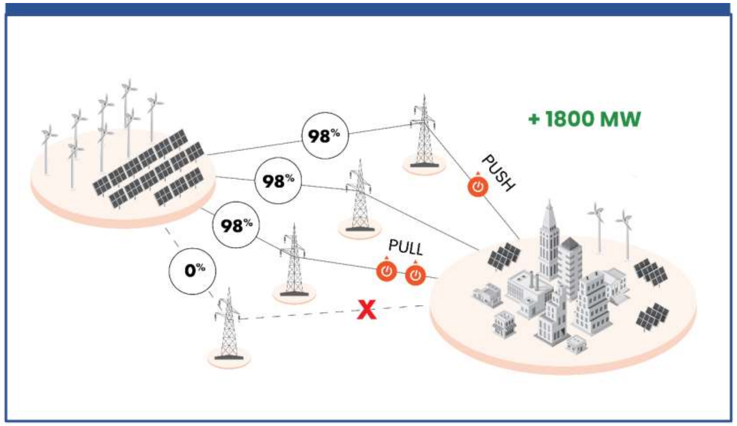
HOPS:

✓ Install Phase shifting transformer (PST) 150 MVA in the substation 110/35 kV Gračac which will be managed through optimization functions (for better utilization of lines and/or minimizing losses in the grid) as a part of the Optimal Power Flow Platform (OPFP);

Before



After



WP 2 - Implemented technologies

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Installation of HTLS conductors on HV OHL in HR

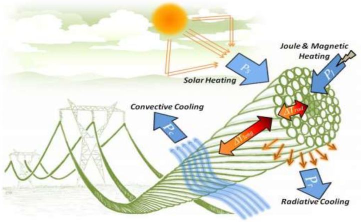
HOPS:

- ✓ Replace existing conductors with high temperature low-sag conductors (HTLS) on the OHL 220 kV Senj-Brinje, with approx. length of 15.5 km;

Upgrade and extension of the DTR system in SI

ELES:

- ✓ development of DTR system on cross-border lines between Slovenia and Croatia as well as on power transformers on 400 kV and MV level



Upgrade and extension of transmission system applications in HR

HOPS

- ✓ Upgrade existing Transmission system applications (WAMS, SCADA, EMS) and ICT infrastructure between the existing and new nodes.

WP 3 - Overview

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Sector coupling integration (power, heat, mobility) involves developing large-scale connection points for e-mobility and waste heat recovery systems on power transformers to improve the sector coupling in Slovenia and incorporate potential new users.

✓ Implementation of waste heat extraction systems from power transformers

✓ Implementation of grid connections for heavy-duty and fast-charging stations

WP 3 - Implemented technologies

Implementation of grid connections for heavy-duty and fast-charging stations

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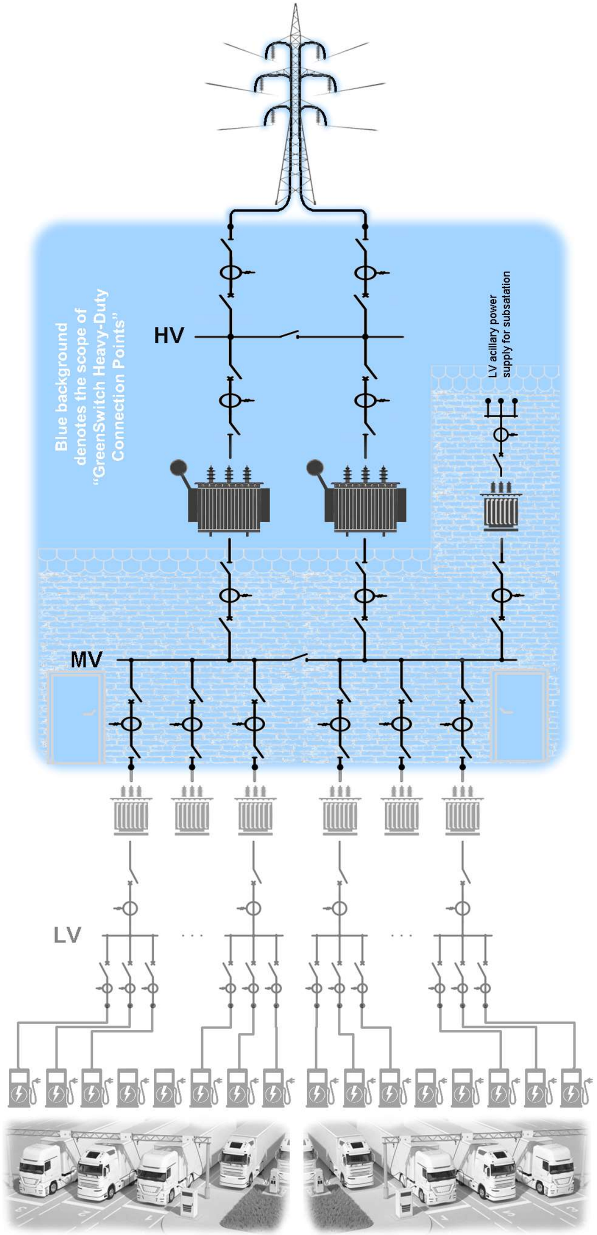
Heavy Duty Hyper charging stations in the vicinity of the highways

High power demand for future.

