



R2D2

Reliability, Resilience and Defense
technology for the grid



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R²D² Workshop

July 8th, 2025



Strengthening Energy Infrastructure against extreme events

ETRA I+D / Ugo Stecchi



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**Reliability, Resilience and
Defense technology for the grid**



Agenda

- Welcome
- R²D² Introduction
- DERs control for flexibility and congestion management – Slovenian Pilot by ELEKTRO LJUBLJANA
- Resilience and physical security enhancement of power distribution infrastructures – Greek Pilot by HEDNO
- Reliability of energy assets through advanced inspection techniques – Portuguese Pilot by EDP NEW
- Q&A and conclusions



Kickoff Poll

<https://forms.office.com/e/gALiGewTBn>



1. According to your experience which are the **major challenges** related to power system resilience?

- extreme weather events (storms, floods, heavy snowfalls, strong winds...)
- increased penetration of renewable energy sources
- increased penetration of distributed energy resources
- cyber attacks
- physical attacks and damage of equipment

2. Concerning **flexibility from RES and DERs** in Distribution Systems, which of the following two statements do you most agree?

- It should be actively used for resilience and security procedures too
- Priority should be given to a full exploitation for market and economic goals before addressing system's resilience

3. What is your perception on **current European legislative and regulation framework** on power system resilience?

- Good, well structured and complete
- generally good but with some gaps
- lagging behind, not evolving at the right pace



Project ID

- R²D²: Reliability, Resilience and Defense technologies for the grid
- Coordinator: ETRA I+D
- Budget Total: € 9.747.375,00
- IA - 18 Partners - 4 Demos
- Oct. 2022 → Sept. 2025

Obj.1 Demonstration of increased energy system reliability and resilience

Obj. 2 Preventing disturbances and ensuring rapid recovery

Obj. 3 Demonstration and validation in relevant environments

Pilots

Elektro Ljubljana

Elektro Ljubljana
Obnovljivi viri energije

SLOVENIA

- ADMS
- AMR
- SCADA
- AMI
- RES Plants
- RTUs

PORTUGAL

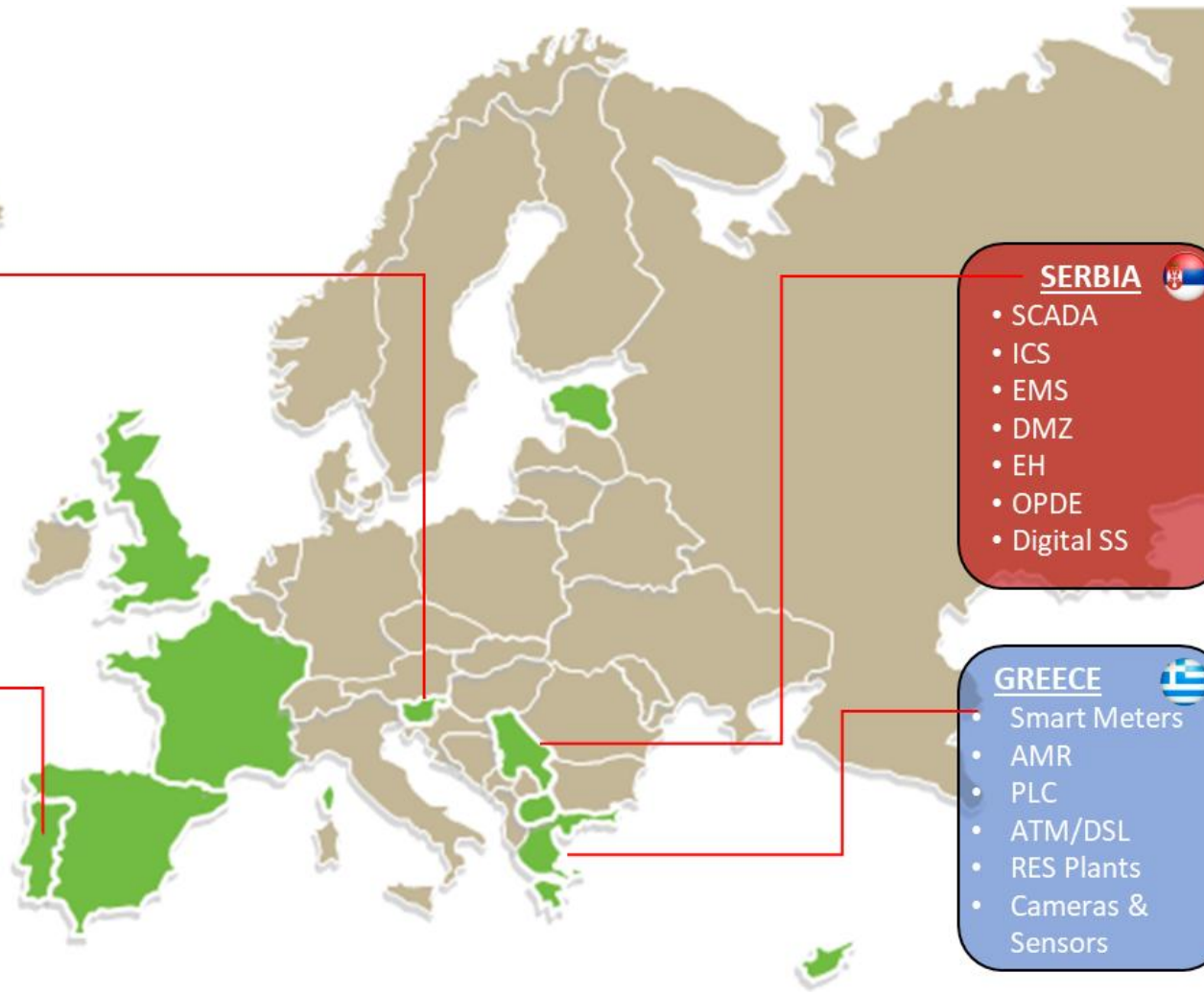
- HV/MV Station
- MV Lines
- Historical records

