INTERRFACE Final event

7 December 2022

INTERRFACE

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 824330

slido

Join at

slido.com

#INTERRFACE

George Boultadakis

Project Coordinator INTERRFACE

European Dynamics

Welcome

INTERRFACE

George Paunescu
Policy Officer

DG ENER

Keynote speech

INTERRFACE

Energy policy

towards decarbonisation through digitalisation

INTERRFACE

Project final event

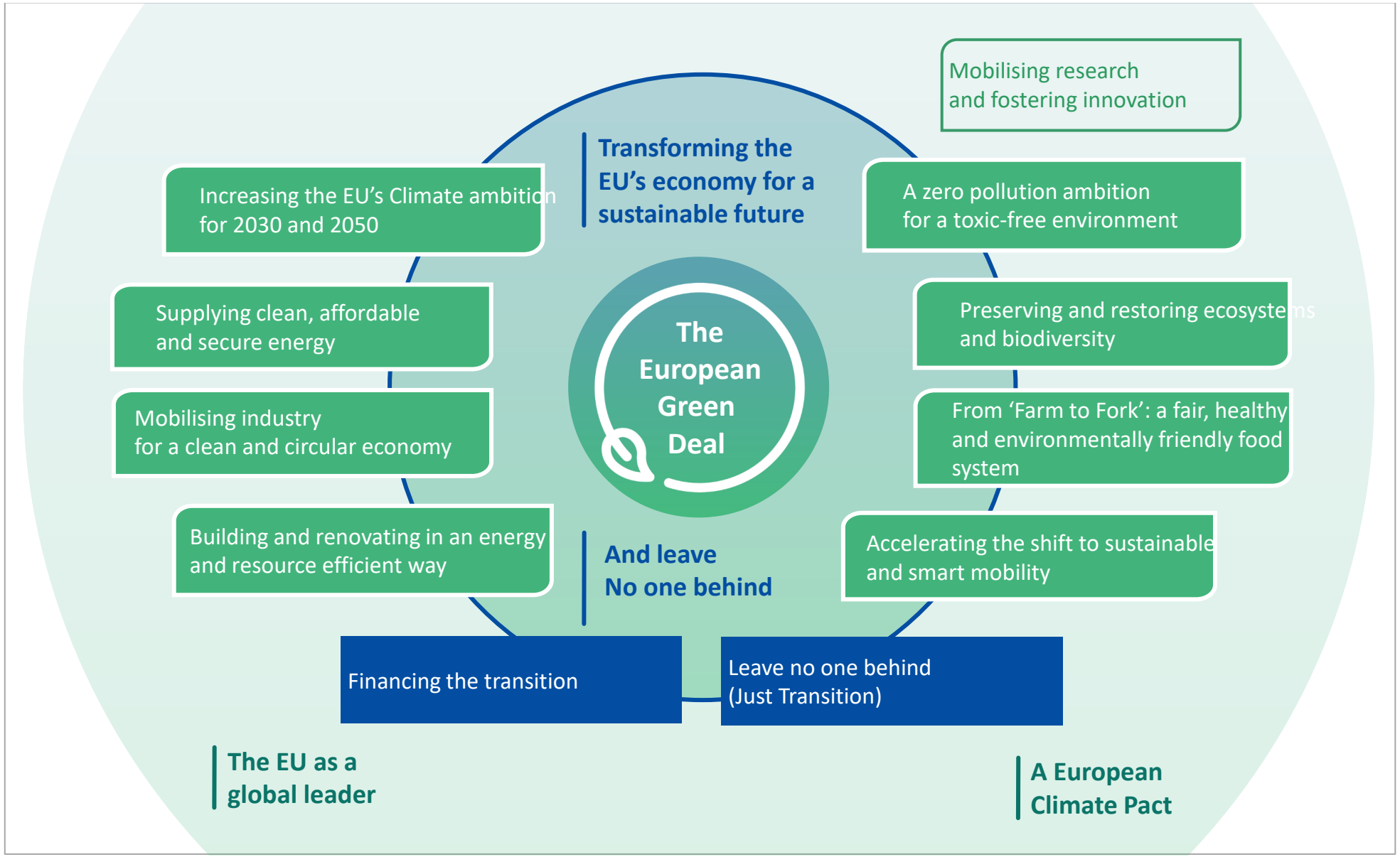
07 December 2022

George Paunescu

Policy Officer, Directorate-General for Energy

Unit - Innovation, Research, Digitalisation, Competitiveness

The European Green Deal (1/2)



European Green Deal (2/2)

Key principles for the clean energy transition, which will help reduce greenhouse gas emissions and enhance the quality of life of our citizens:

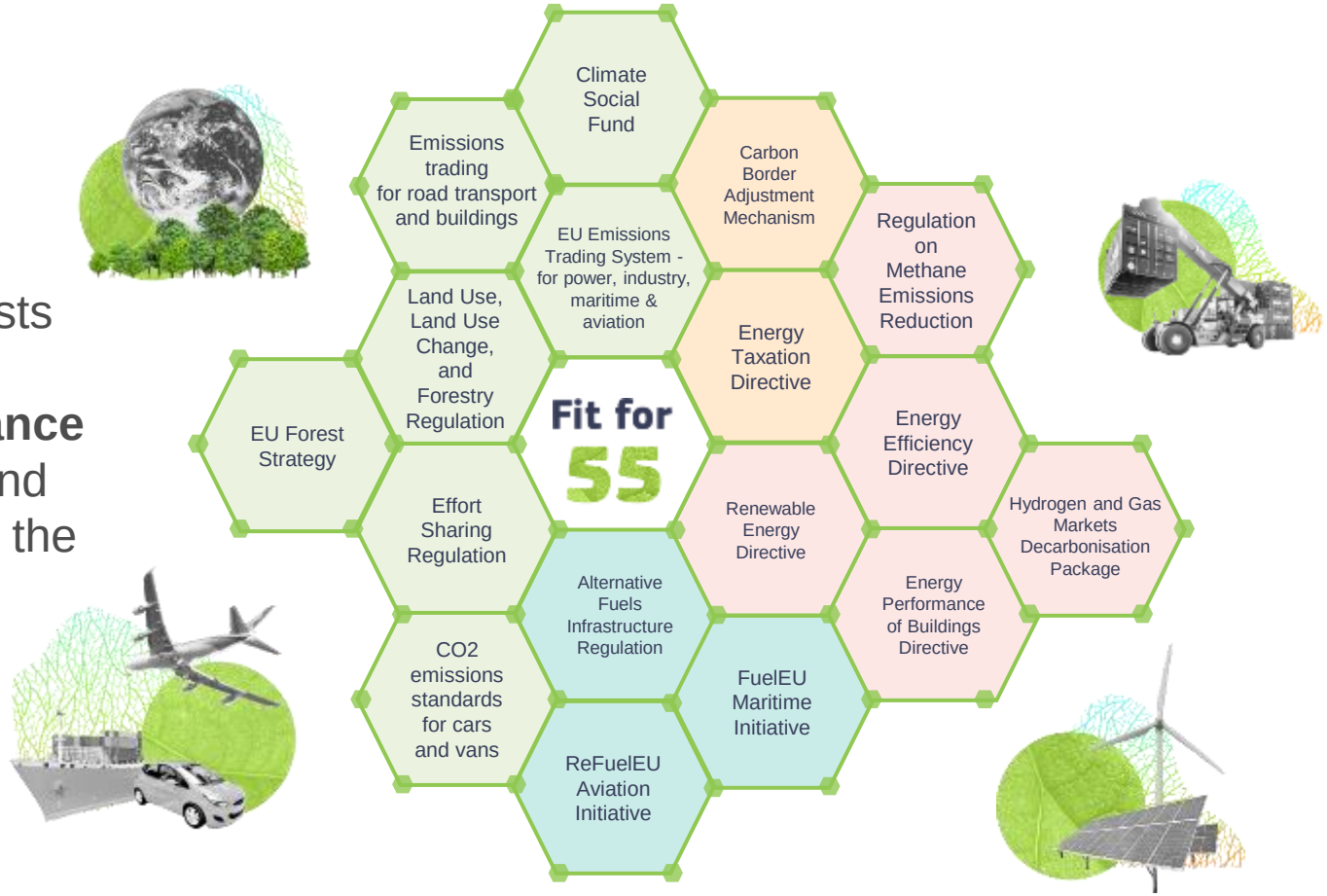
1.ensuring a **secure** and **affordable EU energy supply**

2.developing a **fully integrated, interconnected** and **digitalised EU energy market**

3.prioritising **energy efficiency**, improving the **energy performance of our buildings** and developing an energy sector based largely on **renewable sources**

Fit for 55 Package (1/6)

The Fit for 55 Package consists of a set of **interconnected proposals that strike a balance** between pricing, standards and support measures to achieve the energy and climate targets.



European Commission

REPowerEU (1/4)

REPowerEU (2/4)

URGENT ACTION ON PRICES

Keeping retail energy prices in check by confirming the possibility of price regulation to help protect consumers and our economy.

Guidance on temporary tax measures on windfall profits and use of emissions trading revenues, so governments can ease the pressure on household consumers.

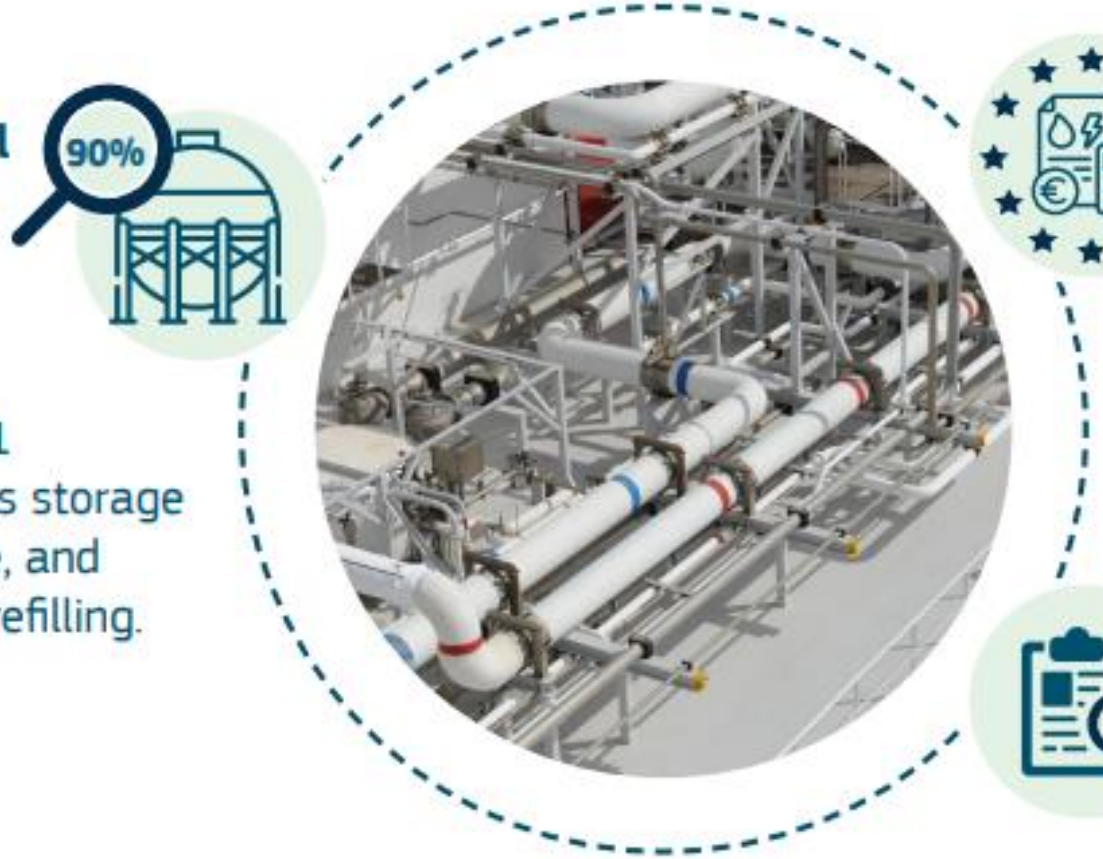
State Aid measures: consultation with Member States on a potential Temporary Framework to grant aid to companies facing high energy costs.

Market actions assessing options to improve the electricity market design.

REPowerEU (3/4)

REFILLING GAS STORAGE FOR NEXT WINTER

A legislative proposal by April on minimum gas storage so Europe better controls its supply, establishing a 90% filling target by 1 October, designating gas storage as critical infrastructure, and allowing incentives for refilling.



Support to **coordinated gas refilling operations**, for example through joint procurement, collecting orders and matching supplies.

Continued **investigation into behaviour by operators**, notably by Gazprom.

REPower EU (4/4)

REPOWEREU TO CUT OUR DEPENDENCE ON RUSSIAN GAS

More rooftop solar panels, heat pumps and energy savings to reduce our dependence on fossil fuels, making our homes and buildings more energy efficient.

Decarbonising Industry by accelerating the switch to electrification and renewable hydrogen and enhancing our low-carbon manufacturing capabilities.

Speeding up renewables permitting to minimise the time for roll-out of renewable projects and grid infrastructure improvements.

2030

Doubling the EU ambition for biomethane to produce 35 bcm per year by 2030, in particular from agricultural waste and residues.

Diversifing gas supplies and working with international partners to move away from Russian gas, and investing in the necessary infrastructure.

A Hydrogen Accelerator to develop infrastructure, storage facilities and ports, and replace demand for Russian gas with additional 10 mt of imported renewable hydrogen from diverse sources and additional 5 mt of domestic renewable hydrogen.

Twin Energy and Digital Transitions

European Green Deal

Path to the Digital Decade

Towards a decentralised, decarbonised and flexible energy system

Digitalising the energy system - EU Action Plan

EUROPEAN COMMISSION

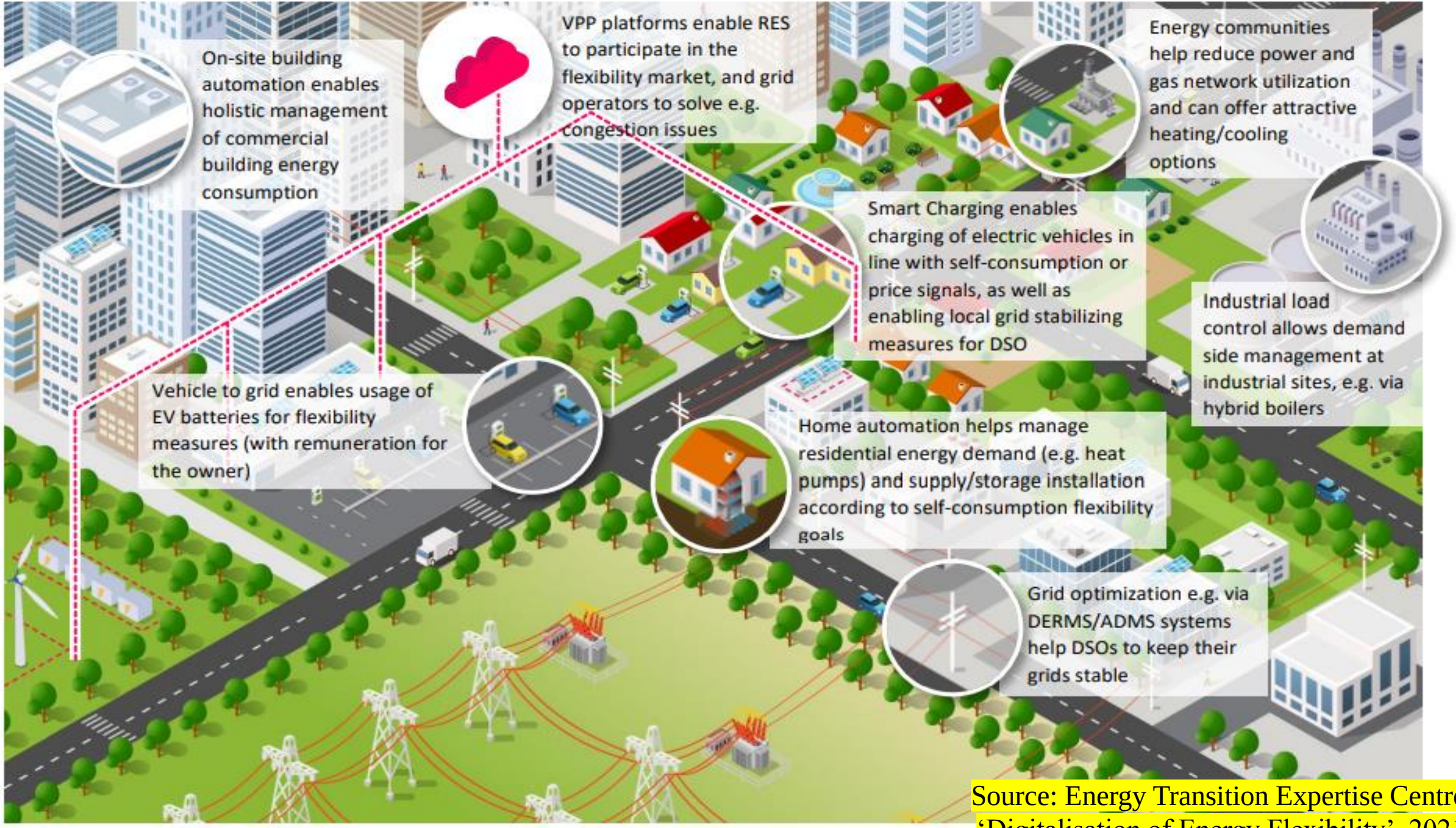
Strasbourg, 18.10.2022
COM(2022) 552 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Digitalising the energy system - EU action plan

{SWD(2022) 341 final}

European Commission



Source: Energy Transition Expertise Centre 'Digitalisation of Energy Flexibility', 2021

EnTEC – ‘Digitalisation of energy flexibility’

- Appropriate measures could facilitate the participation on the wholesale markets of more than 580 GW of flexible energy resources that make full use of digital solutions by 2050.
- It is estimated that this would cover over 90% of the overall flexibility needs in the EU electricity grids.
- Enabling the smart and bidirectional charging of electric vehicles (EVs), the participation of virtual power plants in the energy markets and exploiting the potential of energy communities, smart buildings and smart heating using heat pumps could contribute the largest share of that flexibility

Thank you

European Commission

Sonya Twohig

Secretary General

ENTSO-E

Keynote speech

INTERRFACE

Flexibility & Digitalization: building blocks of the future system

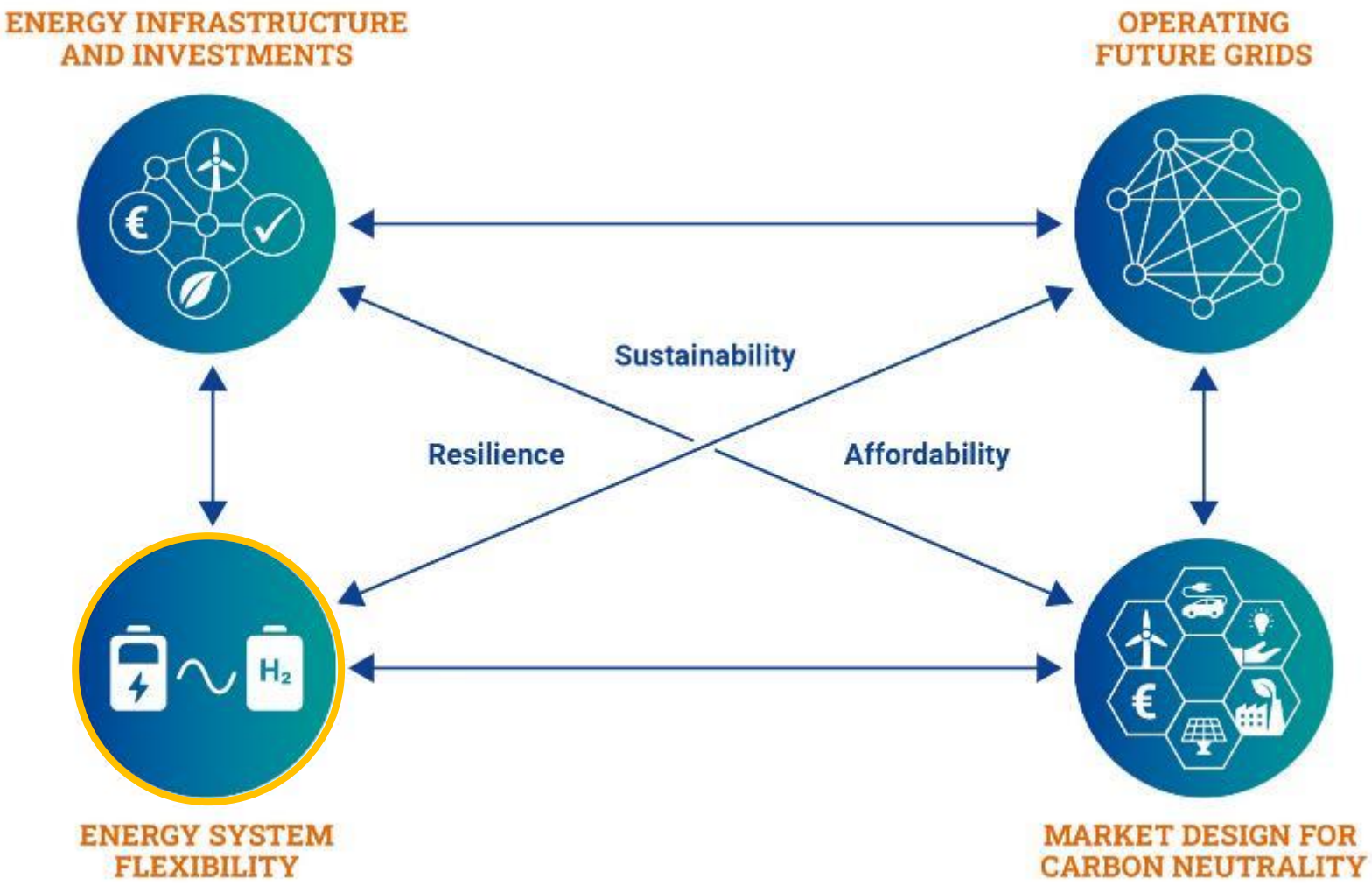
Sonya Twohig, Secretary General – ENTSO-E

INTERRFACE project Final Event – 7 December 2022

entsoe
Reliable Sustainable Connected

ENTSO-E Vision for a Carbon Neutral Europe

The baseline scenario – based on 4 key building blocks



Green shift is now!