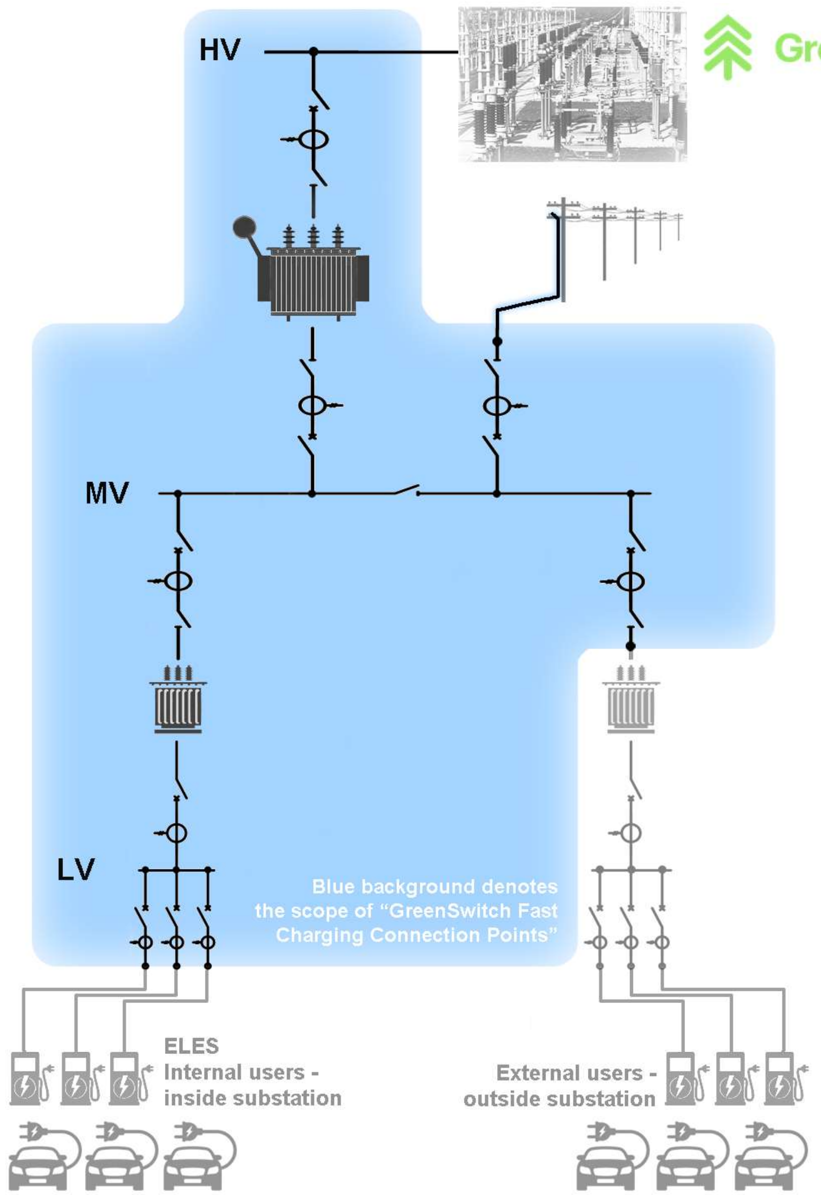
(20MW – 60MW per single location)