SERBIA

- SCADA
- ICS
- EMS
- DMZ
- EH
- OPDE
- Digital SS

GREECE

- Smart Meters
- AMR
- PLC
- ATM/DSL
- RES Plants
- Cameras & Sensors





Current Framework

increasing frequency and severity of extreme weather events

1040 wildfires, 400K ha burnt in 2024 in EU (2024)

Malicious and sophisticated physical and cyberattacks

1,101 weekly attacks against utilities in 2023 +146% of physical consequences in 2024

Increasing electricity demand

Demand annual grow +1,6% in '25-'29 (electrification, data centers, EVs, etc.)

Rapidly changing of energy mix of RES

EU Target +42,5% by 2030

Aging Infrastructure

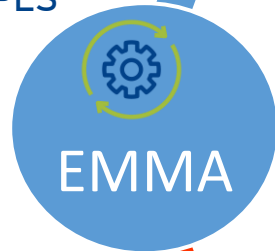
30% of Europe's grid +40 years old - 584 B€ by 2030
10% European in energy poverty



R²D² Solutions

Enhanced maintenance and asset management toolkit

- Drones & cameras to inspect EPES
- AI for asset health and security
- Priority of maintenance
- Optimal crew management
- Outage Planning Scheduler
- Dynamic Line Rating
- Transient Stability
- Topology Transfer



Prevention Systems For Energy Infrastructures Security



Multi-risk assessment framework for power system



- Cyber risk assessment (static and dynamic)
- Cybersecurity posture & CTI
- Simulating extreme natural events
- Contingency analysis and cascading effect
- Disruptive operation and restoration
- Knowledge sharing on cascading effects