Reaching carbon neutrality even faster

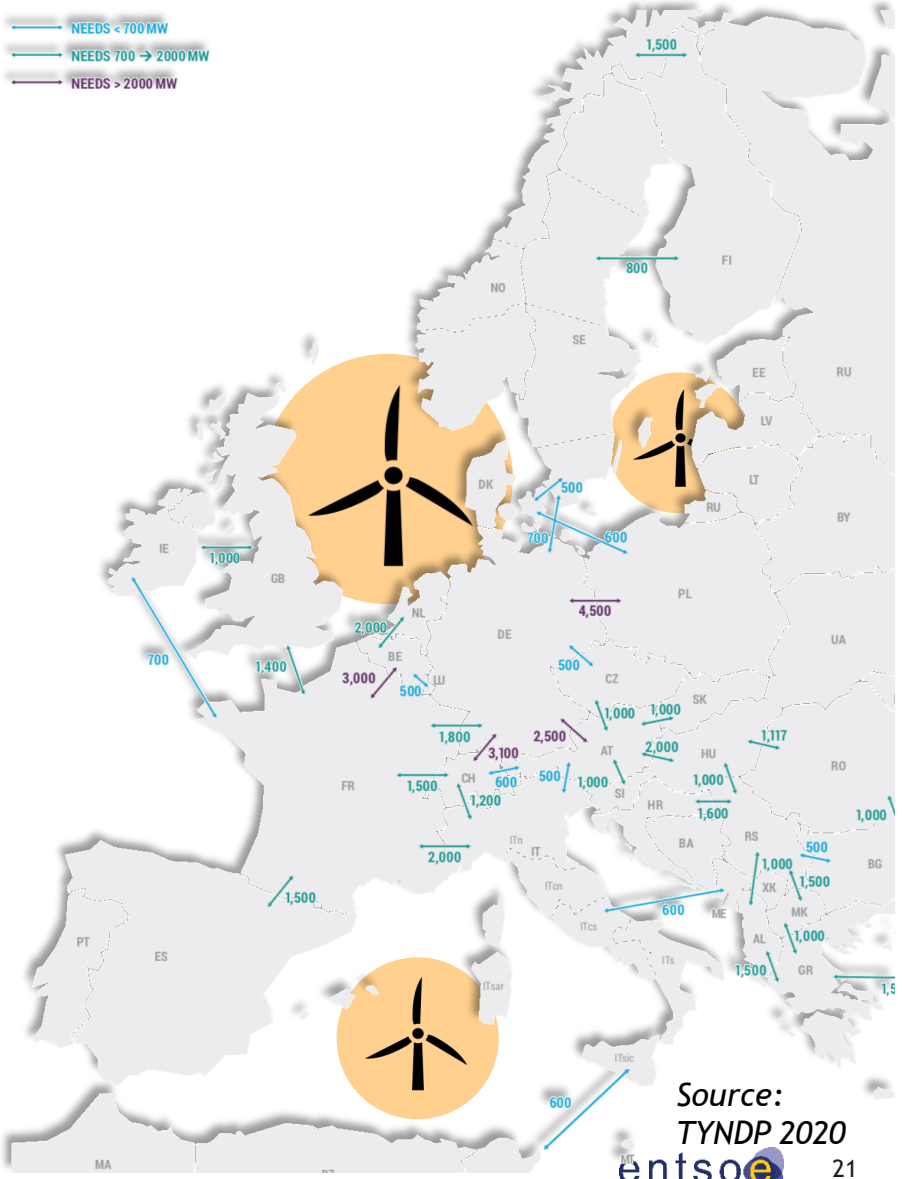
- **10x wind & solar faster**

  Zero target gives radical changes of the power system in Europe

- **10 x more flex**

  Increased integration & cooperation between countries and sectors

- **Accelerated innovation is key:**
  - Fast deployment of mature innovative solutions
  - … and development of new ones

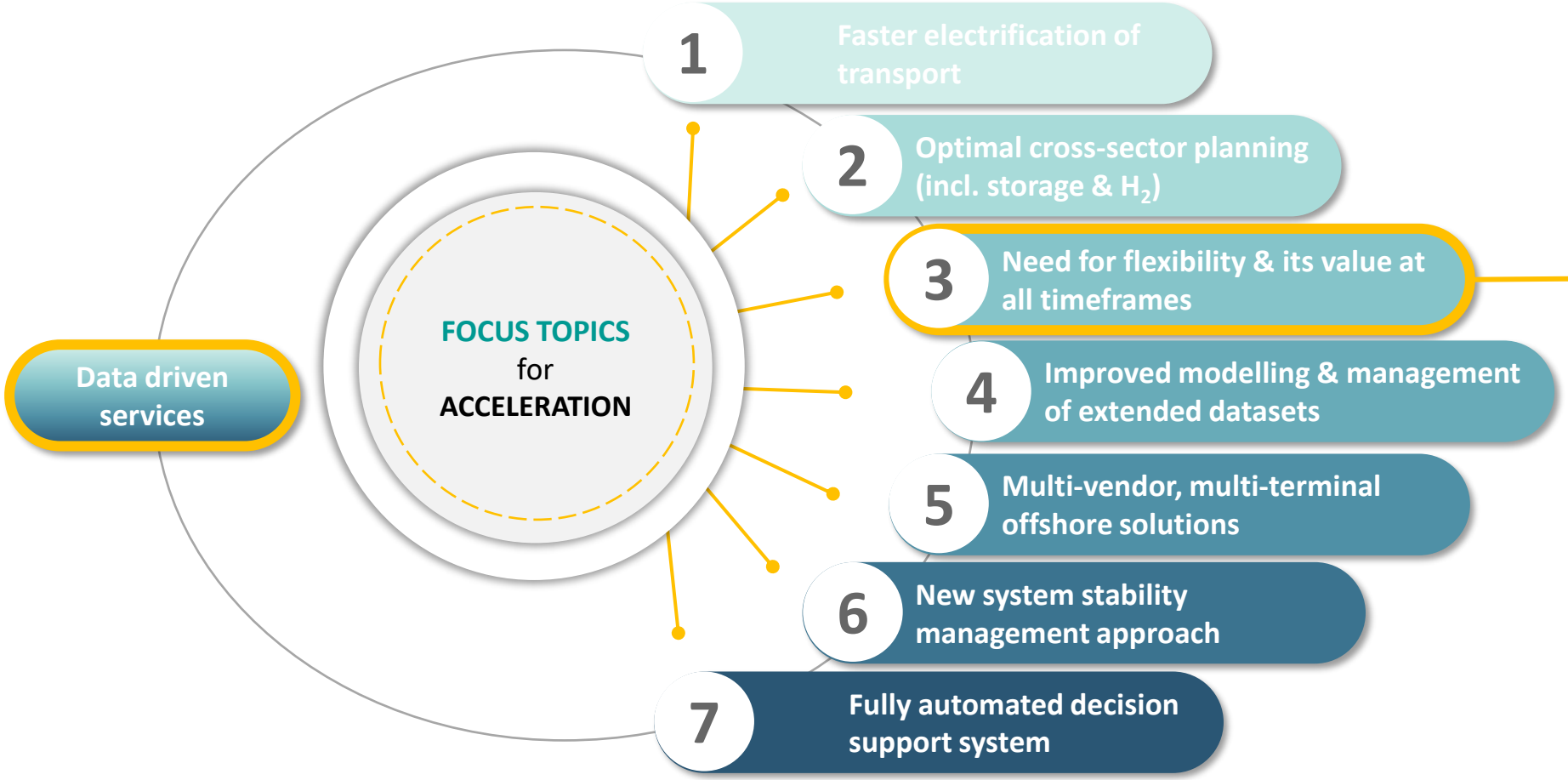


Source: TYNDP 2020

entsoe

Accelerated innovation is key on priority actions

In spotlight: Flexibility & Data driven services



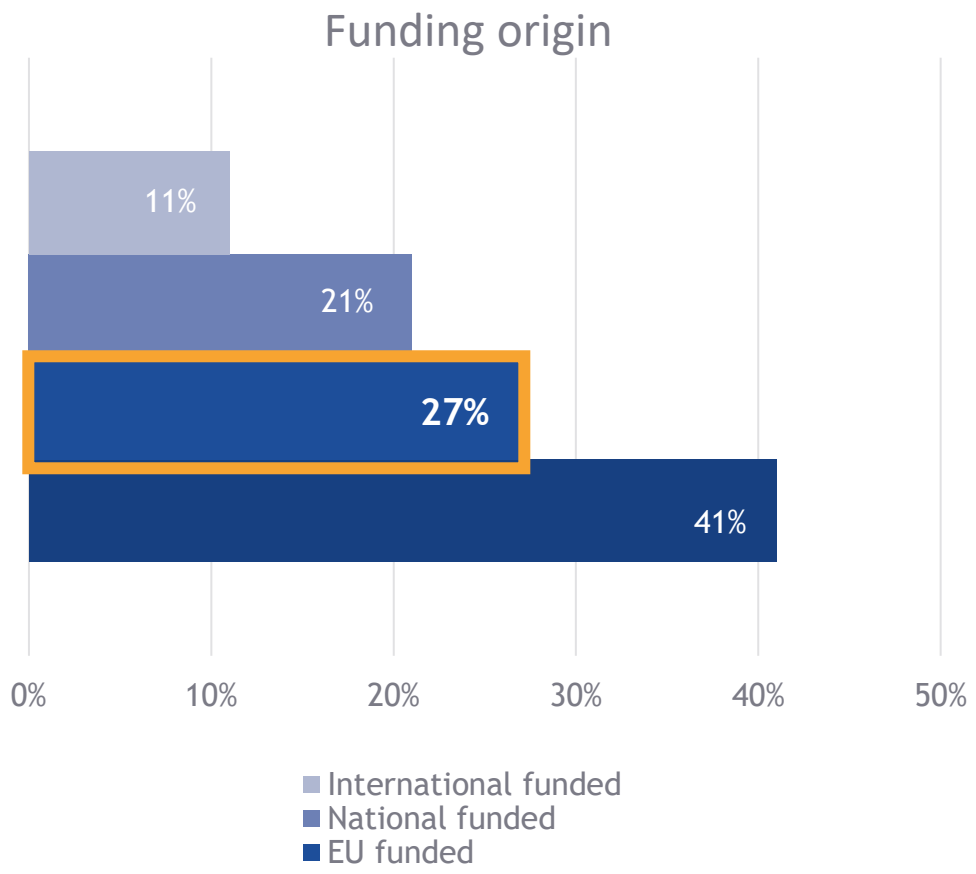
INTERRFACE

- Covers **2 out of 8 priority RDI topics** for TSOs
- Through creating a **platform for interoperable data exchange**, enables the **unlocking and procurement of flexibility** services for the system

EU-funded projects for TSOs

ENTSO-E plays an important part in harmonization of roles and protocols

Out of 117 currently ongoing TSO RDI project:



Source: RDI Monitoring Report 2022 (preliminary data)

ENTSO-E involvement in Horizon-projects

ONENET

BD4NRG

INTERRFACE

int:net
Interoperability Network for the Energy Transition

READY4DC

Thank you for your attention!

Nikos Bilidis
Project Coordinator INTERRFACE

European Dynamics

Introduction to INTERRFACE

INTERRFACE

About INTERRFACE

LC-SC3-ES-5-2018-2020: TSO-DSO-Consumer: Large-scale demonstrations of innovative grid services through demand response, storage and small-scale (RES) generation

Title: TSO-DSO-Consumer **INTERFAC**E a**R**chitecture to provide innovative grid services for an efficient power system

- Project Grant Agreement No. 824330
- Budget: 20.9 M Euro
- Grant: 16.8 M Euro
- Duration: 4 Years

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824330

INTERRFACE Objectives

WHAT

- Integrating small scale & large scale assets to **increase market liquidity** for grid services and facilitate scaling up of **new services** compatible across Europe.
- Driving **collaboration in the procurement of grid services by TSOs and DSOs** enabling the incorporation of location information and grid conditions
- Improving **market signals**, **increase transparency** and **creating strong incentives** to connected customers
- Facilitating **market processes** such as bidding, qualifications, activations and settlement

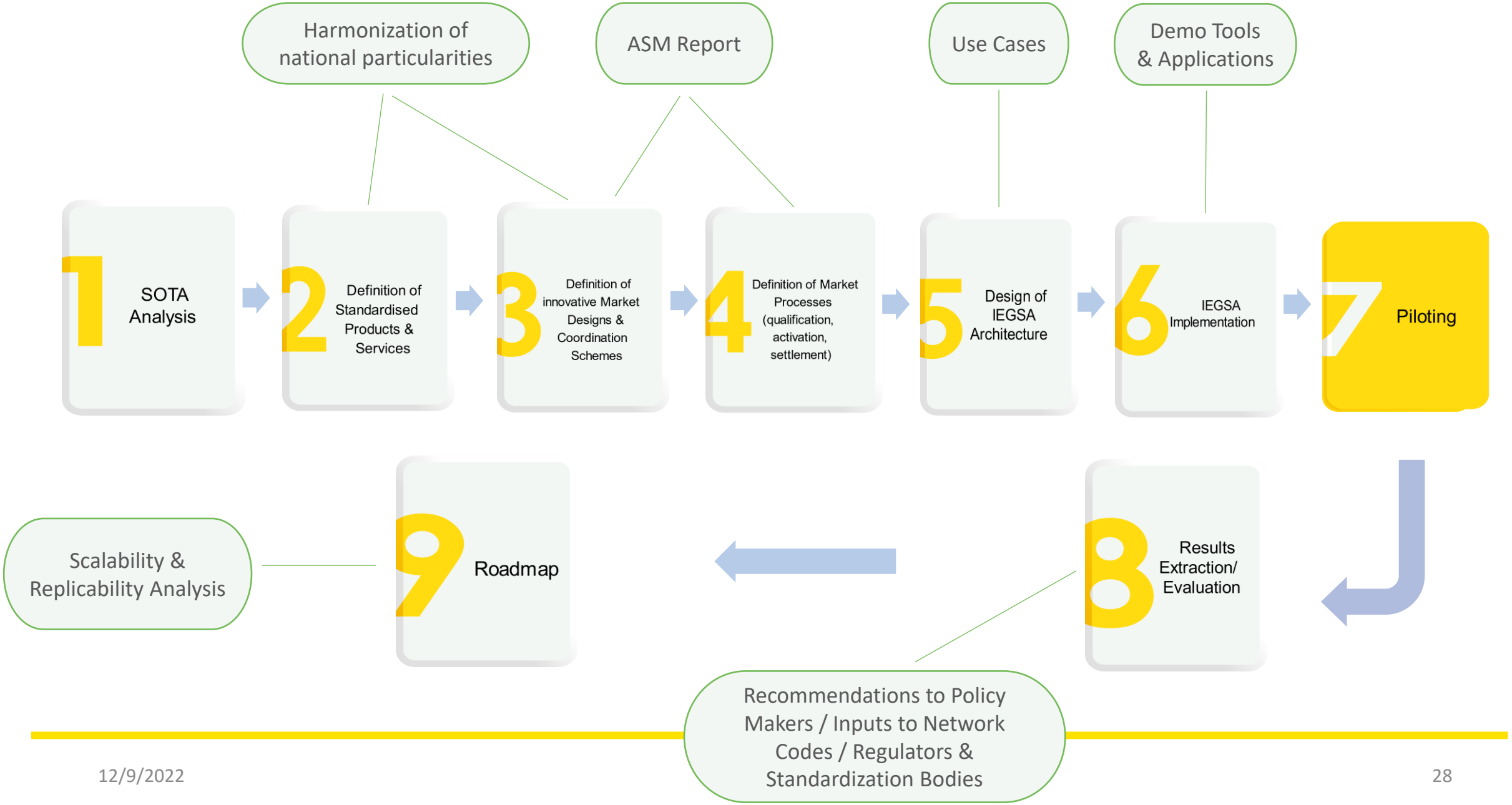
WHO

- Transmission System Operators
- Distribution System Operators
- Market Operators
- Aggregators
- Flexibility Service Providers
- Prosumers / Consumers
- Policy Makers
- Regulators

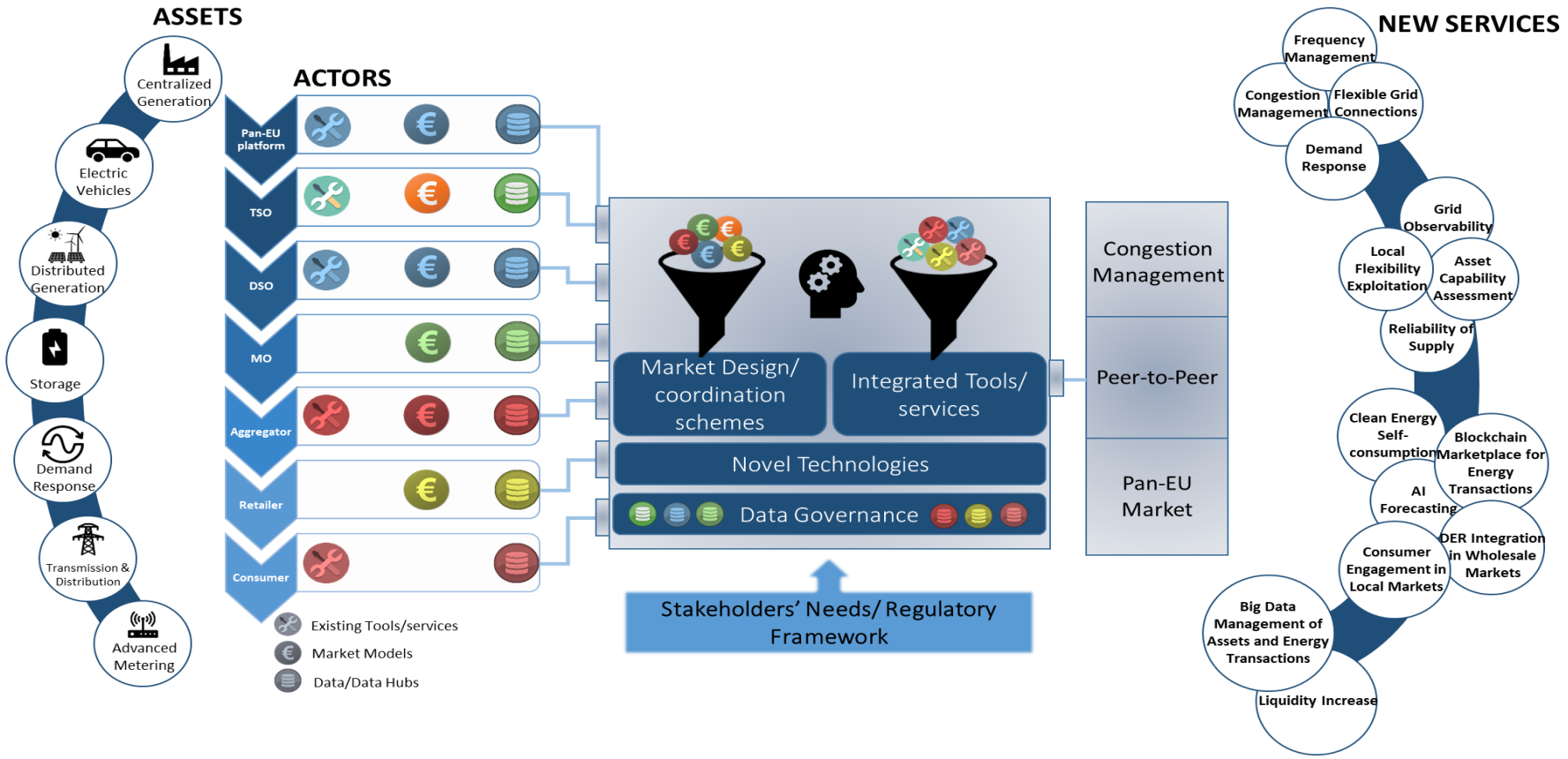
HOW

- Defining & demonstrating **standardized products**, **market designs** & **coordination schemes**
- A common architecture (IEGSA Platform) for **seamless pan-European electricity exchange** linking wholesale & retail markets, allowing all energy stakeholders to **trade & procure** energy services in a transparent, non-discriminatory way.
- Validation of novel concepts and/or IEGSA in **7 Large-Scale** Demonstrators covering 9 countries across Europe