WP 3 - Implemented technologies

Implementation of grid connections for heavy-duty and fast-charging stations

Fast charging stations in the Substations



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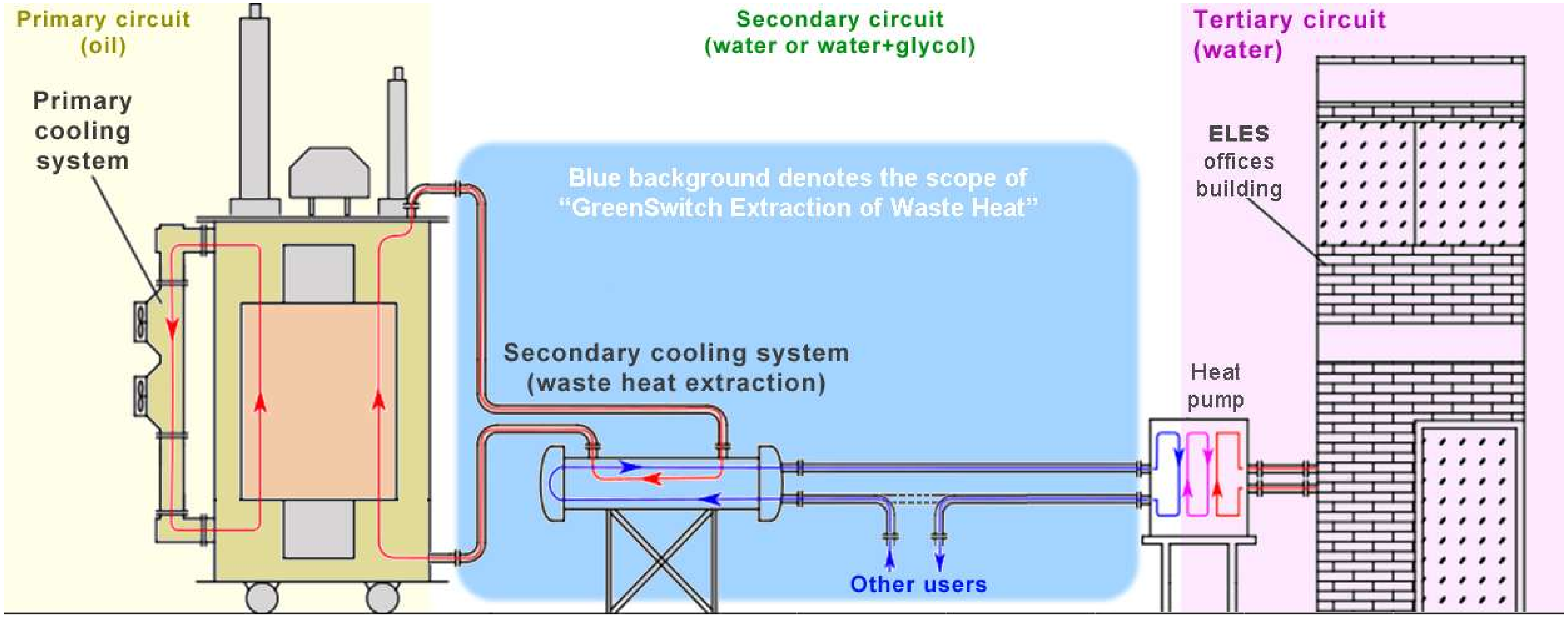
WP 3 - Implemented technologies

Implementation of waste heat extraction systems from power transformers

GreenSwitch

Energy transformer has a lot of waste heat, that can be extracted and smartly used:

- Energy transformers produce waste heat during operation due to copper windings and iron core losses.
- This waste heat is dissipated into the environment.
- An extraction device (heat exchanger) can harness a portion of waste heat.
- Waste heat will be used for district heating of buildings in the vicinity of substations.



WP 4 - An overview of GreenSwitch projects – distribution level

Increasing distribution grid efficiency, security of supply, cross-border, and RES hosting capacity in AT, HR, and SI distribution grids.

Automation and upgrade of HV/MV primary substations

Closing of MV loops

Automation of MV/LV secondary substations

Installation of HTLS conductors on MV OHL

Upgrade of Advanced Distribution Management System (ADMS)

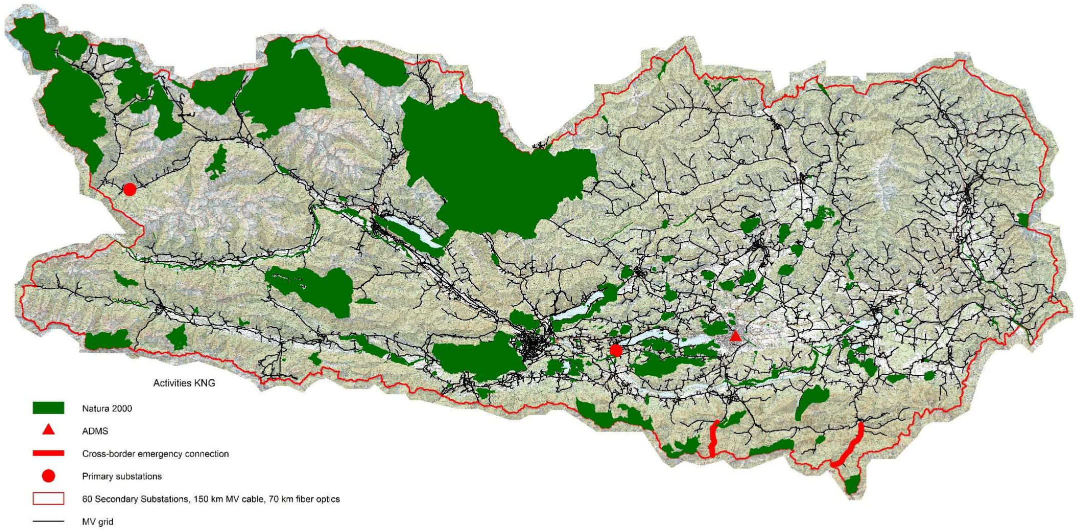
Establishment of the new cross-border MV emergency connection lines