Resilience Suite For TSO & DSO



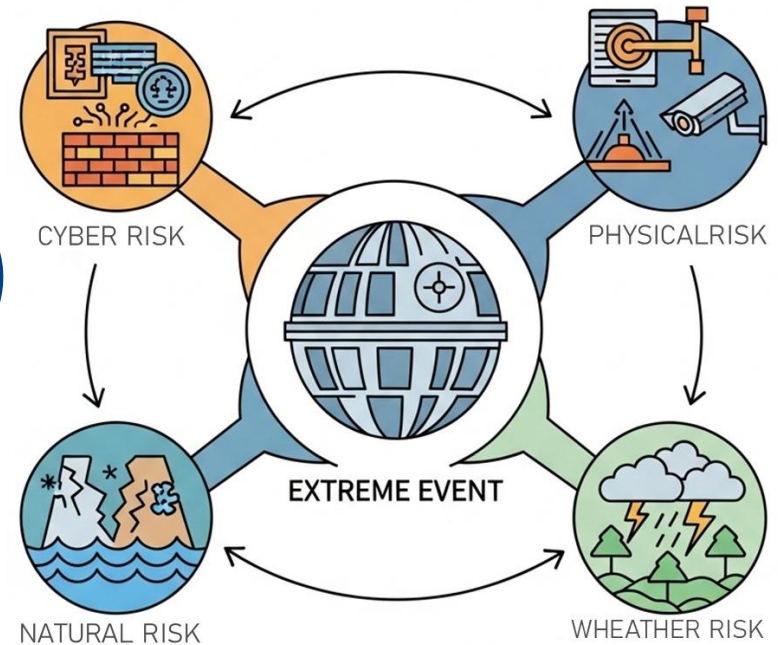
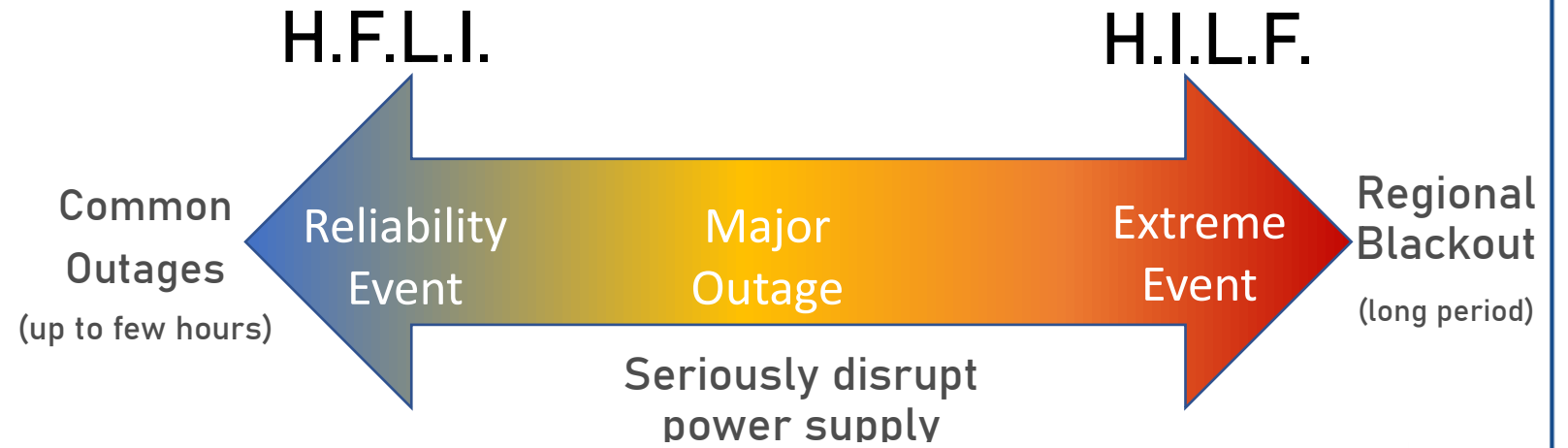
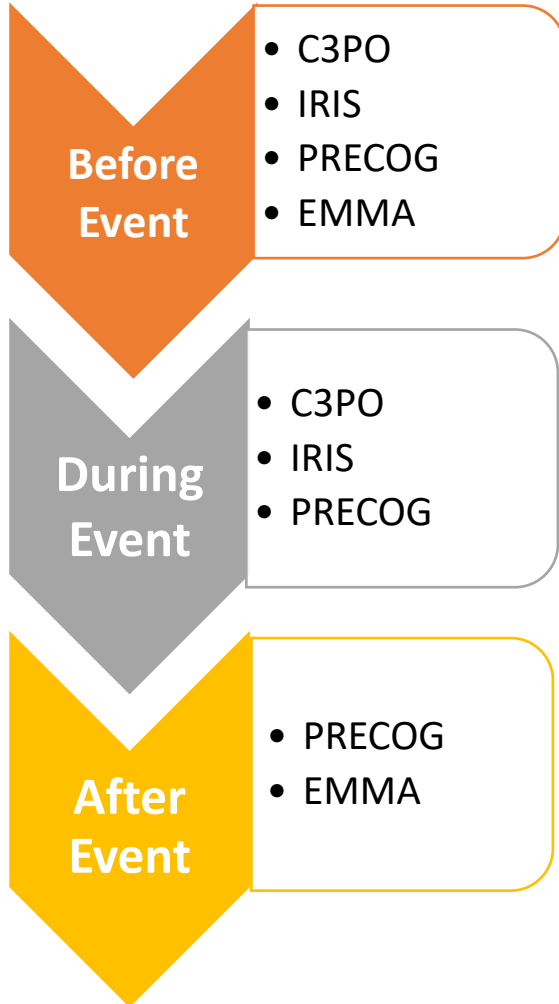
- Network observability and flexibility procurement
- TSO-DSO coordination in case of congestion
- TSO-DSO IGM
- Emergency & Restoration
- Remedial Actions Automation