INTERRFACE Timeline



INTERRFACE Vision
Interoperable Pan-European Grid Services Architecture



"An open architecture for sharing data among all participants in the electricity system value chain (customers, grids, market), from local, regional to EU level. It will enable TSOs, DSOs and customers to coordinate their efforts to maximise the potential of distributed energy resources (DERs), demand aggregators and grid assets, so as to procure energy services in a cost-efficient way and create consumer benefits"

INTERRFACE - Demonstrators

Demo Area 1:
Congestion Management and Balancing Issues

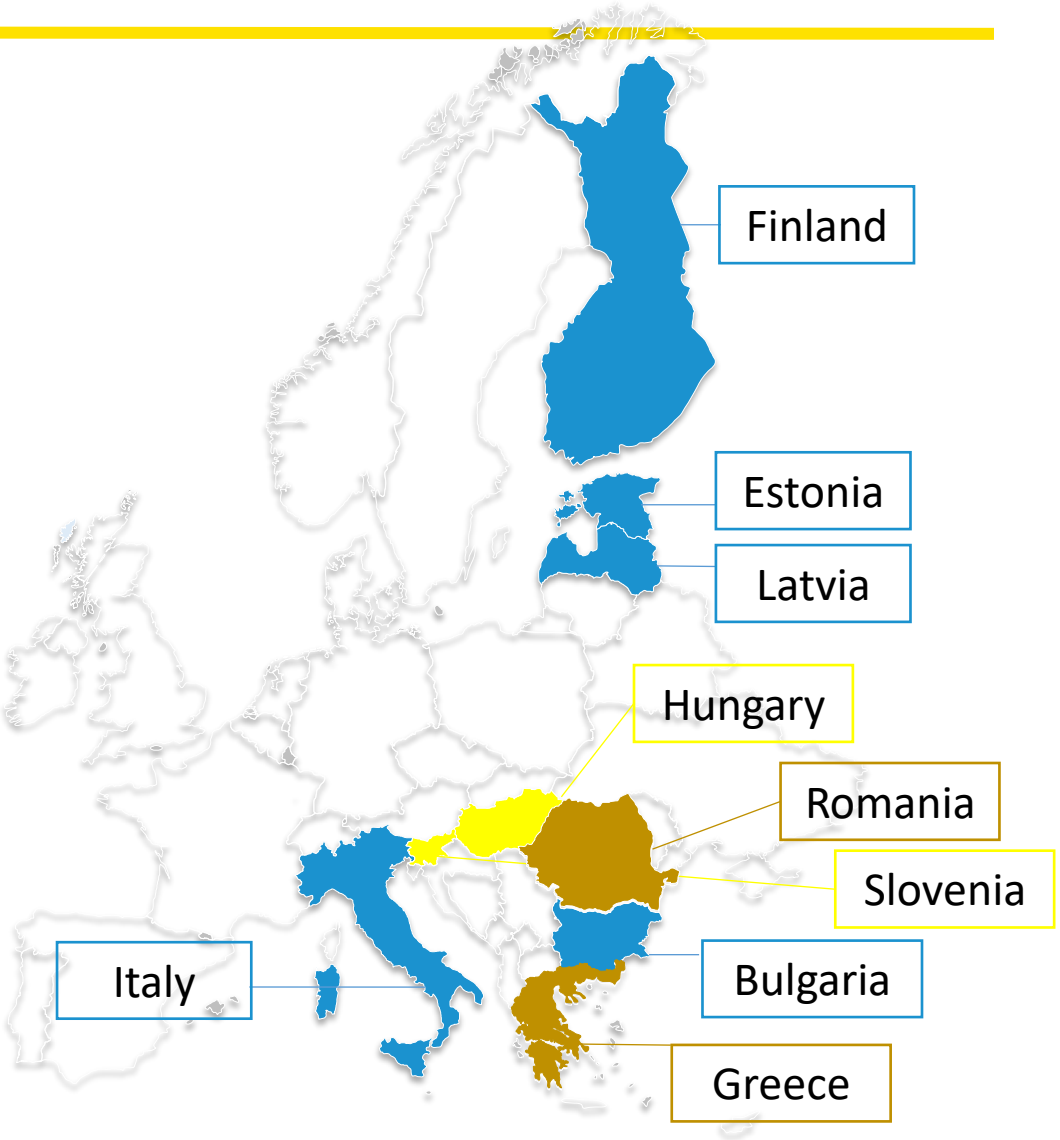
- **DSO and Consumer Alliance** (Centralized Energy Management system for microgrids)
- **Intelligent Distribution Nodes** (Grid Services Management system for flexible LV/MV Networks)
- **Single Flexibility Platform** (Exchange Platform for distributed flexibilities in end-to-end electricity networks)

Demo Area 2:
Peer-to-peer Trading

- **Asset-enabled Local Markets** (Microgrid Local Electricity Markets using the assets capabilities)
- **Blockchain-based TSO-DSO flexibility** (Market Platform with Smart Contract and smart billing)

Demo Area 3:
Pan-EU clearing Market

- **DERs into Wholesale** (A retail-to-wholesale Market approach for DERs' integration)
- **Spatial Aggregation of local flexibility** (A EUPHEMIA-based Market Platform to engage local flexibility resources)



Impact – Road to Markets

- Establish a firm basis for **flexibility markets**
- **Increased TSO- DSO coordination** for Congestion Management and mFRR balancing services (locational information)
- The **flexibility concept** is being enhanced by connecting with multiple products & connectivity to overarching markets and **emerging TSO collaboration based markets in Europe**
- Regulatory steps are underway to enable **DSO flexibility** in all member states

Thank you for your attention!

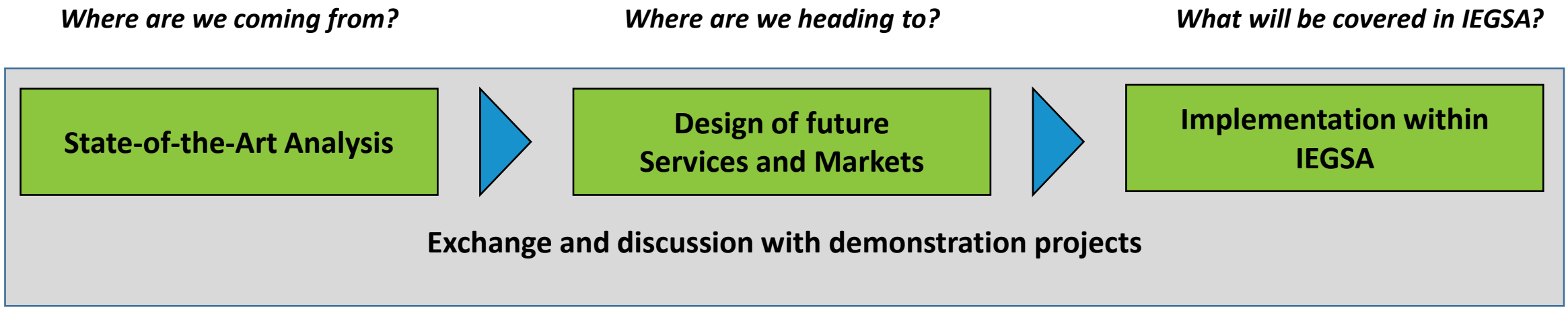
Felix Gaumnitz
Work Package 3 leader INTERRFACE

RWTH Aachen University

Steps towards an improved market design

INTERRFACE

Services and Market Design within INTERRFACE
Objectives



- Definition of Future Services, coordination schemes, roles and market designs for the implementation in the IEGSA platform
- Basis: State-of-the-Art Analysis of user requirements, tools and services, market architectures and the regulatory framework
- Intensive exchange with demonstration projects to ensure consistency

State-of-the-Art Analysis I/II
Selected Results

State-of-the-Art in Feb 2020

Needs of end-users, grid operators and market players

End users

- Changing role of end-consumers towards an active role within electricity markets
- Privacy and security of end-user information is crucial

Grid / system operator

- Congestion management and system balancing are major action fields
- Importance of local information due to decentralization

Market players

- Need of markets for flexibility with defined processes for coordination and information exchange

Existing Market's tools and services

- Fragmented use of services and tools among the survey respondents
- Grid operators stated: Interoperability, information exchange and coordination are key to unlock the flexibility potential of distributed resources
- Identified needs are
  - Integration of different platforms
  - Improvement of data exchange between stakeholders
  - Expansion of current tools to deal with more data
  - Usage of standards

State-of-the-Art Analysis II/II
Selected Results

State-of-the-Art in Feb 2020

Market Design

- Ongoing process of integration and harmonization of market structures
- High level of harmonization of wholesale markets
- Differences in the degree of liberalisation in European retail markets
- Common European projects in the field of frequency ancillary services (MARI, PICASSO, TERRE and IGCC) drive harmonization of procurement and aim at unlocking synergy potentials
- Divergence of approaches for congestion management and lack of coordination between TSOs and DSOs within the field of markets for non-frequency ancillary services

Regulatory Framework

- Identified research domains relevant for INTERRFACE from the Clean Energy package
  - Flexibility mechanisms
  - Consumer data management
  - Framework for Aggregators
  - Peer-to-peer and community-based Energy Trade
  - Electro Mobility
- Detailed analysis of challenges and design issues related to flexibility marketing pilot projects

State-of-the-Art Analysis II/II

Selected Results

State-of-the-Art in Feb 2020

Market Design

- Ongoing process of integration and harmonization of market structures
- High level of harmonization of wholesale markets
- Differences in the degree of liberalisation in European retail markets
- Common European projects in the field of frequency ancillary services (MARI, PICASSO, TERRE and IGCC) drive harmonization of procurement and aim at unlocking synergy potentials
- Dive
man
TSO
non-

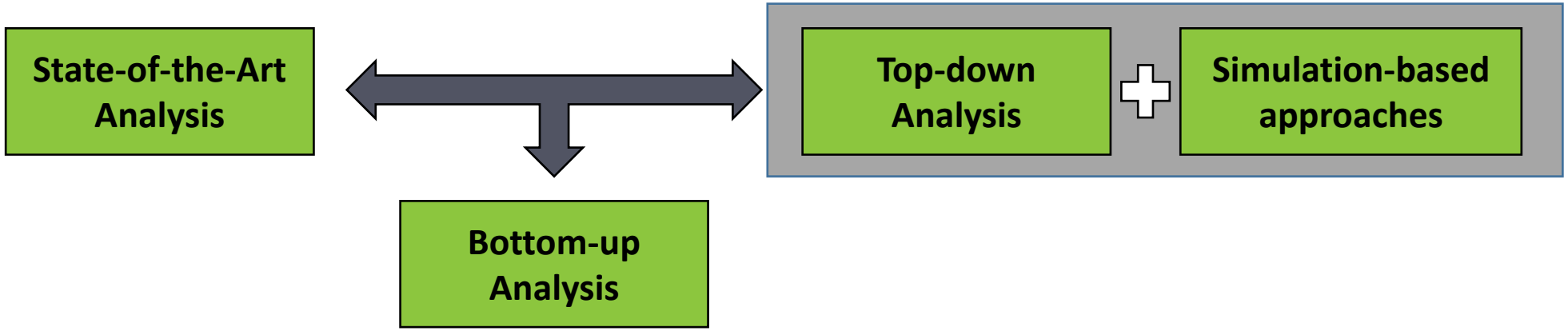
Regulatory Framework

- Identified research domains relevant for INTERRFACE from the Clean Energy package
  - Flexibility mechanisms
  - Consumer data management
  - Framework for Aggregators
  - Peer-to-peer and community-based Energy Trade
  - Electro Mobility
- Detailed analysis of challenges and design issues related to flexibility marketing pilot projects

→ Comprehensive analysis provided valuable insights
→ Development of Services and Market Designs based on the Analysis

Services and Market Design within INTERRFACE

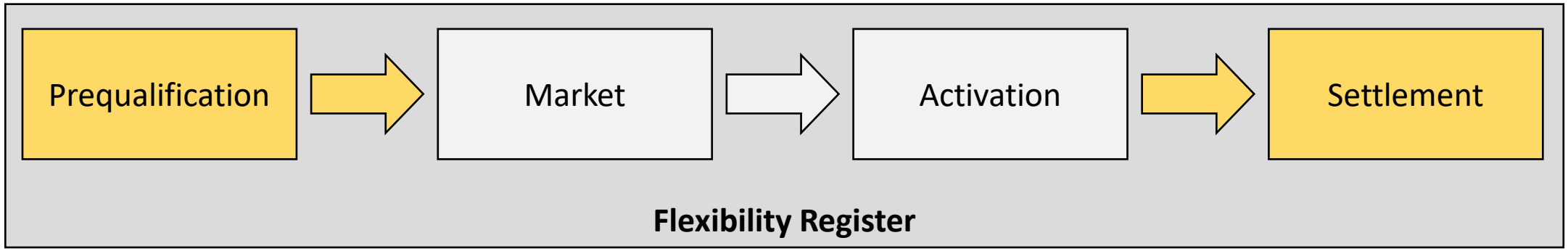
Approach to define Services and Market Designs



- Objective to define products and markets that will be implemented in IEGSA
- Top-down analysis identified comprehensive list of services and markets
- Bottom-up analysis incorporated end-users and demos point of view to ensure consistency
- Iterative process ensured that product and market design adapts to progression of demonstration projects

Services and Market Design within INTERRFACE
Results of the Service and Market Design

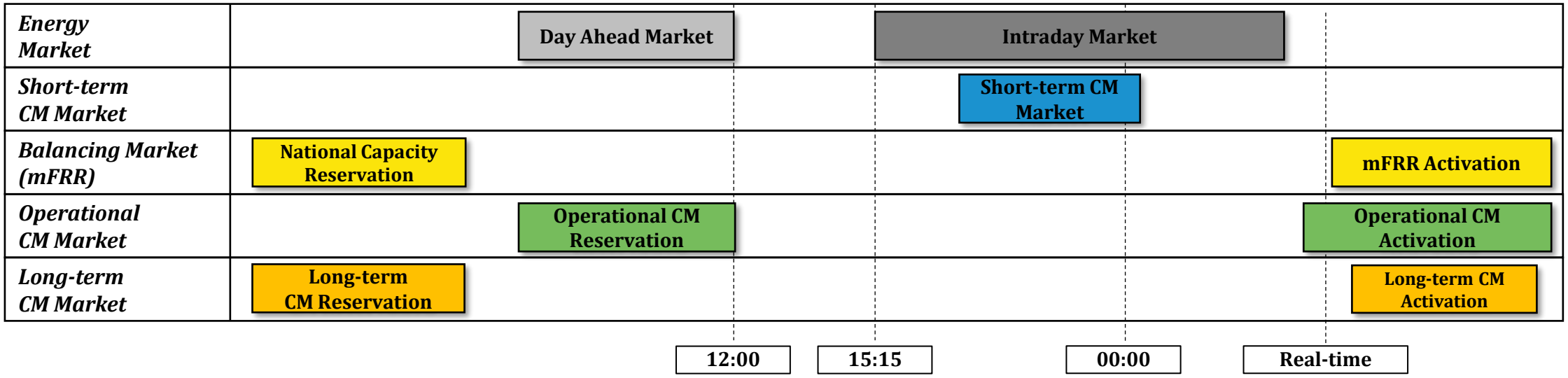
- Analysis of Emerging Services and Market options within the fields of **balancing**, **congestion management** and other **non-frequency ancillary services**
- Identification of common processes independent from specific service and the market design



- Necessary processes for **product and grid prequalification** as well as **settlement**
- Need for a **flexibility register** to share information on potential sources of flexibility

Services and Market Design within INTERRFACE
Results of the Service and Market Design

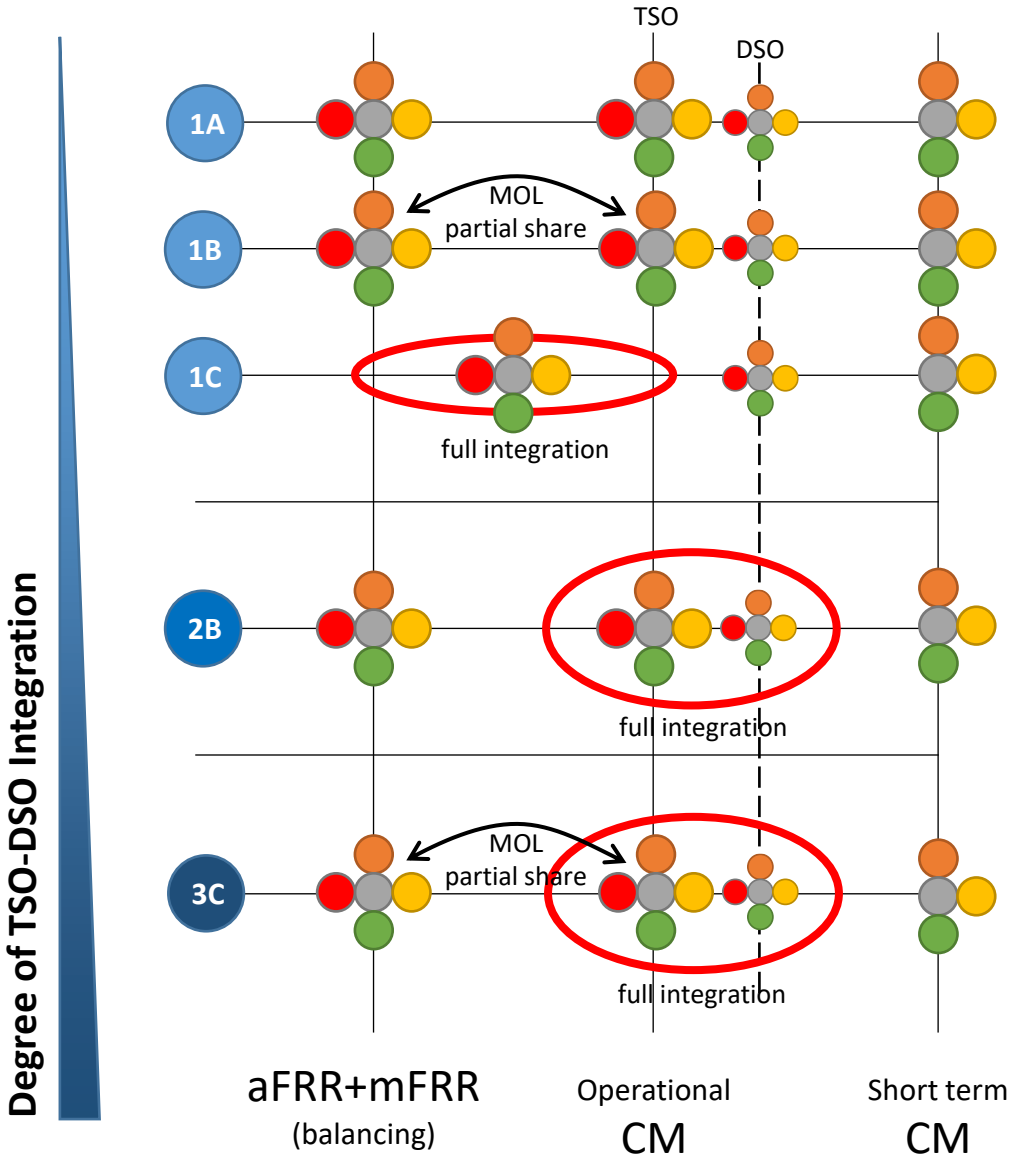
- Consideration of different market options based on multiple dimensions
  - **Time:** Operational vs. Short-term vs. Long-term congestion management
  - **Degree of Market integration[1]:** Separation vs. partial or full integration of congestion management markets and balancing markets
  - **Degree of TSO/DSO interaction[1]:** Separated vs. partial or full integration of TSO and DSO congestion management
- Market sequence and temporal sequence of markets for congestion management



[1] Based on TSO-DSO Report for "An Integrated Approach to Active System Management"

Services and Market Design within INTERRFACE

Results of the Service and Market Design



- Market / Services based on different degrees of TSO/DSO interaction and market integration

Prequalification

- Certification provided to energy units when they have the possibility of executing services
- This is dependent on the capability of the flexible resources and the local network limitations

Reservation of available capacity

- Reserve dimensioning (on the basis of imbalance and congestion forecasts) and reservation of selected flexible resources

Procurement of energy products

- Process aimed at selecting the available resources (by evaluating dedicated merit order lists) for the execution of a service

Activation

- Process triggered by aggregators and aimed at modifying the operation mode of flexibility units in order to provide the service

Settlement

- Process aimed at remunerating flexible resources and distributing costs according to responsibilities

Services and Market Design within INTERRFACE
Results of the Service and Market Design

- Bottom-up analysis showed that described markets for congestion management (long-term, short-term, operational) are covered by at least one demonstrator
  - Market Designs focusing on DSO CM tend to be separated from other markets
  - Market Designs focusing on TSO CM tend to combine Intraday and CM markets