Modernization of ICT networks:
- Optic fiber
- Network nodes, meters/modems, base stations, smart meters…

Installation of MV shunt reactors

WP 4 - An overview of GreenSwitch projects – distribution level

GreenSwitch



2 automatization of primary substations (new constructions)

60 automatization of secondary substations

70 km of fiber optic for connecting additional secondary substations

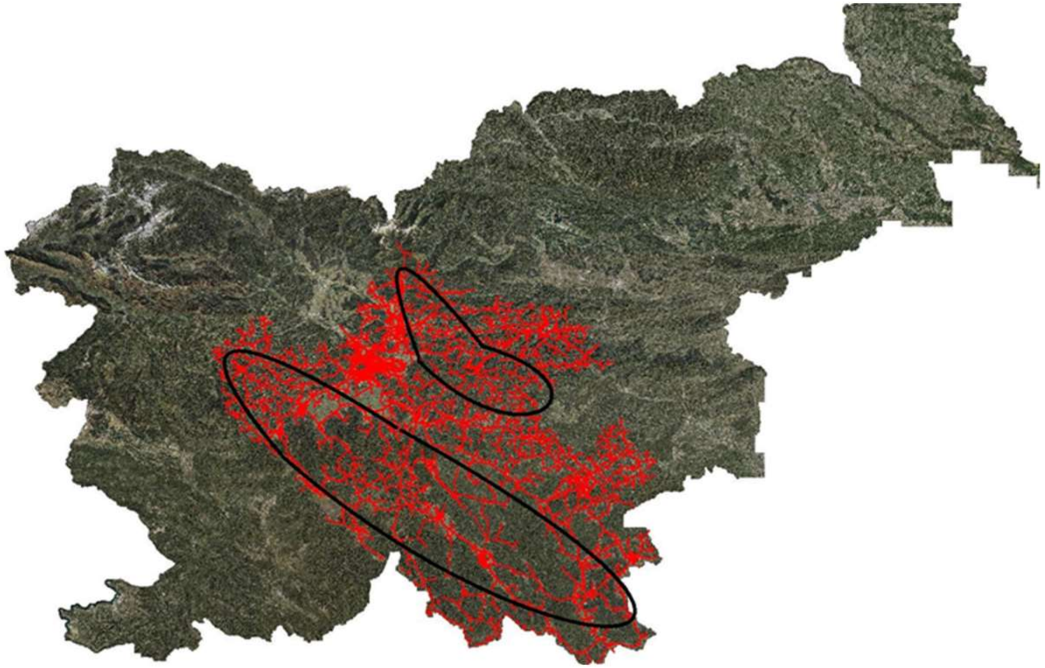
150 km of middle-voltage cable to reinforce the distribution grid

2 cross-border emergency connections

1 new SCADA function for automated fault localization

WP 4 - An overview of GreenSwitch projects – distribution level

GreenSwitch



11.000 LTE meters/ modems for close-to real time monitoring LV network in ADMS

50 automatization of secondary substations (new)