- Blockchain to secure critical communications and
- Tokenization of IGM and CGM
- IT Traffic inspection and OT protocols dissection
- AI model to prevent cyber threats
- Secure new equipment and devices connected to the grid
- Supply-chain security assessment





R²D² Scope



Today's Use Cases



Elektro Ljubljana

- Improved LV observability (IRIS)
- DSO-TSO congestion coordination (IRIS)
- Tokenization of grid balancing data (PRECOG)



- Substation Physical Security (EMMA)
- Windstorm modelling, power losses and mitigation (C3PO)

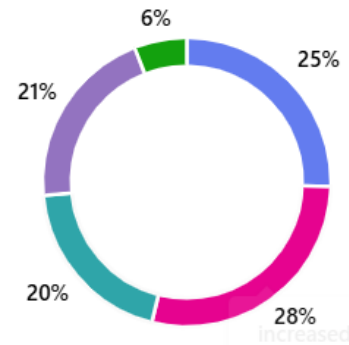


- Overhead lines inspection (EMMA)
- Health of critical component (EMMA)

Poll Results & Considerations

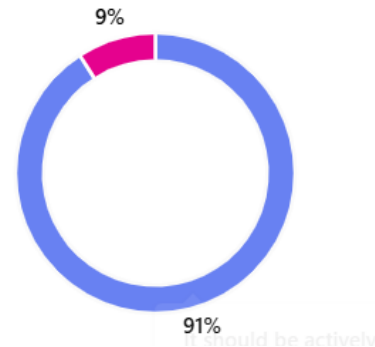
1. According to your experience, which are the major challenges related to power system resilience? (multiple choice) [More details](#)

● extreme weather events (storms, floods, heavy snowfalls, strong winds...)	26
● increased penetration of renewable energy sources	29
● increased penetration of distributed energy resources	20
● cyber attacks	21
● physical attacks and damage of equipment	6



2. Concerning flexibility from RES and DERs in Distribution Systems, which of the following two statements do you most agree? [More details](#)

● It should be actively used for resilience and security procedures too	40
● Priority should be given to a full exploitation for market and economic goals before addressing...	4



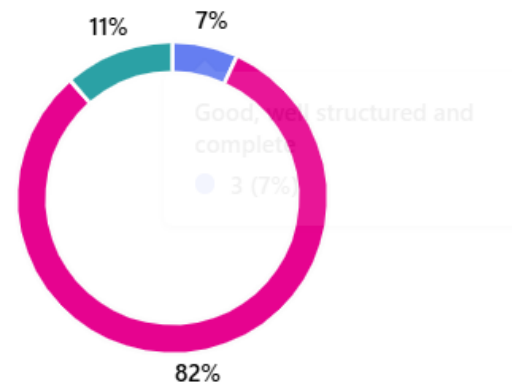


Poll Results & Considerations

3. What is your perception on current European legislative and regulation framework on power system resilience?

[More details](#)

- Good, well structured and complete 3
- generally good but with some gaps 36
- lagging behind, not evolving at the right pace 5





Lessons Learnt

- Reliability must be improved with a comprehensive resilience approach
 - from preventing outages to minimising the impact
 - Strategic reorientation to properly understand the impact of disruptions on people, societies, economic activity, and national security.
- **Microgrids as resilience enablers** → not only for energy communities, self/shared consumption and generation
 - their widespread deployment is often constrained by non-technical factors (i.e. regulatory complexities).
- The Value of Multi-Stakeholder Partnerships: **Collaboration is Imperative!**
 - Disaster response and grid modernisation → Resilience complexity, which can't be resolved by a single entity. working relationships between policy makers, industry, and local stakeholders.
- **Public investment in grid resilience**
 - The Iberian blackout demonstrates that grid resilience is not merely a national issue but a transnational one
 - Proposal to adopt "**European Grids Package**" by the end of 2025 (strategic investments, interconnections, bottleneck elimination, and simplified permit procedures)
 - benefits extending far beyond the immediate operational metrics of the utility.



IMPACT QUESTIONNAIRE

<https://forms.office.com/e/2HUCJeFi8N>

Let us know your perception and awareness on the power system's resilience





If you want to know more?

- Visit R²D² website r2d2project.eu
- Contact us: info@r2d2project.eu
- Explore R²D² Repository: zenodo.org/communities/r2d2project/
- BRIDGE UC Repository: <https://ses.jrc.ec.europa.eu/use-cases>



THANK YOU!

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