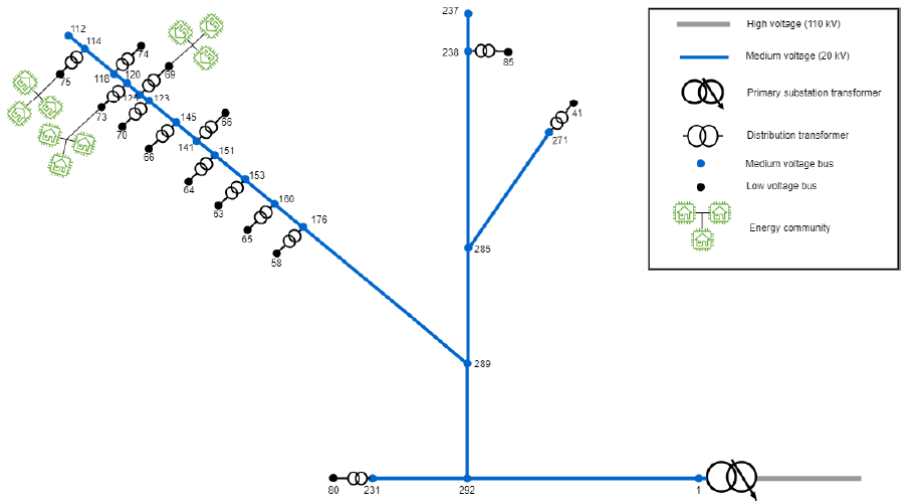
➢ **Comprehensive definition of Services and Markets essential for later implementation**

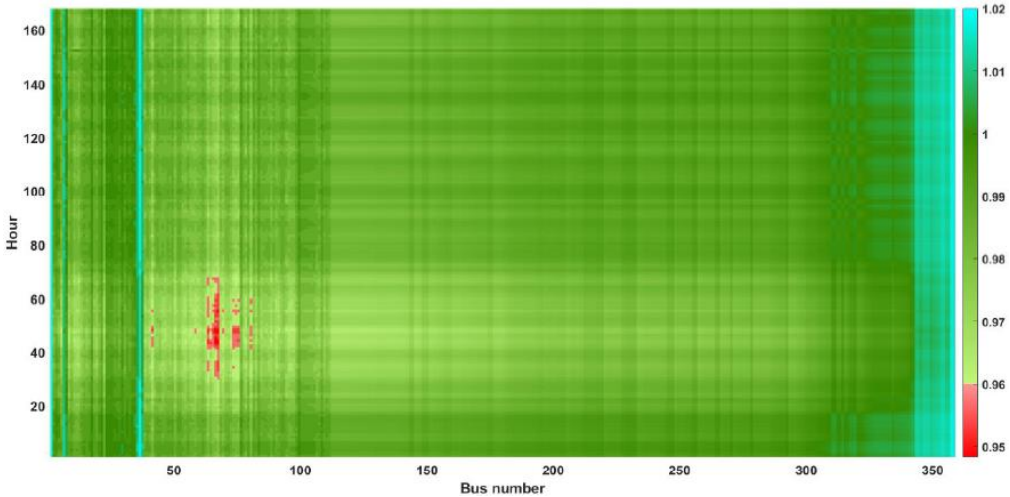
- Simulation based approach can overcome the limitation that evaluating CM market designs the demonstrators are limited to regulatory specifics and their scope
- Development of simulation frameworks for congestion management markets incorporating different design options

Services and Market Design within INTERRFACE

Selected results of the Simulation-based approaches for CM markets

- Two simulation frameworks have been developed and used to investigate the effects of CM markets for DSOs
- CM market is a multi-stakeholder decision problem with complex interactions
- Congestion management markets offer additional flexibility for DSO that can effectively resolve congestions
- Flexibility potential highly dependent on grid structure, underlying constraints and price expectations
- Some congestions require very local flexibility where flexibility is limited in terms of volume and availability





Thank you for your attention!

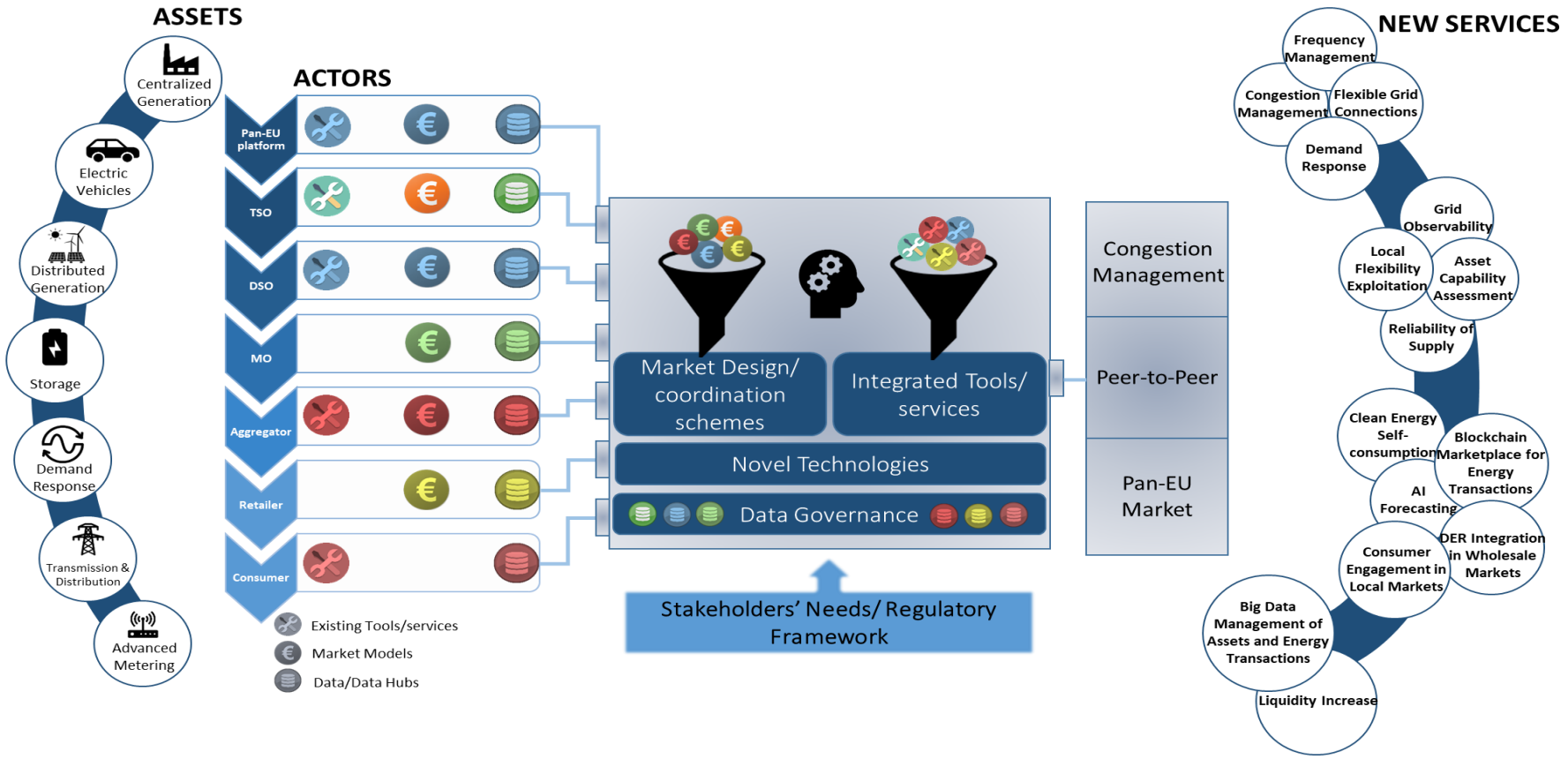
Nikos Bilidis
Project Coordinator INTERRFACE

European Dynamics

IEGSA: INTERRFACE's proposal for integrated pan-EU grid services

INTERRFACE

INTERRFACE Vision
Interoperable Pan-European Grid Services Architecture

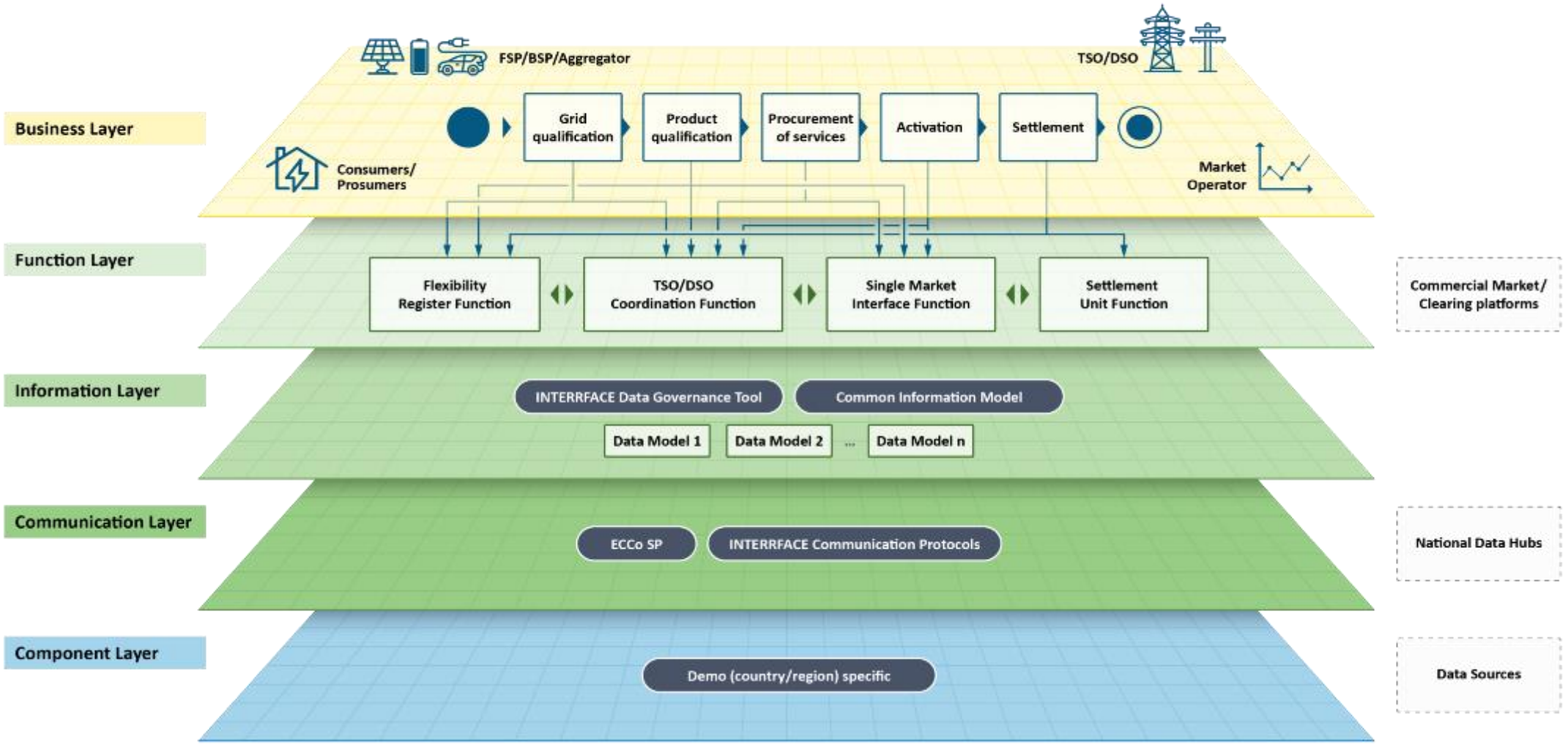


"An open architecture for sharing data among all participants in the electricity system value chain (customers, grids, market), from local, regional to EU level. It will enable TSOs, DSOs and customers to coordinate their efforts to maximise the potential of distributed energy resources (DERs), demand aggregators and grid assets, so as to procure energy services in a cost-efficient way and create consumer benefits"

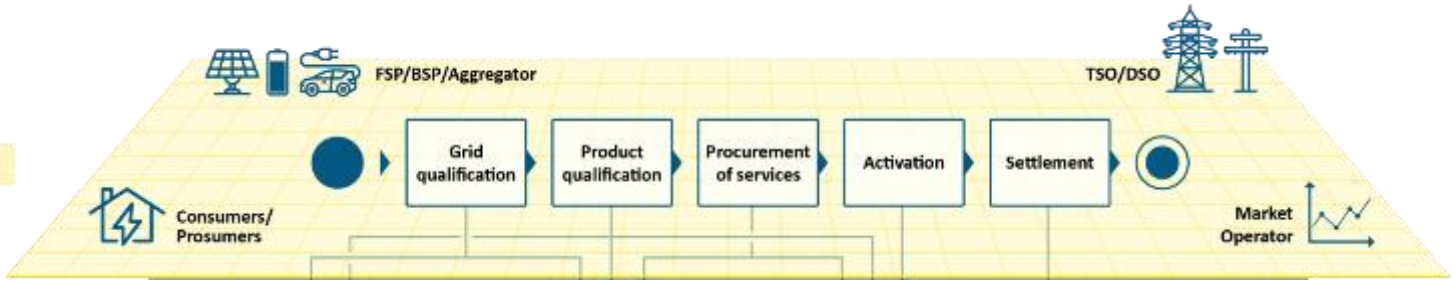
IEGSA Challenges

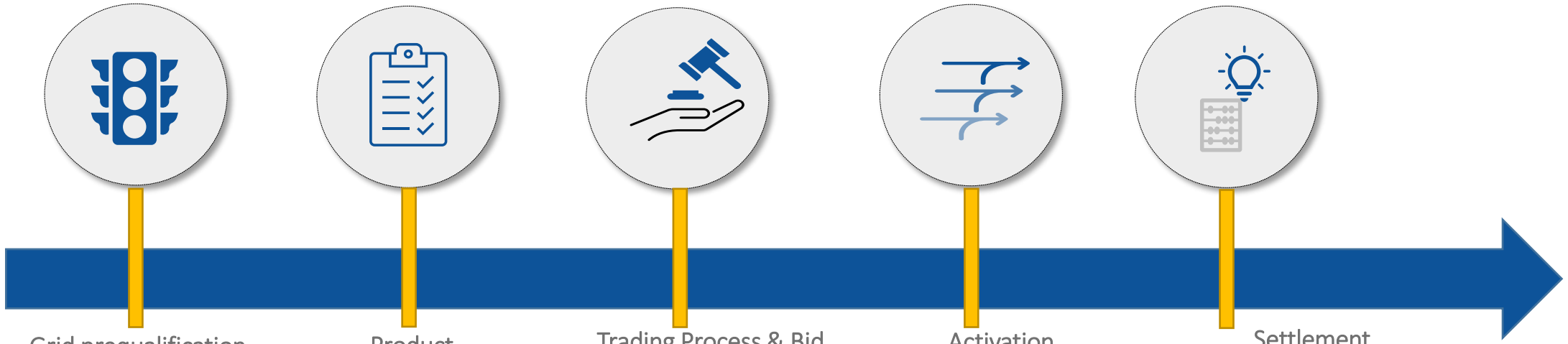
- Ensure transparency between actors → Bring market signals closer to the consumer → Lower entry barriers for small players
- Fragmented markets both at national and pan-European level
- Service procurement by SOs does not often take into account actual grid constraints (qualification processes)
- Lack of coordination between TSOs and DSOs. Limited data exchange. Individual procurement of services.
- Data silos / Different Communication Protocols / Incompatibility of legacy systems
- Reluctance on behalf of stakeholders to change practices and move towards more harmonised solutions and systems

INTERRFACE Platform - IEGSA
Interoperable pan-European Grid Services Architecture



INTERRFACE Platform - IEGSA
Interoperable pan-European Grid Services Architecture





Grid prequalification

- Custom **automated algorithm** (promoting TSO/DSO coordination)
- Direct **SO involvement**
- ***Traffic light*** **system**

Product Prequalification

- **UI Based**
- Automated inference to steer the **process based on product requirements**

Trading Process & Bid Qualification

- **Automated algorithm** promoting TSO/DSO coordination
- Direct **SO involvement**
- Gathering of **qualified bids**
- Issuing for **MOLs**

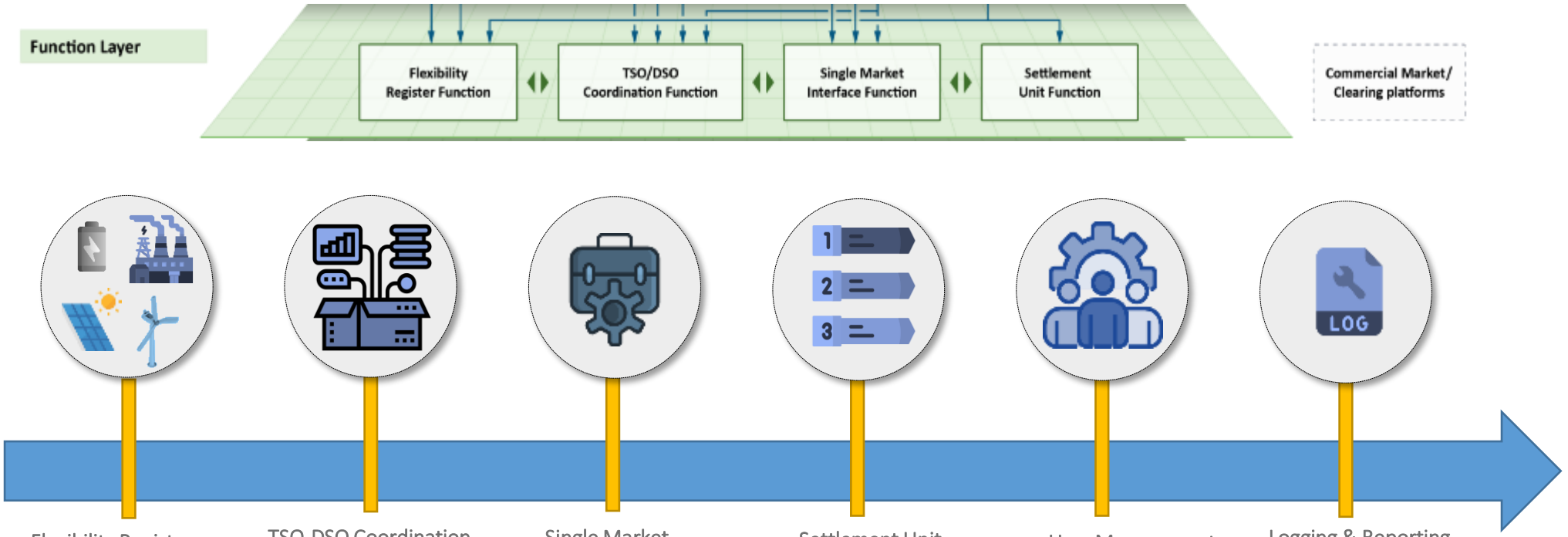
Activation

- Allowing SOs to **activate bids**
- Synchronization with integrated markets to **keep track of activations**

Settlement

- **Custom** settlement **algorithms**
- Gathering and **organization** of **settlement data**
- **Calculation** of energy settlement

INTERRFACE Platform - IEGSA
Interoperable pan-European Grid Services Architecture



Flexibility Register
- Repository for flexibility assets
- Groups of assets Management of flexibility assets
- information on temporal available flexibility

TSO-DSO Coordination Platform
- Gateway for SOs to IEGSA
- information to SOs for facilitating coordination
- Data exchange with SOs

Single Market Interface
- Integration with different markets
- Data exchange and synchronization
- Assisting the trading process and facilitating activation

Settlement Unit
- Gathering of settlement data
- Connection to datahubs for settlement data validation
- Perform energy settlement according to the applied methodology in each case

User Management
- RBAC authentication and authorization
- Administration via global roles
- Handling of official EIC codes

Logging & Reporting
- Data exchanges & events logging
- Reports generation based on selected parameters
- Statistics

Conclusions

- IEGSA can support different innovative and standardized market designs and services definitions
- IEGSA supports the application of coordination schemes for TSOs and DSOs featuring different level of market integration and different levels of cross-Operator collaboration
- IEGSA lowers entry barriers for small pro- or consumers
- IEGSA contributes to increased transparency for consumers by sharing market and price signals
- Easy access to market / Empowering the role of aggregators
- Hosting market designs for peer-to-peer and local trading

Lessons Learnt

- The proper **adoption of role descriptions** defined by HEMRM will allow an efficient interaction and coordination among different actors.

- Market challenges are inherently tied to the complexity and multiplicity of new and existing products, services, markets, and processes across Europe→ **stricter requirements on market platforms** are needed and **harmonization in market designs and product definitions** is crucial.

- **Technical challenges** require further alignment and compliance with existing and future **standardization activities**.

- IEGSA development should consider **alignment with key initiatives at EU and International level**, such as: DSBA architecture, metadata, IDS information model, etc., to ensure **enhanced interoperability**

- Integration with multiple distributed data exchange platforms at **cross-border** or even at **cross-sector** level will release **data-driven services** among the different business actors

- **Regulatory compliance** with relevant frameworks is also crucial.