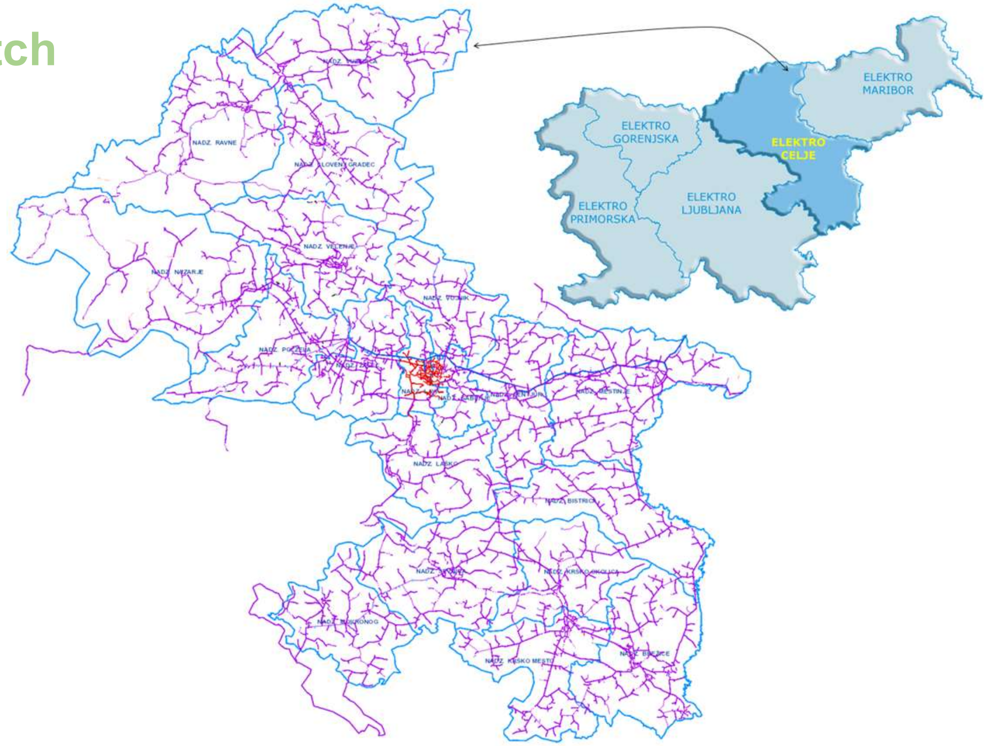
50 network nodes of fiber optic for connecting additional secondary substations

100 km of middle-voltage cable to reinforce the distribution grid

80 automatization of secondary substations (existing)

Upgrade of ADMS function for improved network control

WP 4 - An overview of GreenSwitch projects – distribution level



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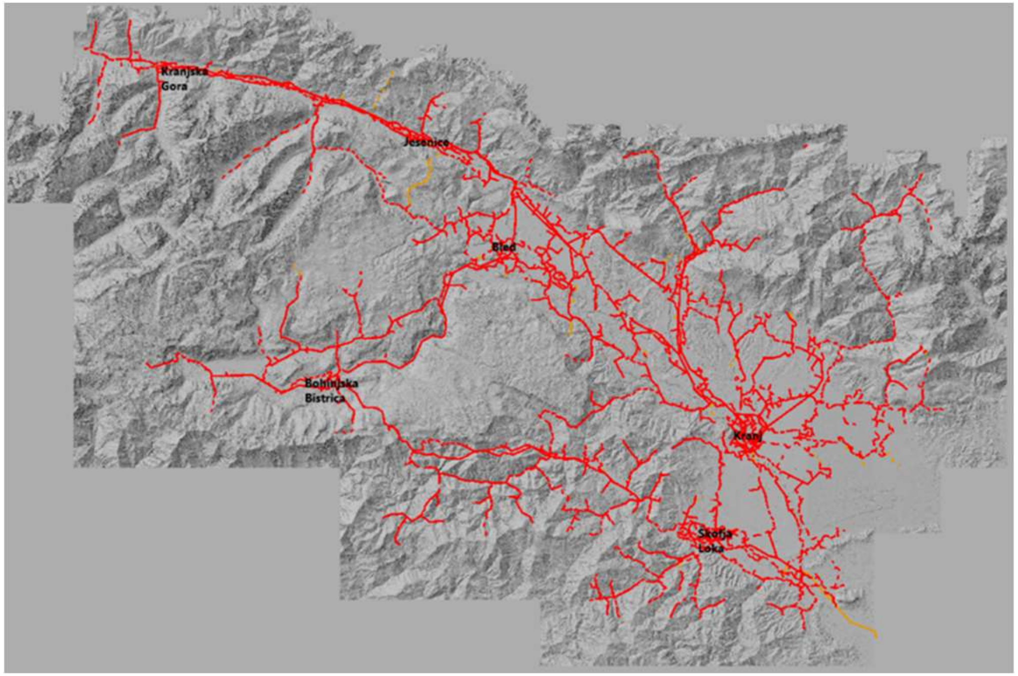
3192 RT substation meters for real time monitoring and ADMS support	151 automatization of secondary substations	169 ICT communication points for connections of the automated secondary substations
95 km of middle-voltage cable to reinforce the distribution grid and enable closed loop operation	18 reclosers to enable automation and 10 closed loop operation in MV network (95km)	1 new SCADA function for automated fault localization

WP 4 - An overview of GreenSwitch projects – distribution level

GreenSwitch



2 automatizations of primary substations

50 automatization of secondary substations (10 new)

3 new Radio Access Network base stations

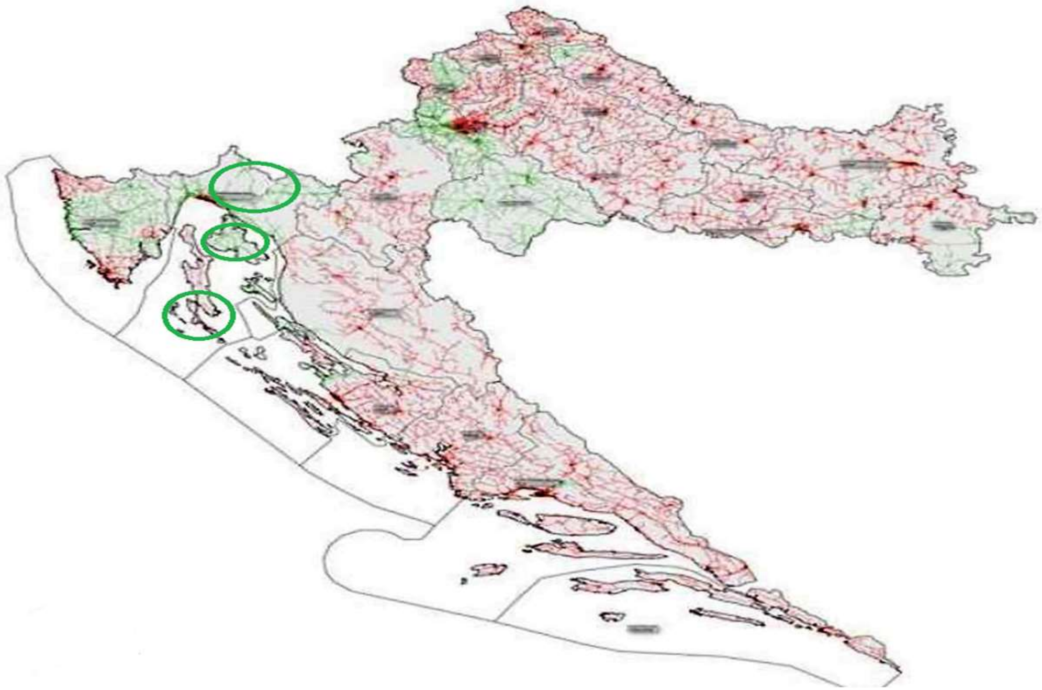
9 km of middle-voltage cable to reinforce the distribution grid

2 cross-border emergency connections (1 new, 1 upgraded)

1 new ADMS system

WP 4 - An overview of GreenSwitch projects – distribution level

GreenSwitch



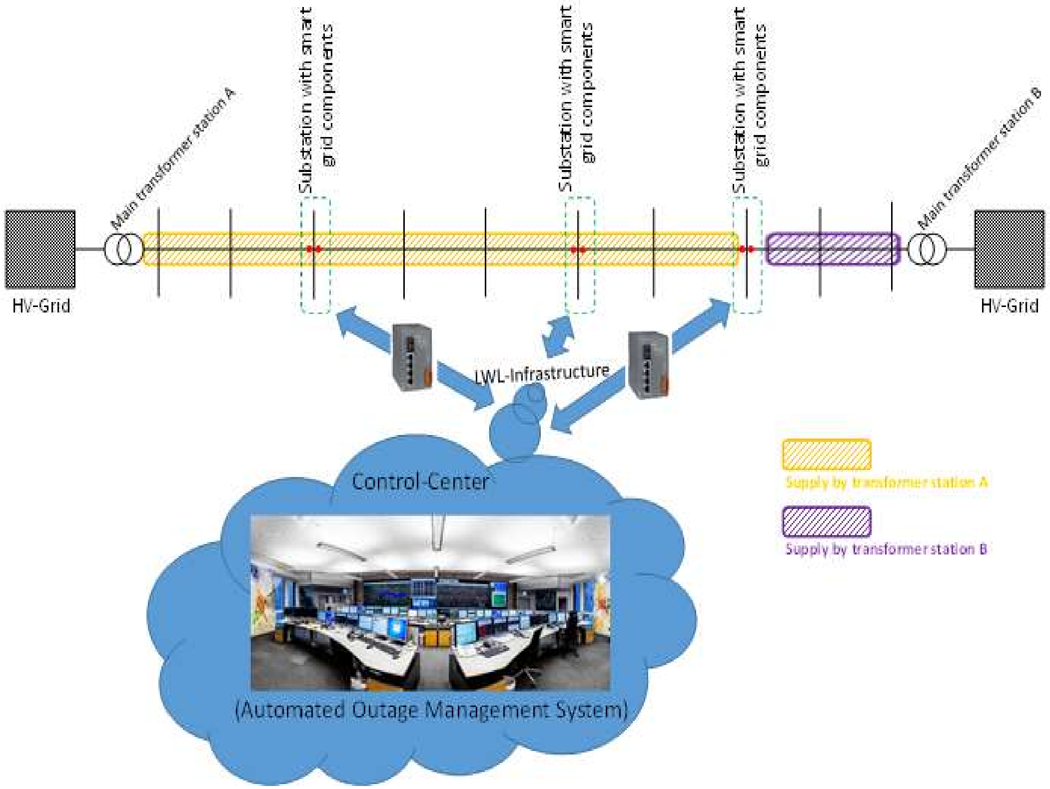
Implementation of shunt reactors in three primary substations and one secondary substation