Panel discussion #1

Making the difference through data exchange

INTERRFACE

Moderator:

Rolf Riemenschneider
Head of sector IoT
DG CNECT

Konstantinos Kotsalos
Contributor
BRIDGE WG Data Exchange

Alberto Dognini
Energy Ecosystem Coordinator
OPEN DEI

Nikos Bilidis
Project Coordinator
INTERRFACE

Digitalisation of Energy

Data exchange and governance

16 November 2022

Rolf Riemenschneider
Head of Sector IoT
DG CONNECT/E4
European Commission

Digitalising the energy system - EU Action Plan

EUROPEAN COMMISSION

Strasbourg, 18.10.2022
COM(2022) 552 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Digitalising the energy system - EU action plan

{SWD(2022) 341 final}

European Commission

Visionary use-case for sector coupling: Energy connected to Electromobility and Smart Buildings

Renewable Energy

Sector-Coupling

Optimisation of renewable energy production and usage

Bi-directional EV-charging

Smart Home and Buildings

Delivering a fair and green deal for consumers:

- Market push through e-Mobility
- Efficient integration of renewables
- Integrated smart home/building services through IoT
- Storage / EV batteries to mitigate peak capacity

Digital Infrastructure investments:

- **Substitution** of fossil fuels by electricity et al.
- **Grid elasticity** through efficient operation
- Electric vehicle charging – grid integration
- **Agile consumers** to reduce energy consumption in buildings and ‚jump' on renewable sources

- **Connected and interoperable x-sector data services**

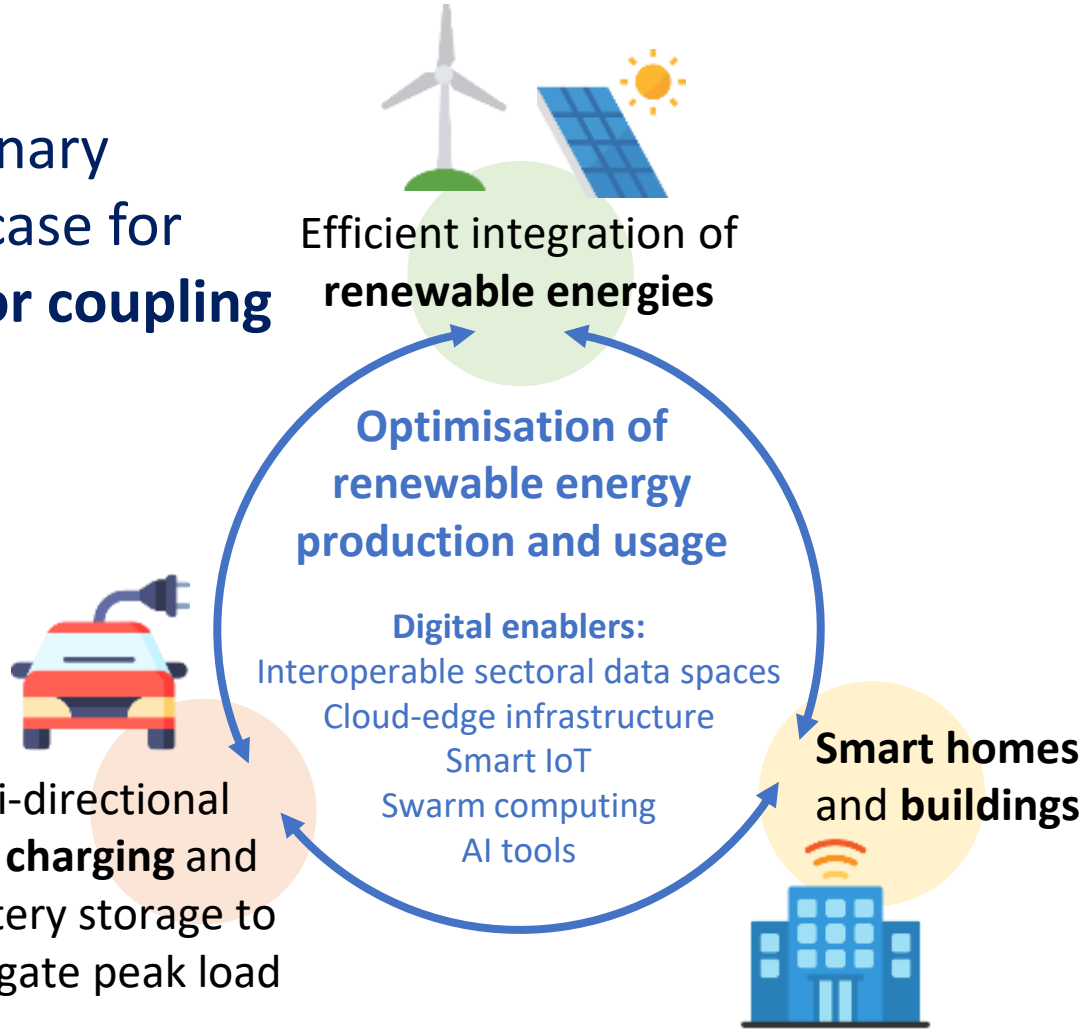
European Commission

Towards interoperable data spaces

Leveraging the **momentum**

- **BRIDGE Data WG**
- **GAIA-X -** energy data space
- Converging guidelines: **Open DEI design principles for data spaces**

Visionary use-case for **sector coupling**



European Commission

Horizon Europe – preparing the ground

omega-x

DATA CELLAR

ener share

SYNERGIES

HORIZON-CL5-2021-D3-01-01: Establish the grounds for a common European energy dataspace

EDDIE
EUROPEAN DISTRIBUTED DATA INFRASTRUCTURE FOR ENERGY

Timeline: 2022 - 2025

HORIZON-CL5-2021-D3-01-03: Interoperability community

int:net
Interoperability Network for the Energy Transition

European Commission

THANK YOU

Useful links:

- **European Data Strategy**:
  https://ec.europa.eu/digital-single-market/en/policies/building-european-data-economy

- **BRIDGE Framework**:
  https://www.h2020-bridge.eu/

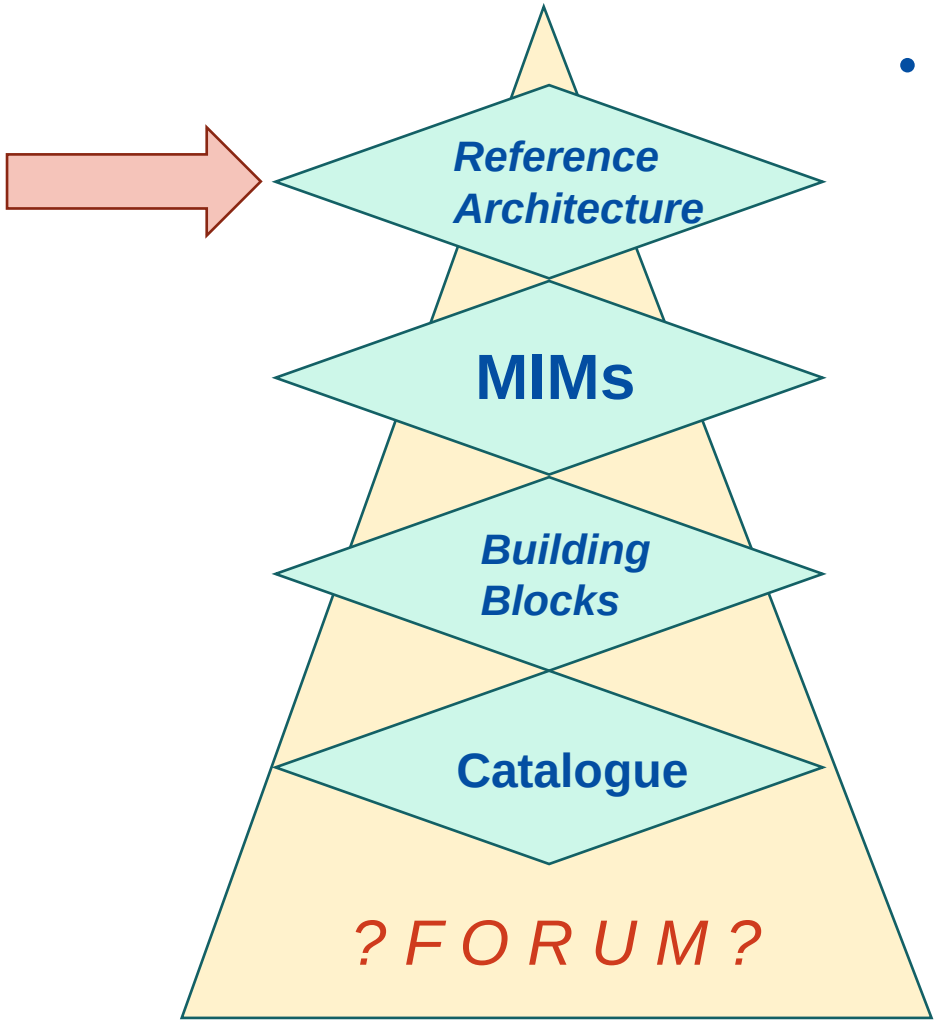
- **GAIA-X Initiative**:
  https://www.data-infrastructure.eu/GAIAX/

- Coordination & Support Action OPEN DEI
  → **https://www.opendei.eu/**

- Link on Europa: **Digitalisation of the energy sector**

BACKUP SLIDES

MIMS – Strategic Orientation

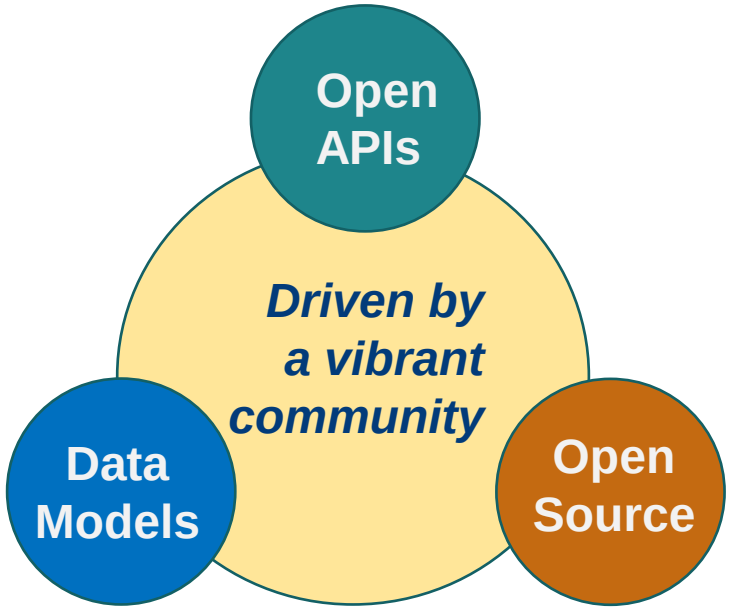


- ***Cornerstones for Data Spaces***

  are *Open Standards / APIs*:

  → build a vibrant community

  → agreed principles on governance & steering



- *Minimal Interoperability Mechanisms (MIMs)*

  .. are *pivotal points* of data interoperability:

  → *minimal but sufficient capabilities to achieve ('goud enough') interoperability of data, systems and services*

  → *development of a viable market – cutting costs, minimising risks and preventing vendor-lock-in*

European Commission

Panel discussion #1

Making the difference through data exchange

INTERRFACE

Moderator:

Rolf Riemenschneider
Head of sector IoT
DG CNECT

Konstantinos Kotsalos
Contributor
BRIDGE WG Data Exchange

Alberto Dognini
Energy Ecosystem Coordinator
OPEN DEI

Nikos Bilidis
Project Coordinator
INTERRFACE

Active poll

0

Join at

slido.com

#INTERRFACE

1) On a scale 1-5, how critical are the barriers data exchange issues impose on enabling flexibility sources?

1 - Not critical at all 5 - Extremely critical

Score: 0.0

1	2	3	4	5
0%	0%	0%	0%	0%

Panel discussion #1

Making the difference through data exchange

INTERRFACE

Moderator:

Rolf Riemenschneider
Head of sector IoT
DG CNECT

Konstantinos Kotsalos
Contributor
BRIDGE WG Data Exchange

Alberto Dognini
Energy Ecosystem Coordinator
OPEN DEI

Nikos Bilidis
Project Coordinator
INTERRFACE

Aimilios Orfanos

General Manager

ReVolta

INTERRFACE Succes Stories #1

INTERRFACE

“Make the most from batteries”

Our mission: provide digital tools for sustainable & affordable storage

Revolta

Expertise in storage and energy management for energy-intensive industries

ReVolta is an engineering firm, specializing in software for management of energy asset.

Team of engineers/developers, located in Belgium and Greece.

ReVolta's engineers help companies reduce their energy bill by using their expertise in **management of energy storage and demand response assets.**

We use software tools to leverage your asset's **energy flexibility and optimize your consumption and produce white-label software solutions on-demand.**

Key skills

- Energy Storage
- Demand Response
- Energy Management Software
- Forecasting & Optimization
- Artificial Intelligence

StoreNet value creation

StoreNet enables batteries to provide **behind-the-meter services together with services to electricity grid operators. It connects storage to market platforms, while increasing battery lifetime.**

Behind-the-meter services

- Peak-shaving
- Load-shifting
- Own consumption From renewables
- Backup

Grid services

- Ancillary services (FCR, aFRR, mFRR)
- Balancing market
- Voltage regulation
- Black-start

Energy markets

- Sell energy in the DA/ID market
- P2P trading
- Real-time Power Purchasing Agreements (PPA's)

Functioning principles

Forecast

- Energy market prices
- RES production
- Local consumption
- Backup needs

Optimise

- Objectives: maximize revenue + battery life
- Constraints: power output, client needs
- ➔Schedule optimal capacity allocation

Perform

- Execute applications through edge programming logic
- Applications stack in real-time

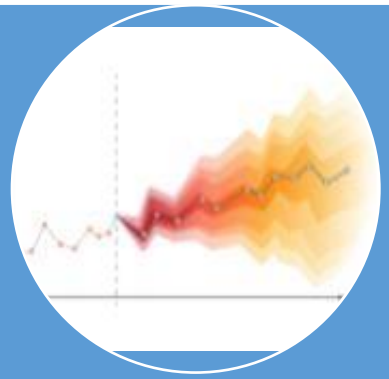
ReVolta’s technology stack

EdgeNet controller

Plug&play interoperable gateway for battery monitoring & control. Its edge intelligence algos allow scheduling the battery’s use in various applications. Its fully containerized firmware can be hosted in any simple RaspberryPi hardware. EdgeNet allows to connect to the ReVolta pool but is also able to interface with local EMS’s through an API.

ReVolta cloud

ReVolta’s cloud includes a back-end and front-end that enables optimal scheduling & management of the batteries.

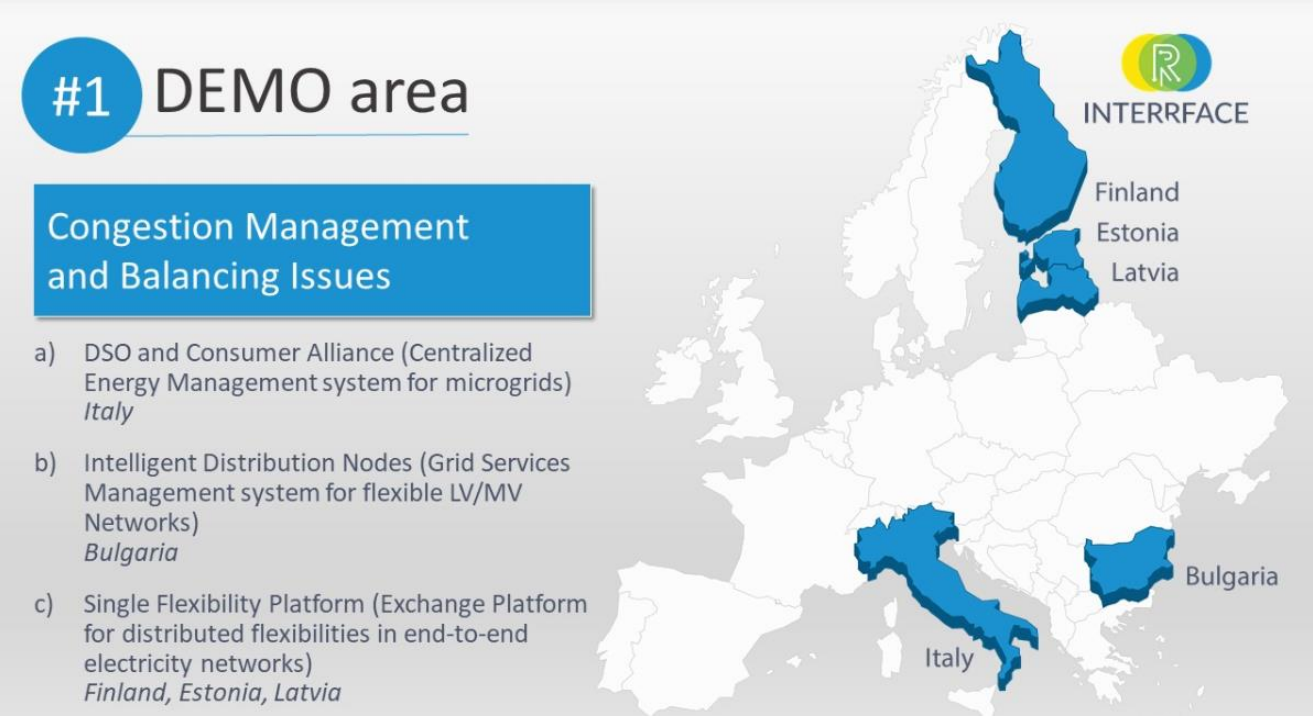


OptiSchedule

OptiSchedule allocates battery capacity in DA and ID and maximizes the battery’s generated revenue. OptiSchedule forecasts & models the battery’s scheduled use and uses it to optmise asset consumption & flexibility.

Factsheet for INTERRFACE

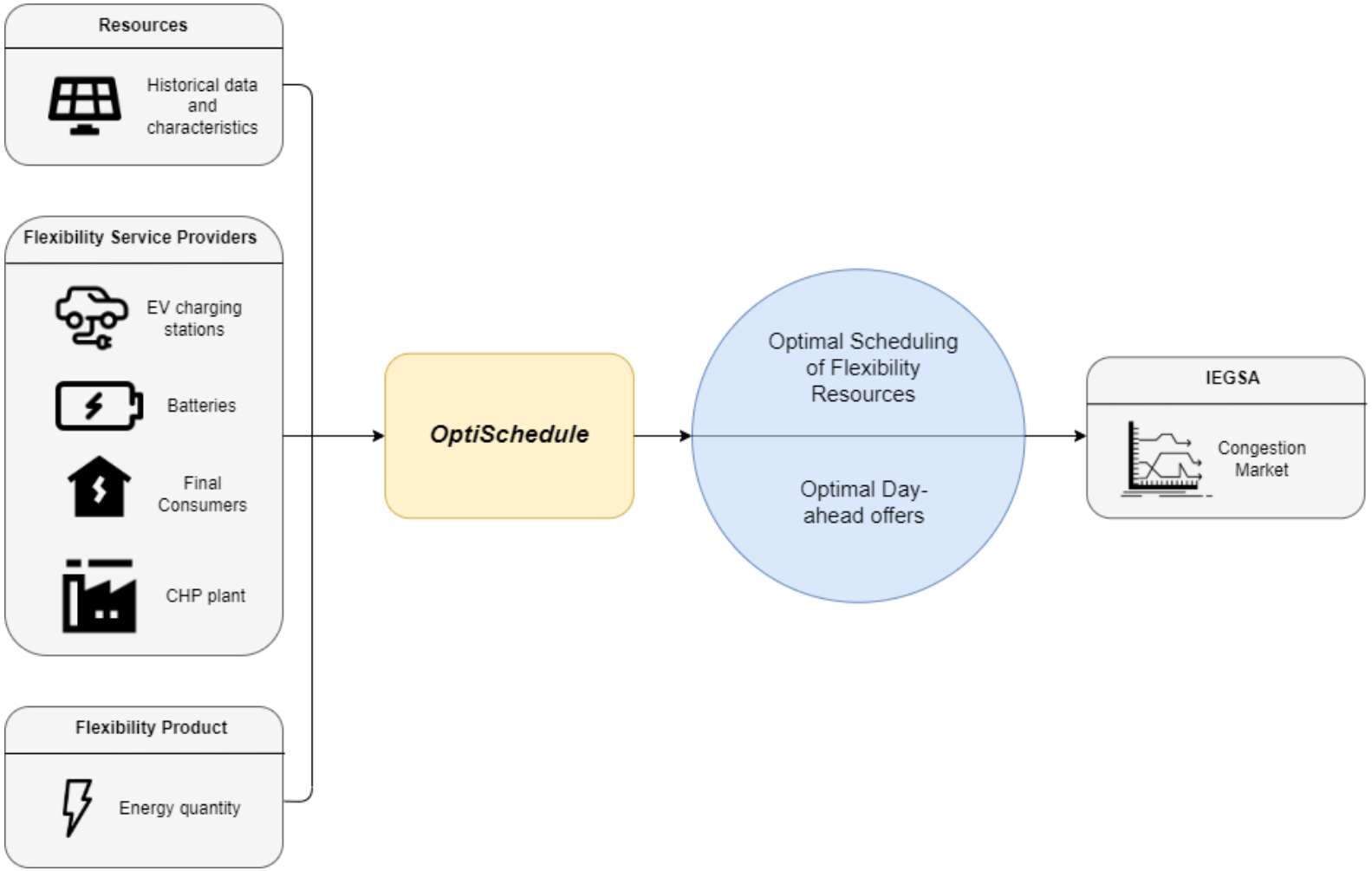
- Use case: Congestion Management and Balancing Issues
- Demo area #1: Osimo, Italy
- Partner: ASTEA
- Application developed: OptiSchedule
- Forecast & optimization to offer flexibility to alleviate congestion
- Assets managed: CHP, EV charging stations, batteries