Upgrading secondary equipment and relay protection in three primary substations

12 km of high temperature low-sag conductors (HTLS) conductors on OHL 35 kV

WP 4 - Implemented technologies

GreenSwitch



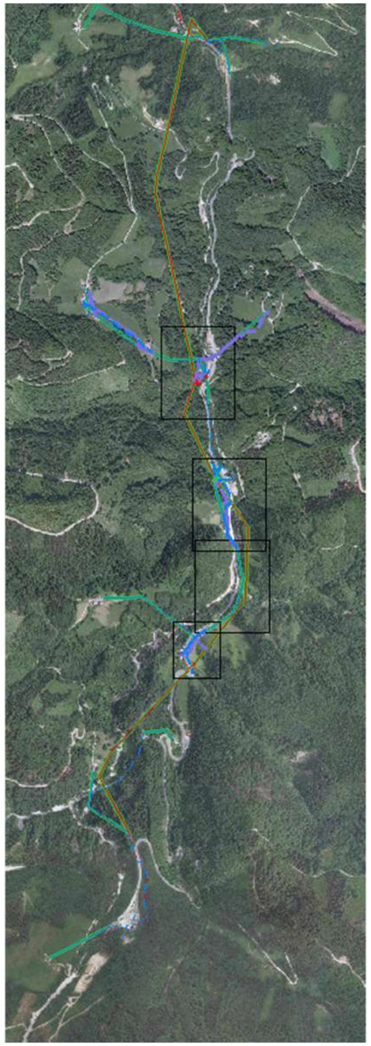
Before GreenSwitch

- Reclosers with no remote controllability
- No remote measurements
- No remote fault localization
- Unilaterally supplied feeders
- In the event of a fault, the entire feeder must be taken out of service

After GreenSwitch

- Reclosers with remote controllability and remote measurements through new ICT connections;
- Remote fault localization;
- Supply possibilities on both sites of the feeders;
- Implementation of ADMS (SCADA functionality);
- Automated resupply configurations;
- Enhancement of the middle voltage grid to ensure enough supply capacities beyond open connection points;
- In the event of a fault, the fault area is isolated and a restoration of supply is automatically triggered trough the ADMS.