Project objectives

- To build a platform that would unlock flexibility from distributed assets for DSO's
- To assess flexibility potential of different types of assets
- To create end-to-end solution that could fit any market context

Connection to the IEGSA



Achievements / Lessons Learned / Value added

- Achievements
  - Creation of end-to-end platform for optimization ➔ new product!
  - Successful modeling and management of 4 types of assets
  - Discovery and demonstration of interesting flexibility potential for DSO's
- Lessons learned
  - Distributed flexibility has a great role to play in managing the grid
  - Interoperability and standardized communication between partners is key
- Value added
  - With OptiSchedule and IEGSA, the DSO can tap into a huge flexibility potential
  - With OptiSchedule ReVolta has added a new service for its clients

Sebastien Boi - Floris Vankrunkelsven

Accounts & Operations Manager - Consultant

PulseLabs

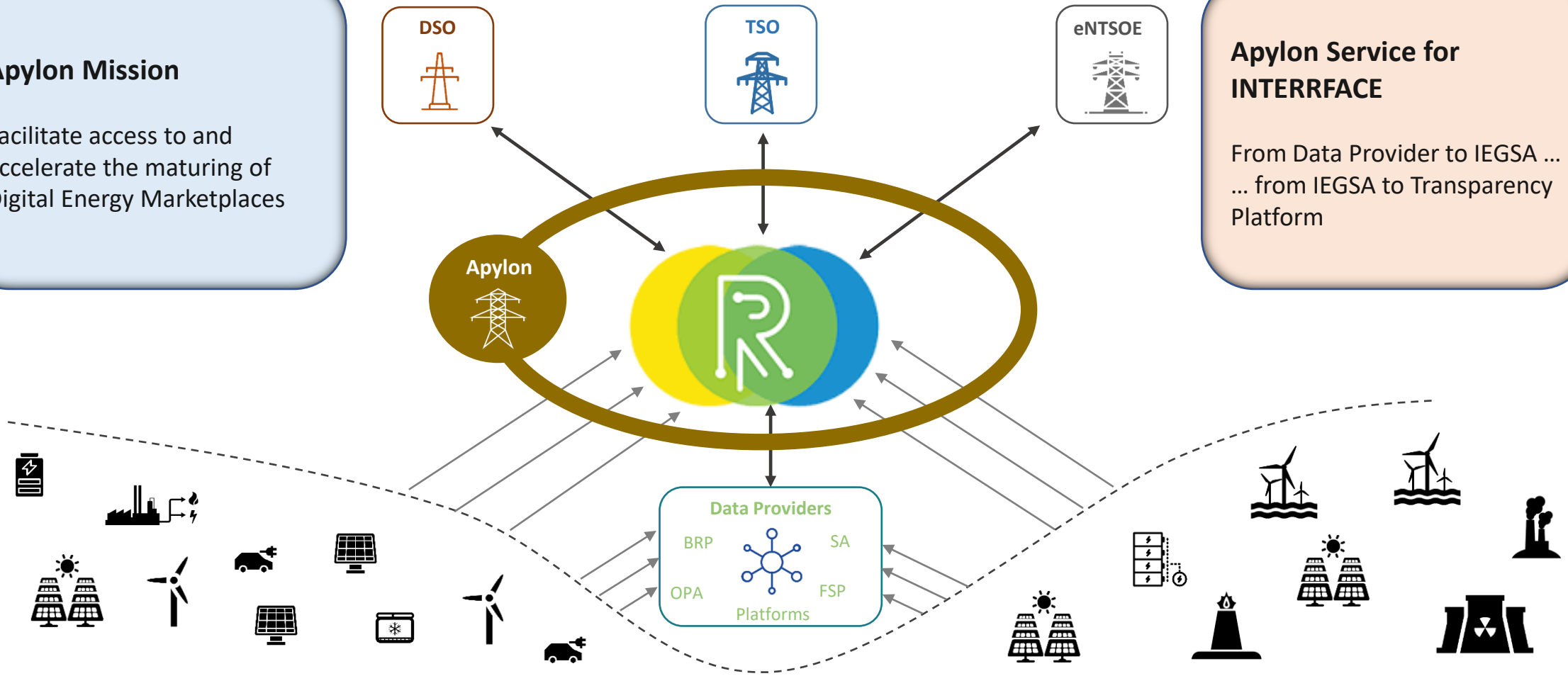
INTERRFACE Succes Stories #2

INTERRFACE

Digital energy market integration with Apylon

Apylon Mission

Facilitate access to and accelerate the maturing of Digital Energy Marketplaces



Apylon Service for INTERRFACE

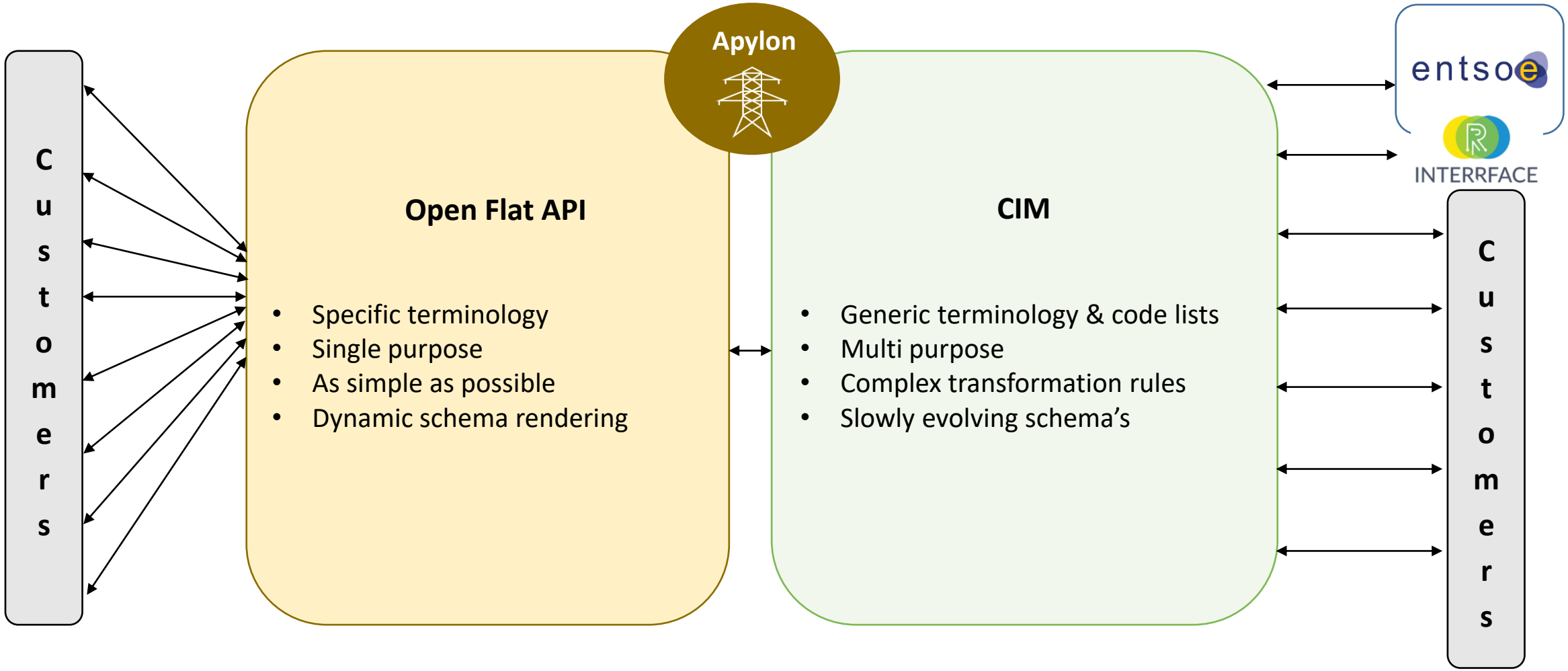
From Data Provider to IEGSA …
… from IEGSA to Transparency Platform

www.apylon.eu

Objectives

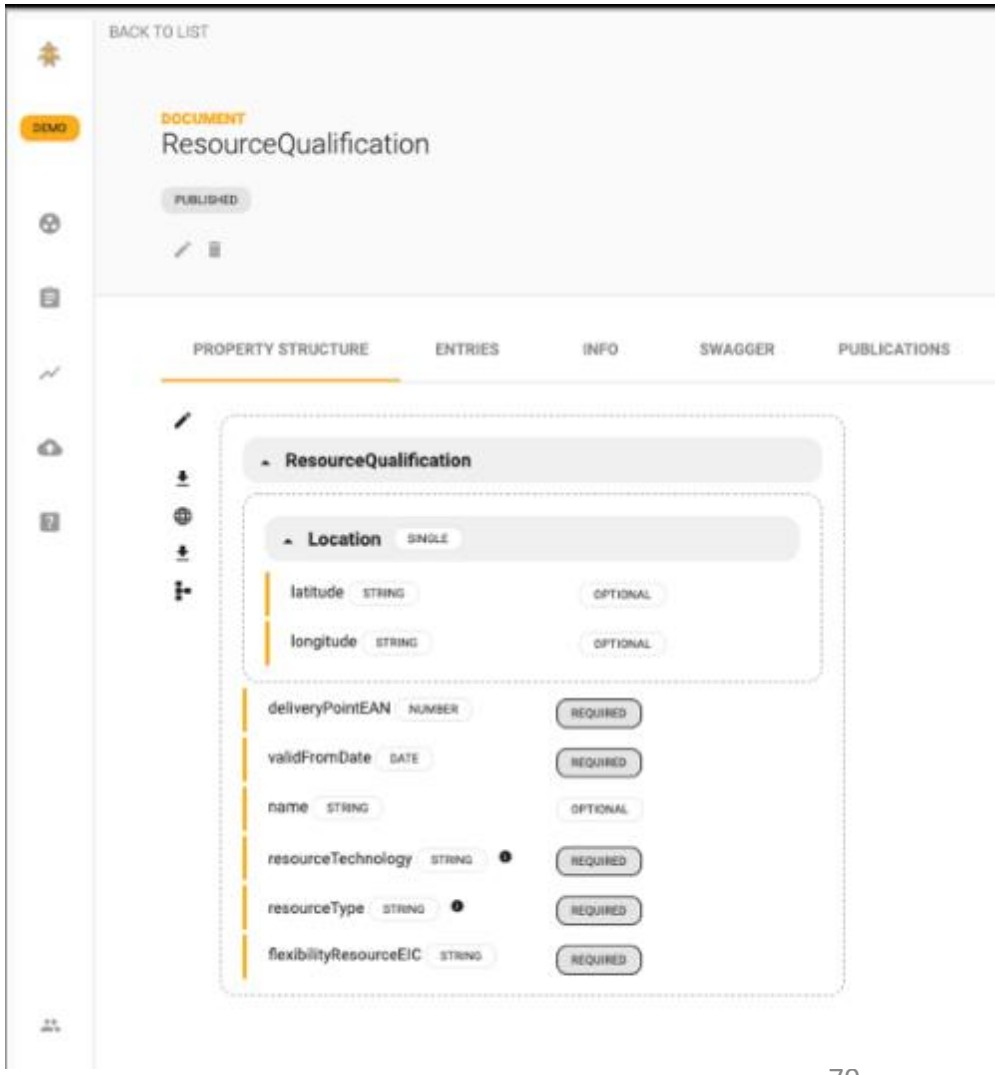
- Decrease integration complexity for CIM data providers
- Decrease time to market for new CIM profiles
- Experiment with useful flexibility data sets for transparency
- Foresee component IEGSA can integrate in its architecture

Data transformation to CIM and back



Achievements

- Cautious not to add complexity on top of generic CIM standard
- Agnostic and reusable logic
- MVP application and UI developed
- Latest and opensource technologies:
  - OpenAPI
  - Azure Blob storage
  - JSONata
  - Node-red ETL



Coffee break

INTERRFACE

Kalle Kukk

Work Package 5 leader INTERRFACE

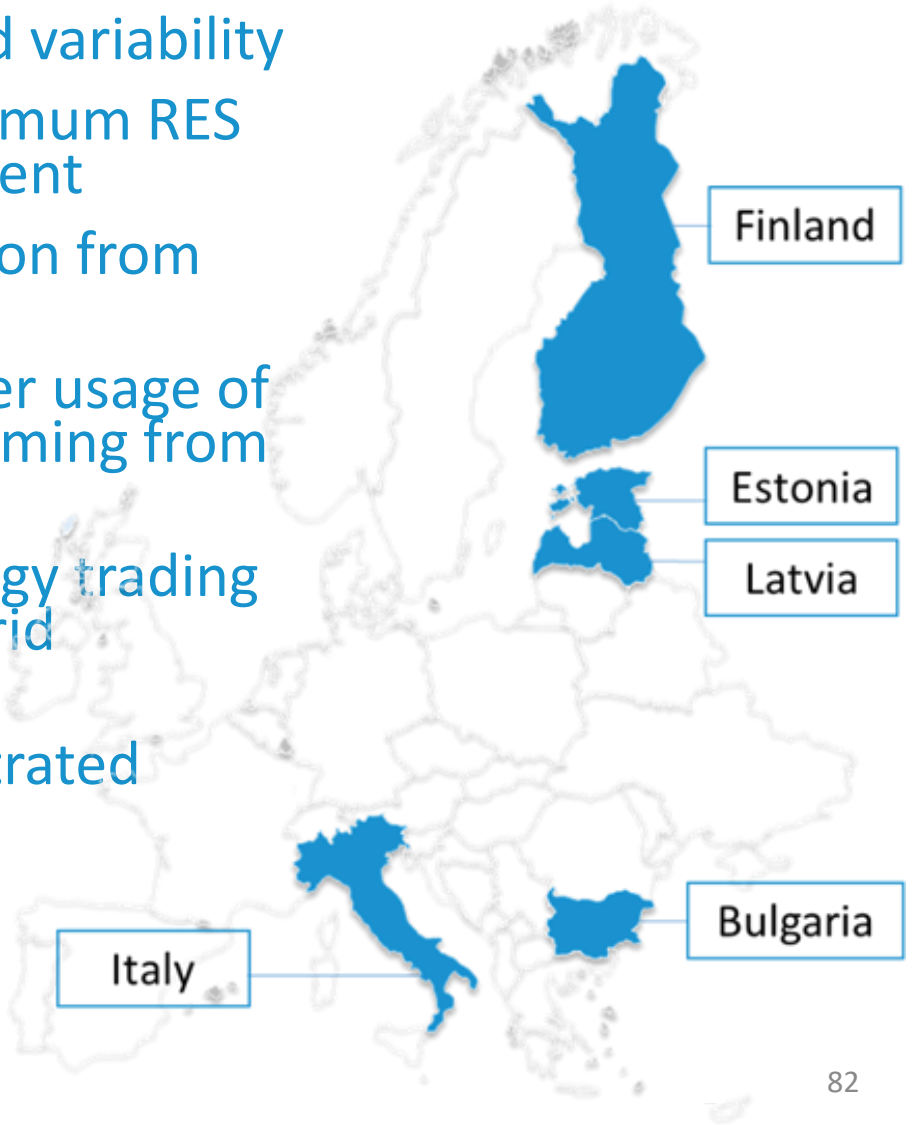
Elering

Demo area #1: Congestion Management & Balancing

INTERRFACE

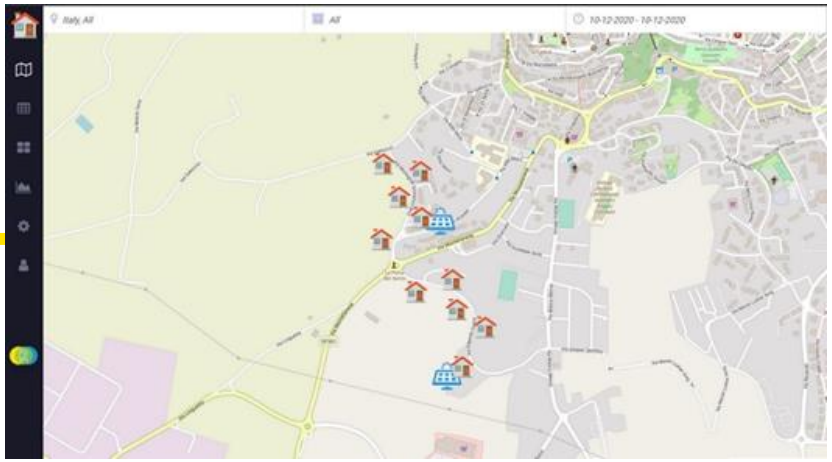
Objectives

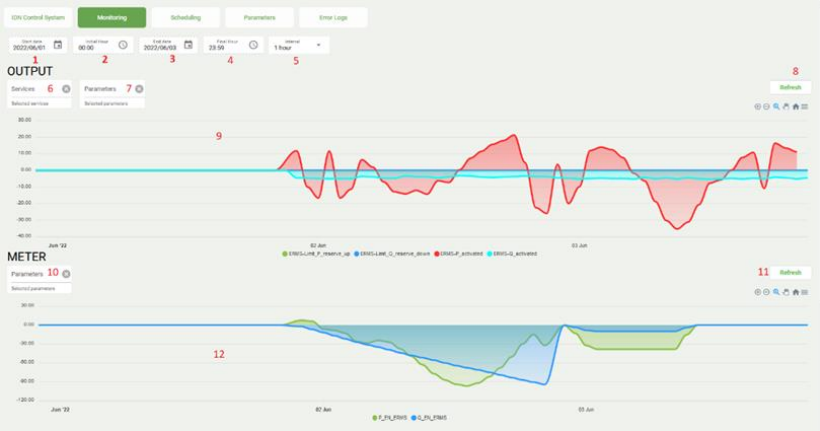
- Improve network reliability and alleviate net load variability
- Implement demand response strategies for maximum RES self-consumption and electricity flows management
- Demonstrate balancing services common provision from active control management of building sites
- Demonstrate a common platform for cross-border usage of frequency/balancing management services stemming from the distribution network resources
- Provide an applicable common platform for energy trading among market participants that allows flexible grid connections of DERs with minimum investments
- Evaluate different business cases of the demonstrated solutions and review the added-value provided

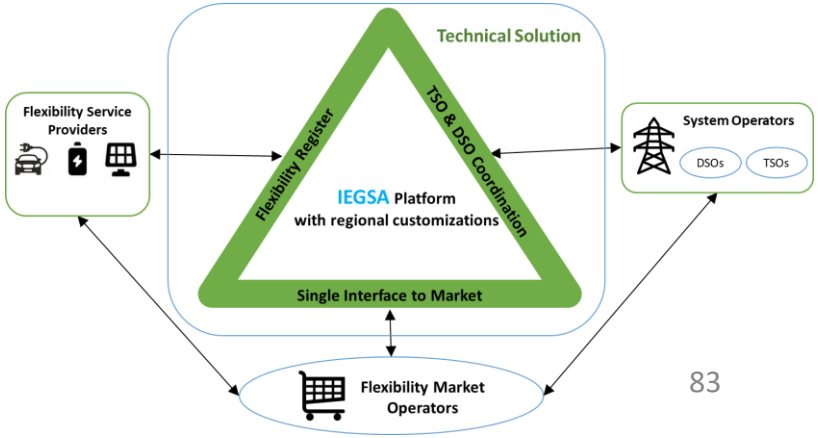


Scope of the demonstrators

- DSO and Consumer Alliance
  - ➢ Flexibility achievable in the MV/LV network featured by high share of RES; large users (CHP/district heating plant) + aggregator (battery aggregator) + Local Energy Communities (LEC) controllable loads, batteries
- Intelligent Distribution Nodes
  - ➢ Optimising demand and minimizing energy costs of buildings; extra income to flexible buildings by providing services to system operators; big data analysis and forecasting
- Single Flexibility Platform
  - ➢ Market Platform for distributed flexibilities; regional solution for several countries; balancing and congestion management products; data interoperability







Innovation

- TSO-DSO coordination processes to enhance power quality on the TSO/DSO networks, e.g. PTDF-based grid impact assessment, multilevel optimisations
- Technical solution (IEGSA) and data management (extensions to Common Information Model, usage of cloud platform) adaptable to different geographical and business conditions
- New flexibility products, e.g. operational congestion management
- Solutions satisfying the requirements of planned demand response network code and digitalisation action plan
- Testing of the solutions with real markets (distributed assets, municipal scale minigrid managed by DSO, regional Nordic market), stakeholders (aggregators, local energy communities, residential users, independent market operators) and data (grid data, metering data, market data)

Results and lessons learned

1. Congestion management is doable with existing market places – by connecting the physical world to the market processes. However, novel flexibility products still need to be implemented in real life.
2. Local energy communities and independent aggregators can be a way for both in achieving a greener Europe and in engaging final users/prosumers. Providing the services, while optimising the consumption pattern. Reliability of FSPs needed though – availability of flexibilities, monitoring.
3. End-to-end testing of common IEGSA platform for consumers, communities, aggregators, MOs and SOs. However, smooth integration of different systems and flexibility of digital platforms is needed („Common Data Space“?).
4. Data standardisation, availability and sharing of data are needed – grid data, metering data, incl. sub-metering. Consent management mechanisms need to be in place for private data. However further interoperability is needed (reference models like CIM, HEMRM in data interoperability implementing acts?).
5. Coordination between SOs and FSPs could help to mitigate congestion management issues in the DSO/TSO networks allowing to postpone investment in the network infrastructure. Novel optimisation algorithms will be required, e.g., based on PTDF approach, near-real-time data.

Impact achieved

- ✓Engagement of distributed flexibilities, incl. storage, residential loads
- ✓Attracting independent aggregators to the market, effective interaction with the market and system operators
- ✓Improved TSO-DSO cooperation
- ✓Improvement of quality in the DSO network
- ✓Defining the role of small DSOs in the future seamless pan-European market
- ✓Contribution on the role of energy communities in engaging final users and in promoting renewables at local scale
- ✓Extended economic opportunities and market participation of distributed resources

Uršula Krisper

Demo 6.2 leader INTERRFACE

Elektro Ljubljana

Demo area #2: Peer-to-peer trading

INTERRFACE

Task 6.1 “Asset-enabled local markets”

- To provide data-driven, simulation-based demo of a realistic local asset-enabled energy market, where transactions beneficial for the distribution grid are facilitated via dynamic pricing (DNUT – dynamic network usage tariff).
- The state of the network is monitored by the Integrated Asset Condition Management system (IACMS), which allows real time estimation of a component loadability values.
- The demonstration of a local market was simulated at 3 sites (2 HUN, 1 SLO), local distribution system operators are involved to provide grid and consumption/production data.

- Establish the theoretical and computational background of an asset enabled local electricity market platform
- Define the structure and elements of the IT implementation
- Establish data connections towards the demo sites (DSOs)
- Establish data connections towards the Interrface‘s IEGSA

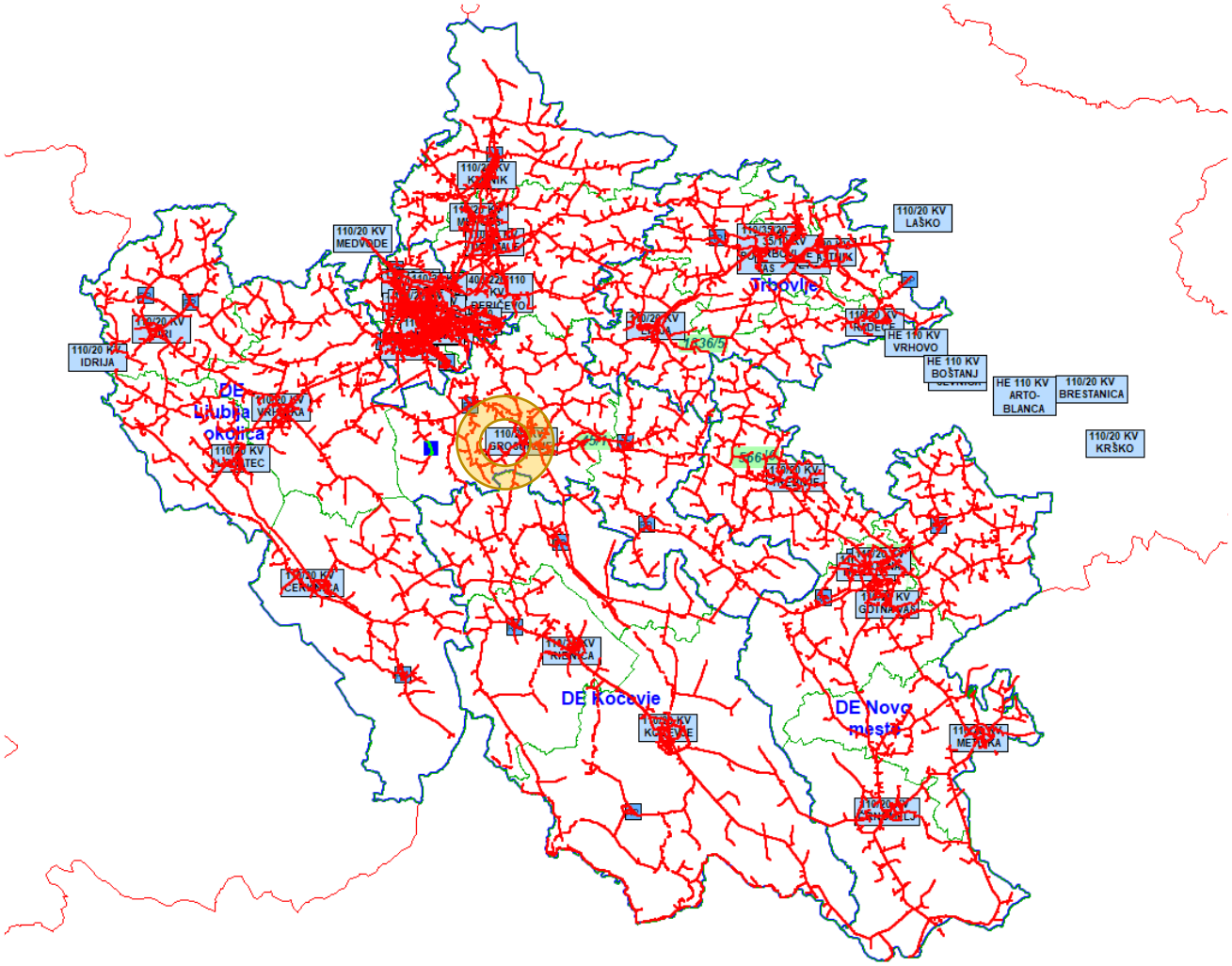
Local market concept

- **Continuous peer-to-peer trading** platform in the **intraday** timeframe
  - 15min (could be also 60min) energy products with **locational information** (place of grid connection)
  - Gate opening: on D-1 afternoon
  - Gate closure: close before delivery (e.g. H-1)
- **Dynamic network usage tariff (DNUT)** according to the actual network state and demo scenario
  - Bid prices are different in each node: energy price given by the seller + DNUT calculated by the market algorithm based on expected effects (e.g. on the grid loss, voltage, congestions, asymmetry)
  - Not automatic bid matching → bids should be hit
  - Anonymized trading is not obligatory
  - DNUT calculation is based on load-flow like calculation
  - DNUT can have different tariff elements, all mainly based on the grid effects as well as on related parameters such as the distance of partners, time of network use or the frequency of network use
- The market algorithm considers the grid limitations through an **IACMS** (Integrated Asset Condition Management System)
- Market participants: any local grid connected users

The demo sites

Selection of the demo areas:

- SLO: analyses on power network to identify the MV/LV transformers loaded close to the limits, while considering LV smart meters, the 15 minutes data availability
  - To enable trading: identification of RES, types of customers
  - Assets perspective: installation of the LISA and IMOTOL sensors,
- HUN:
  - NKM:
    - Full smart meter roll-out in the demo area
    - Household RES
    - Data center and sensor installations thus more information is available
  - E.ON:
    - High and increasing PV penetration area
    - 15min metering only at MV
    - include households → LV transformer district included



Task 6.1 Specifics on Slo demo

- Area of Substation Grosuplje (2nd): total number of the metering points 12.615. Two selected MV/LV transformer station supply with the electricity alltogether:
  - Households: 248
- RES:
  - CHP
  - Hydro
  - Solar 3, buil-inmicro solar power plant , it is connected behind the meter
  - Wind

SPODNJA BESNICA DRČAR 20/0,4 G-309	Number of metering points	Type of consumption: House holds	Type of consumption: other	RES
1.OB BREGU	12			
2.PROTI VNAJNARJEM	17			
3.PROTI ZALOGU	14			
4.ČEZ CESTO + J.R.	5			
GRADIŠČE 20/0.4 G-071	Number of metering points	Type of consumption: House holds	Type of consumption: other	RES
1.VIKENDI SMER BIFE BOR	20	18	2	0
2.OB GLAVNI CESTI	30	29	1	
3.KB.SPODNI HIŠI + J.R.	3	2	1 (public lightning)	
4.GRADIŠČE	8	8		
5.PROTI TP SMRJENE VIKENDI	40	40		2 (Solar behind rhe meter)
6.PROTI VRHU DESNO KO	[illegible]	17		
7.VIKENDI PROTI VRHU PSO1,2,3.	16			
8.PROTI VRHU DESNO+LEVO PSO	21	21		

Name of the MV/LV transformer station

Name of the feeder

Task 6.1 Specifics of the Hungarian (NKM) demo

Pilot project implementation in the MV/LV transformer circuit (Nr. 042-014) in Zsombó, Hungary

- ✓ 182 existing connection points for customers
- ✓ Total capacity of 74.3 kW of rooftop PV solar power plants owned by 11 prosumers
- ✓ Low voltage battery storage system of 30 kW/140 kWh capacity
- ✓ Current and voltage sensors for real-time conditions of the network
- ✓ Replacing the conventional measurements by smart meters (97% coverage)
- ✓ Public electric vehicle charger hub
- ✓ Developing a local control and data collection system
- \+ Increasing the PV solar power plants (~20 kW) and local battery energy storage (~6 kW) by controllable inverters

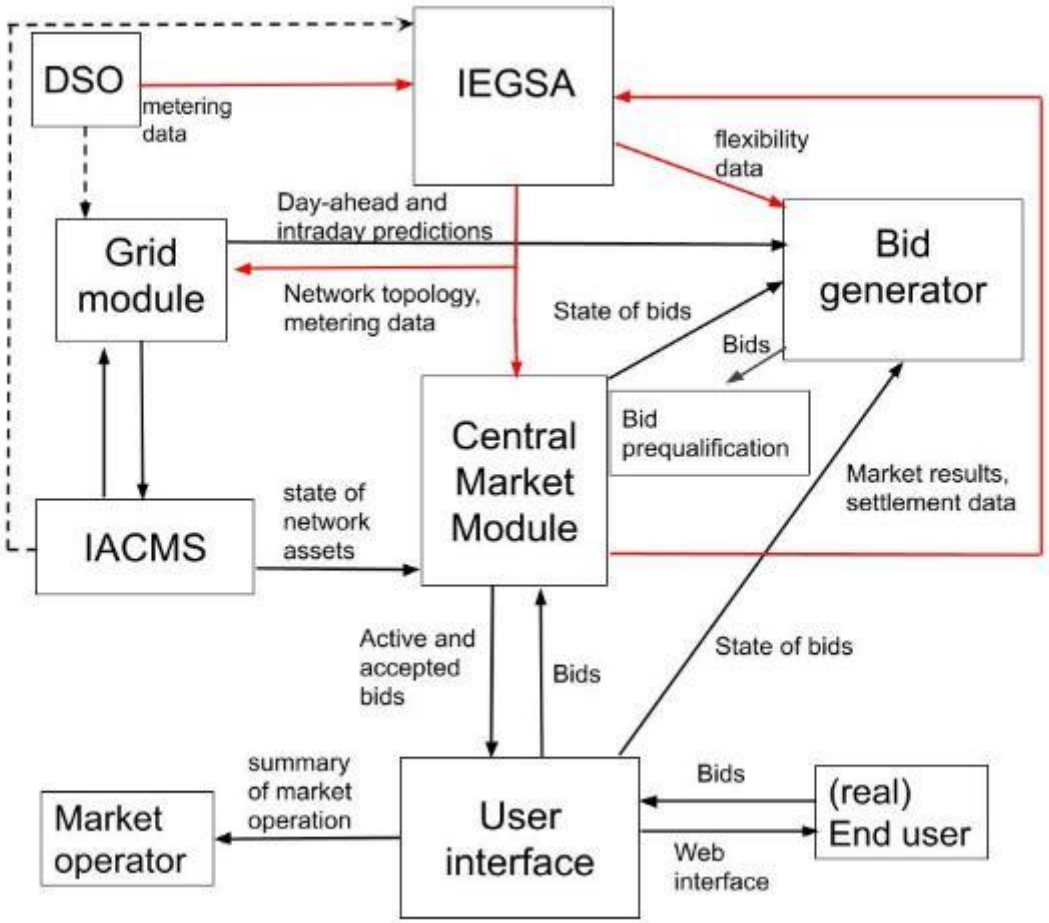
The E.ON HU demo site

Mohács-Belvárdgyula MV line

- Promising demo site because of
  - Increasing number of renewables
    - 1,5 MW PV is operating
    - 0,5 MW PV connection request is ongoing
  - Larger amount of booked capacity

- Beside of the PV penetration on the MV line, the LV network in Bóly also faces big challenge due to the proliferation of household size PV plants. Therefore one MV/LV tr. Supply area was included in the demo site.
- To enable trading: identification of RES, types of customers
- Assets perspective: line, transformer data, transformer condition information

Integration with IEGSA



Marked connections were established in the second part of 2021, after finall clarification of the integration with IEGSA.

Additional possible integration points are:

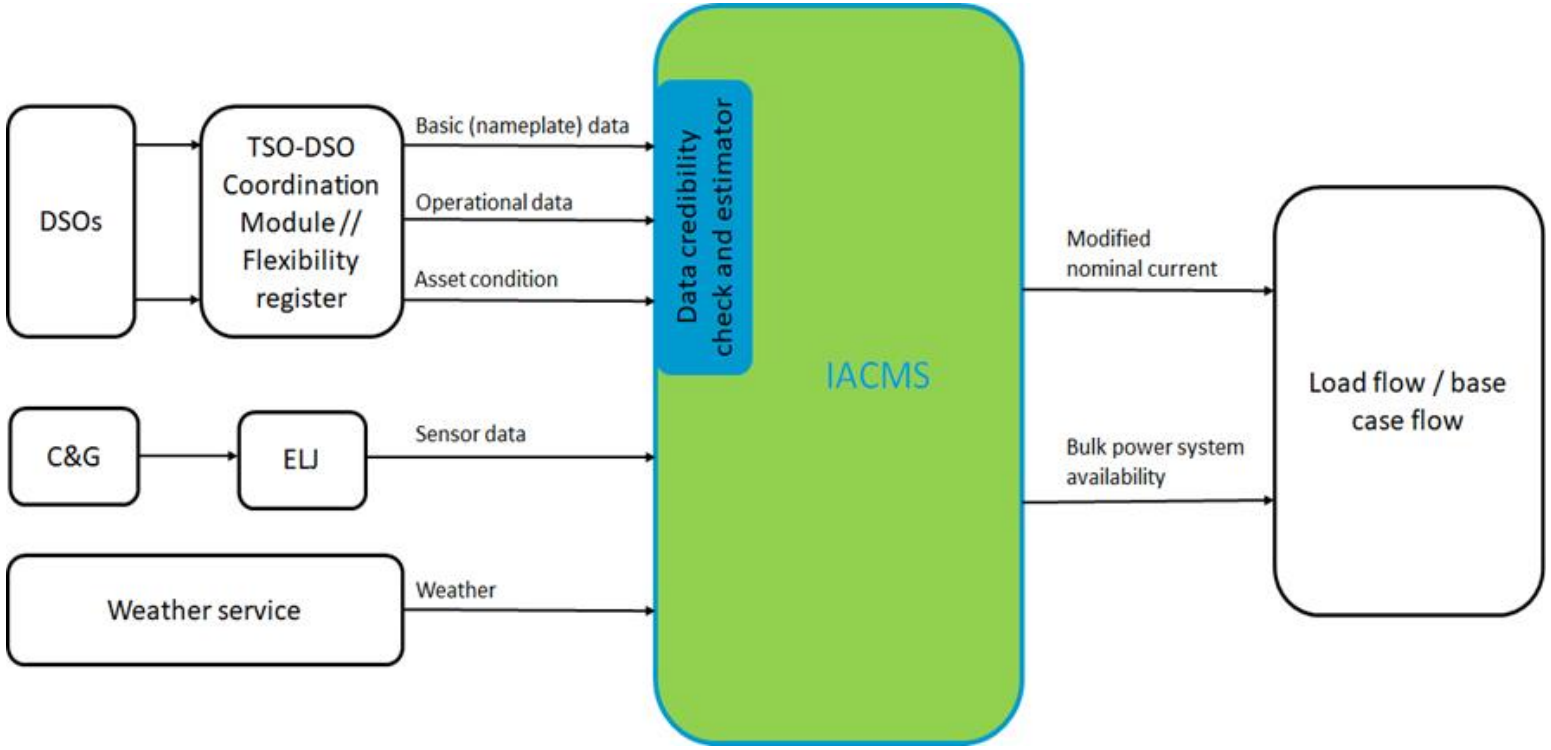
- user registration – flexibility register,
- for the TSO-DSO coordination, the additional information comes from grid sensors-IAMCS as
- market results (including settlement data) are presented to IEGSA through the UI of the market

Integrated Asset Condition Management System (IACMS)

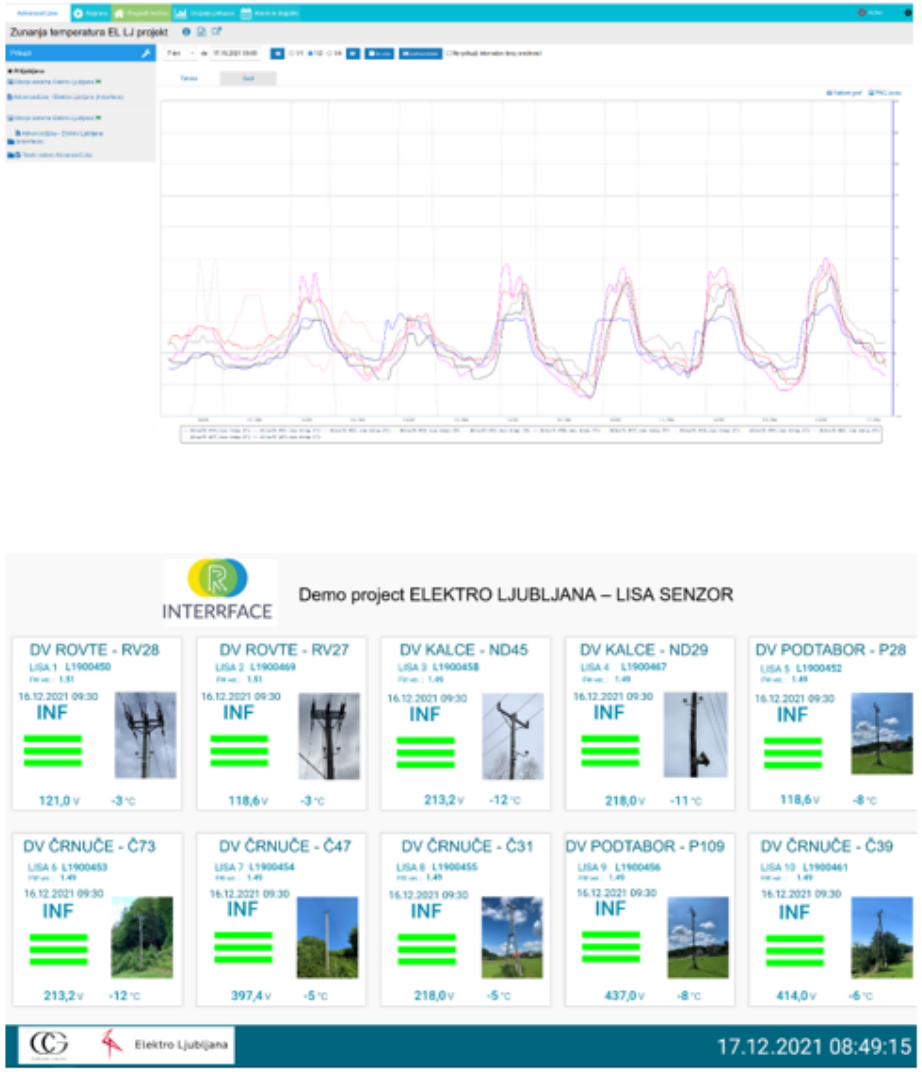
The role of the IACMS in the platform is to maintain safe operation of equipment while serving trading needs as much as possible.

This is achieved by modelling thermal behaviour of equipment and respecting aging procedure.

In the final prototype version IACMS algorithms are ready to simulate the response of real equipment such as cables, transformers, and overhead lines.