WP 4 - Implemented technologies

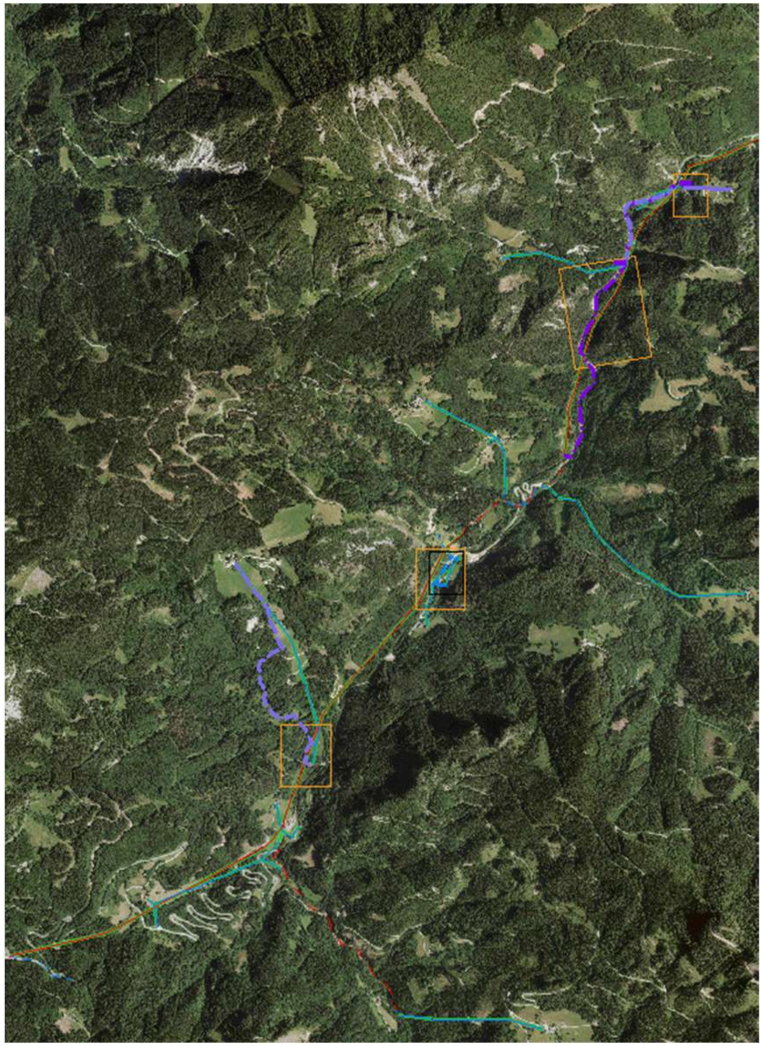


Establishment of the new cross border MV emergency connection line via the Loiblpass

- Connection via MV cable in the tunnel;
- Establishment of two secondary substations on each side of the border;
- Enhancement of the middle voltage route on AT side of the border;
- Information of power flow exchange and process of operations in case of the fault.

Enhancement of the existing cross border MV emergency connection line via the Seebergsattel

- Automation of the uninterrupted switching procedures in case of a fault;
- Enhancement of the middle voltage route on AT side of the border;
- Information of power flow exchange and process of operations in case of the fault.

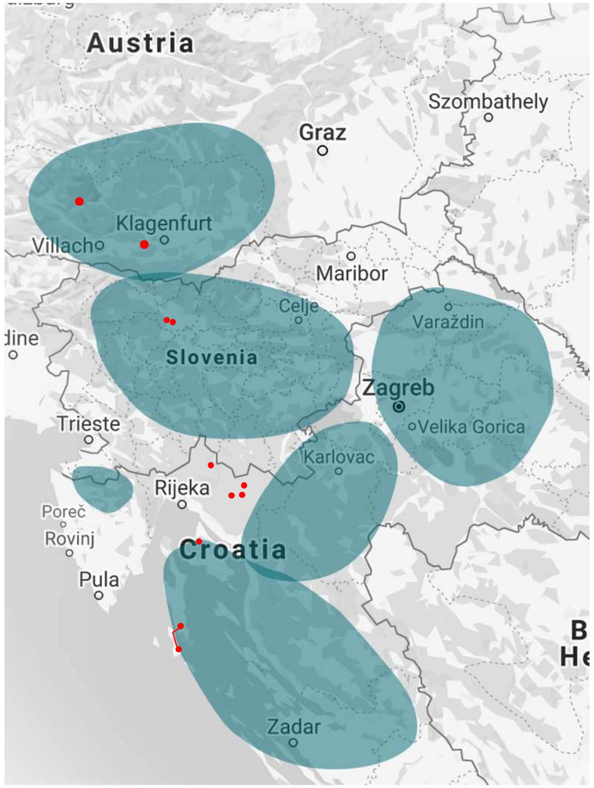


WP 4 - Implemented technologies

GreenSwitch

Primary substations:

- Modernization of automated primary substations in AT, HR and SI;
- Installation of smart components with advanced functionalities and the integration to the SCADA system;
- Coordinated voltage control;
- Upgrade of the secondary equipment and advanced protections.



Legend:
Automatisation of primary substations
HTLS
Shunt reactors

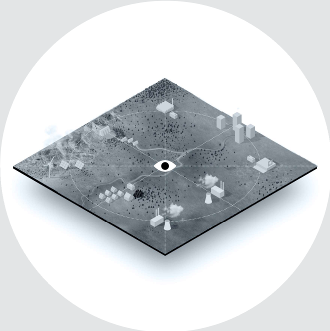
Shunt reactors:

- Upgrade of primary and secondary substations;
- Connecting and integrating new loads and distributed generation;
- Better power quality;
- Optimized grid operation.

HTLS:

- Higher transmission power;
- Supporting integration of RES;
- Improving security of supply on the islands.

Conclusions



Grid Controllability
is one of three key
elements supporting
RES integration.

EU should look for more
grid controllability
projects because of their
efficiency.

The biggest challenge
is to switch from national to
international infrastructure
project planning, design, and
implementation, etc…

Thank you

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Additional information available at:

www.greenswitchproject.eu