Quick detection of the place of failure on single circuit MV overhead lines– LISA Sensors



IMOTOL Sensors, Online Measurement of Stresses in Legs of Towers

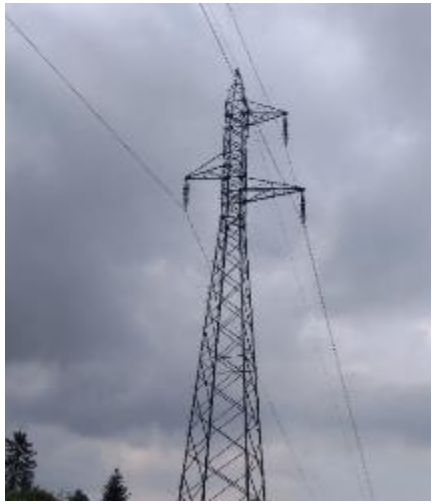
C & G D.O.O. LJUBLJANA

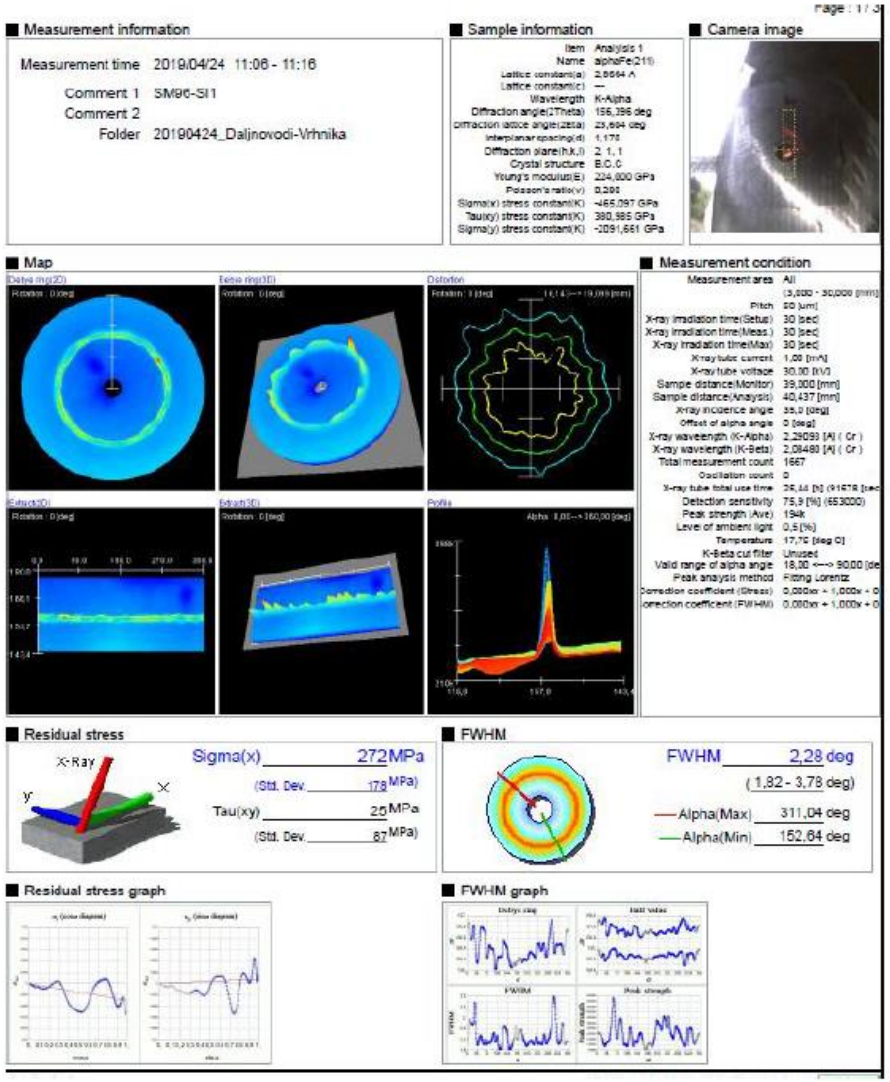
University of Maribor
Faculty of Mechanical Engineering

INTERRFACE

IMOTOL SENSOR

SENSOR	STATUS
SM96	
SM98	





Scenario summary

Several scenarios in meaning of detailed simulation running parameters were developed, an overview can be seen in table.

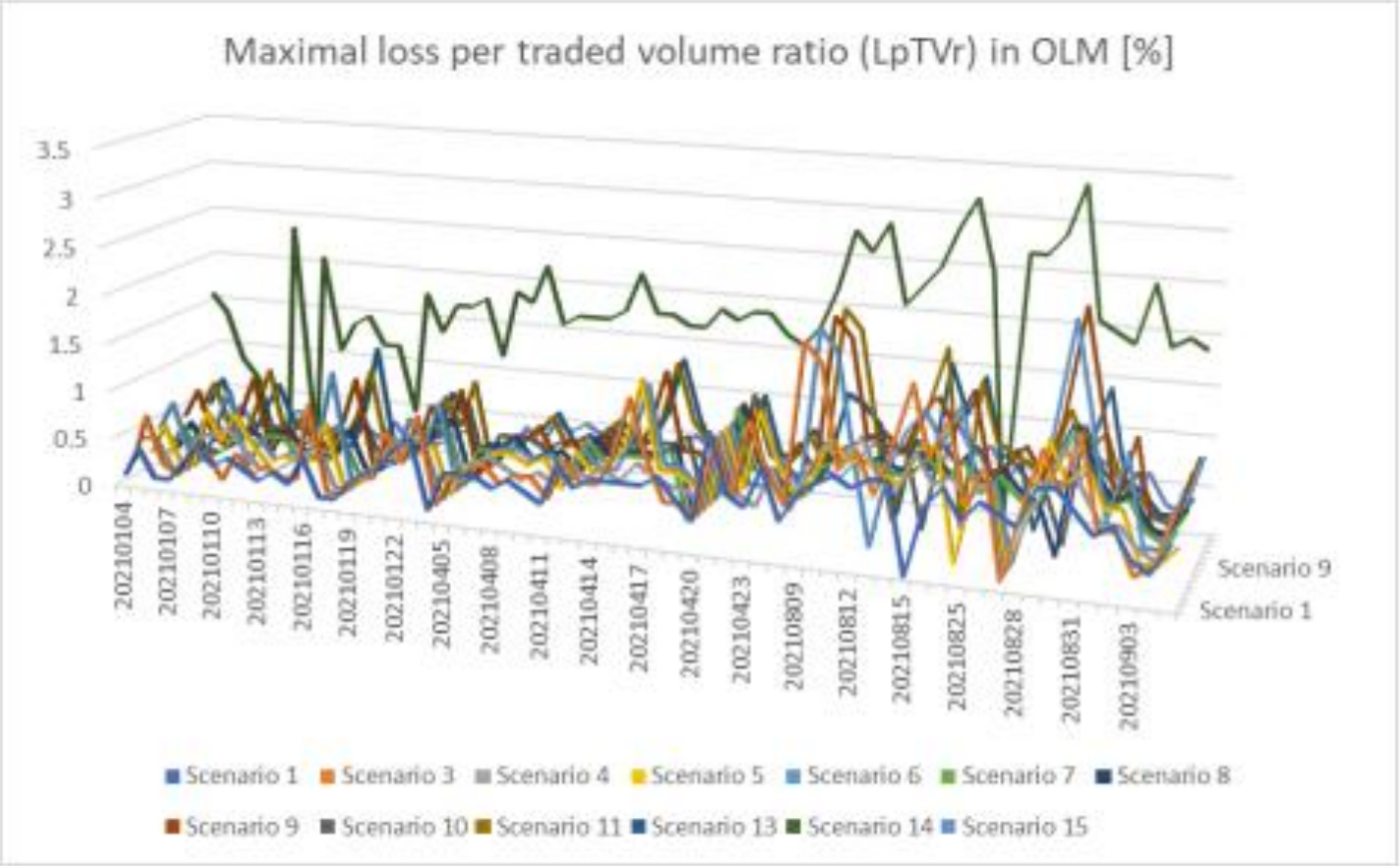
By developers, some scenarios were mentioned as dedicated for a pilot location and also recommended to be analysed by the DSOs.

Number	Start date	End date	Name (DNUT change / data availability change)
1	2021.01.04	2021.01.24	Base
2	2021.07.12	2021.07.25	Grid measurements included in the estimation
3	2021.04.26	2021.05.16	Shared DNUT
4	2021.05.17	2021.06.06	Fix DNUT for bidder, remaining for aggressor
5	2021.06.07	2021.06.20	Congestion management limit
6	2021.06.21	2021.07.11	Congestion management limit + punishment
7	2021.01.25	2021.02.21	Voltage limit in the DNUT
8	2021.02.22	2021.03.14	Voltage limit with DNUT punishment
9	2021.07.26	2021.08.15	Losses + congestion management
10	2021.03.15	2021.04.04	Losses + voltage limit
11	2021.09.06	2021.09.26	Losses + congestion management + voltage limit
12	2021.09.27	2021.10.17	Extra flexibility offers added
13	2021.10.28	2021.11.07	DSO storage use case 1
14	2021.11.08	2021.11.21	DSO storage use case 2
15	2021.11.22	2021.12.05	Asymmetry consideration test
16	2021.12.06	2021.12.19	Non-anonym bids, without automatic pairing
17	2021.04.05	2021.04.25	Base case for spring
18	2021.08.16	2021.09.05	Base case for summer
21	2022.01.03	2022.01.24	DSO congestion forecast test with increased base case flow

start date	end date	Number of the scenario in D 6.1	Name of the scenario	15min metering+ profiles	15min metering + (feeder-time series metering)	Loss off	Loss on	Loadability (CM)-IACMS off	Loadability (CM)-excluded trades over limit	Loadability (CM)-limit excludes trades + punishment close to limit	Voltage regulation (VR)-off	Voltage regulation (VR)-excluded trades over limit	Voltage regulation (VR)-excluded trades over limit + deadband punishment	Symmetric load distribution	Asymmetric load distribution	Order types-only metering (history) based	Order types-flexibility orders added	Order types-(extra DSO storage usa cases)battery for supply quality improvement	Order types-(extra DSO storage usa cases) battery as market facilitator	DNUT sharing (Who pays the DNUT)-agressor	DNUT sharing (Who pays the DNUT)-50-50% agressor and bidder	DNUT sharing (Who pays the DNUT)-fix cost for bidder + remainder by agressor	Anonymity and automatic matching-anonym with automatic pairing	Anonymity and automatic matching-non-anonym without automatic pairing	Comments
2021 01 04	2021 01 24	1	**Simplest case**	x			x	x			x				x	x				x	?		x		
2021 02 22	2021 03 14	8	VR limit + punishment test	x		x		x					x		x	x	?			x			x		
2021 05 17	2021 06 06	4	DNUT fix for bidder, remainder by agressor	x			x			x			x		x		x					x	x		
2021 06 21	2021 07 11	6	CM limit + pusihment test	x		x				x	x				x	x	?			x	?		x		
2021 08 16	2021 09 05	18	BC summer	x			x	x			x				x	x				x					test BC-n
2021 09 06	2021 9 26	11	**Loss+CM+VR**	x			x			x			x		x	x	?			x	?		x		
2021 09 27	2021 10 17	12	**Extra flexi orders -> expected BC!**	x			x			x			x		x		x			x	?		x		cancelled

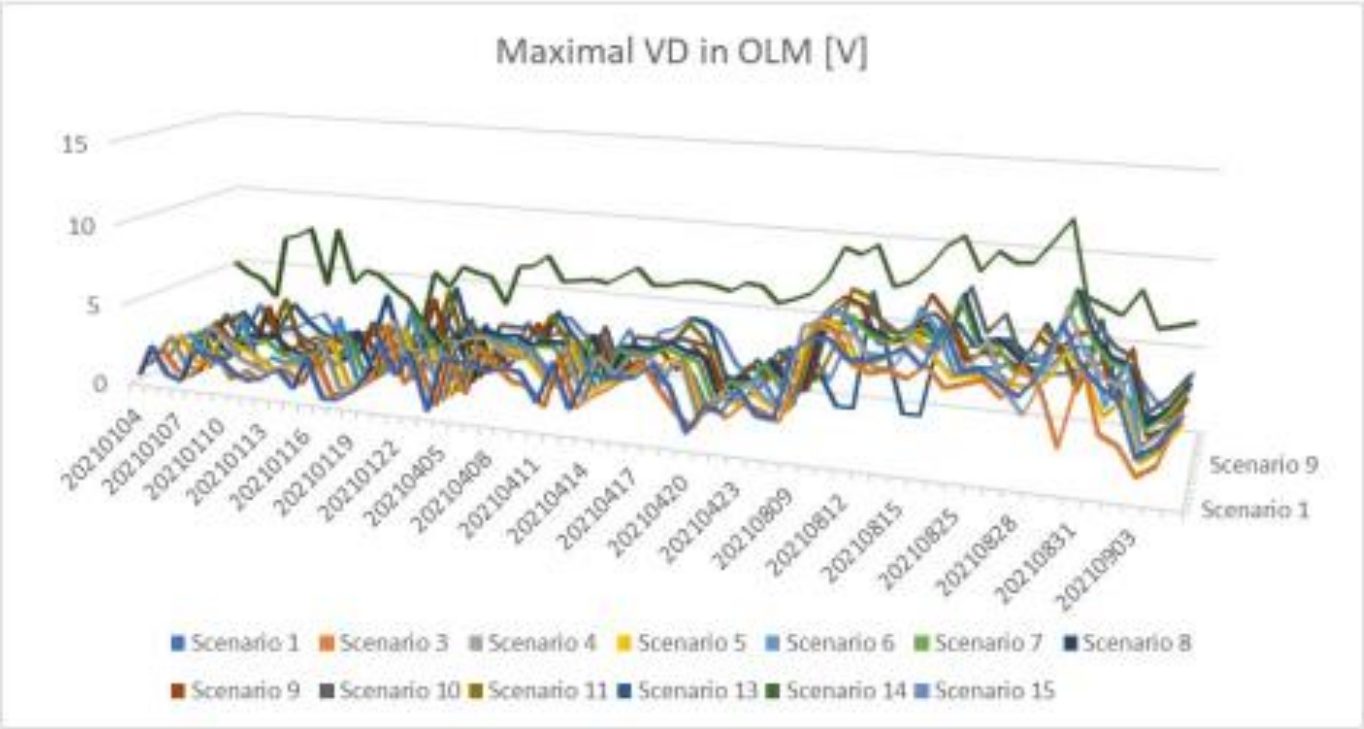
Pilot site in Hungary, the NKM, one of the results

- The maximal loss per traded volume ratio (LpTVr) in OLM (over trading periods where only local market (OLM) is active) [%] varied between 0% and 1.2% as displayed this Figure.



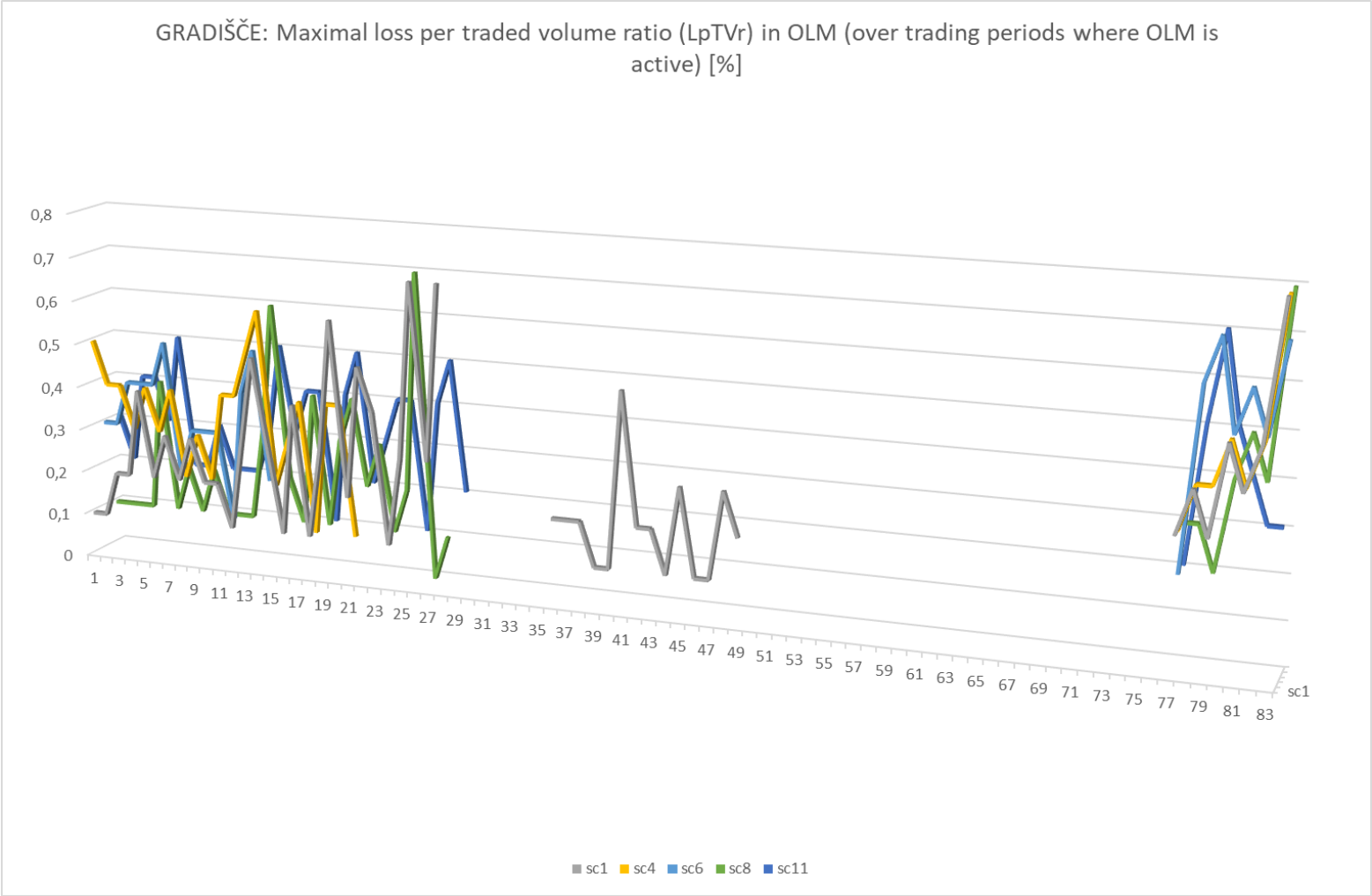
NKM

- This Figure shows the maximal voltage deviation (VD) in OLM [V] (over all prosumers and periods) varied between 1 V and 9 V. Mostly there are no significant differences between the scenarios here either. There is, however, one significant difference between the scenarios – as in scenario 14 the values are significantly higher, and at this level the voltage deviation could have a significant impact on the network.



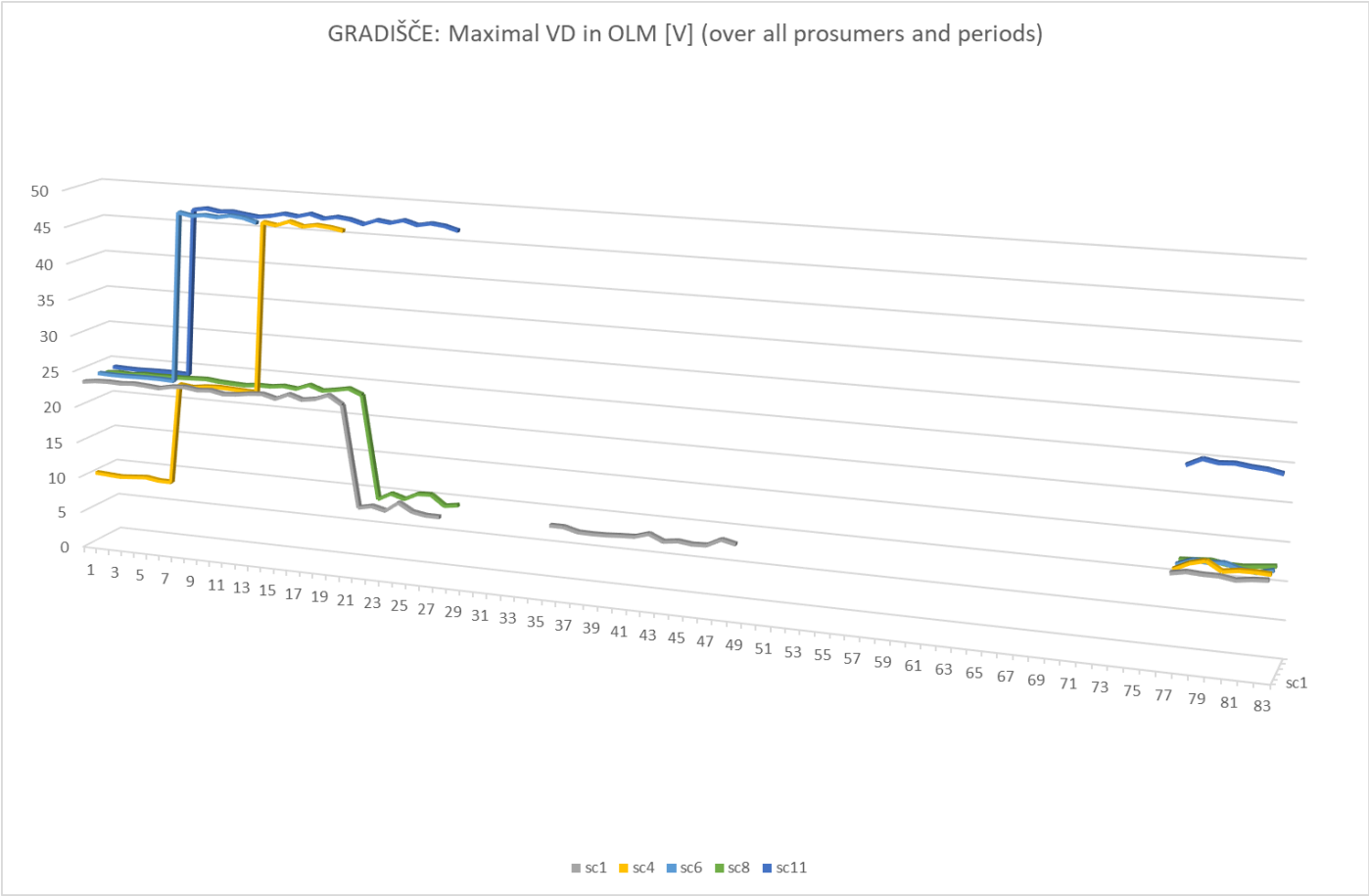
Slovenia, pilot site Gradišče

- The maximal loss per traded volume ratio (LpTVr) in OLM (over trading periods where only local market (OLM) is active) varied between 0% and 0,8%



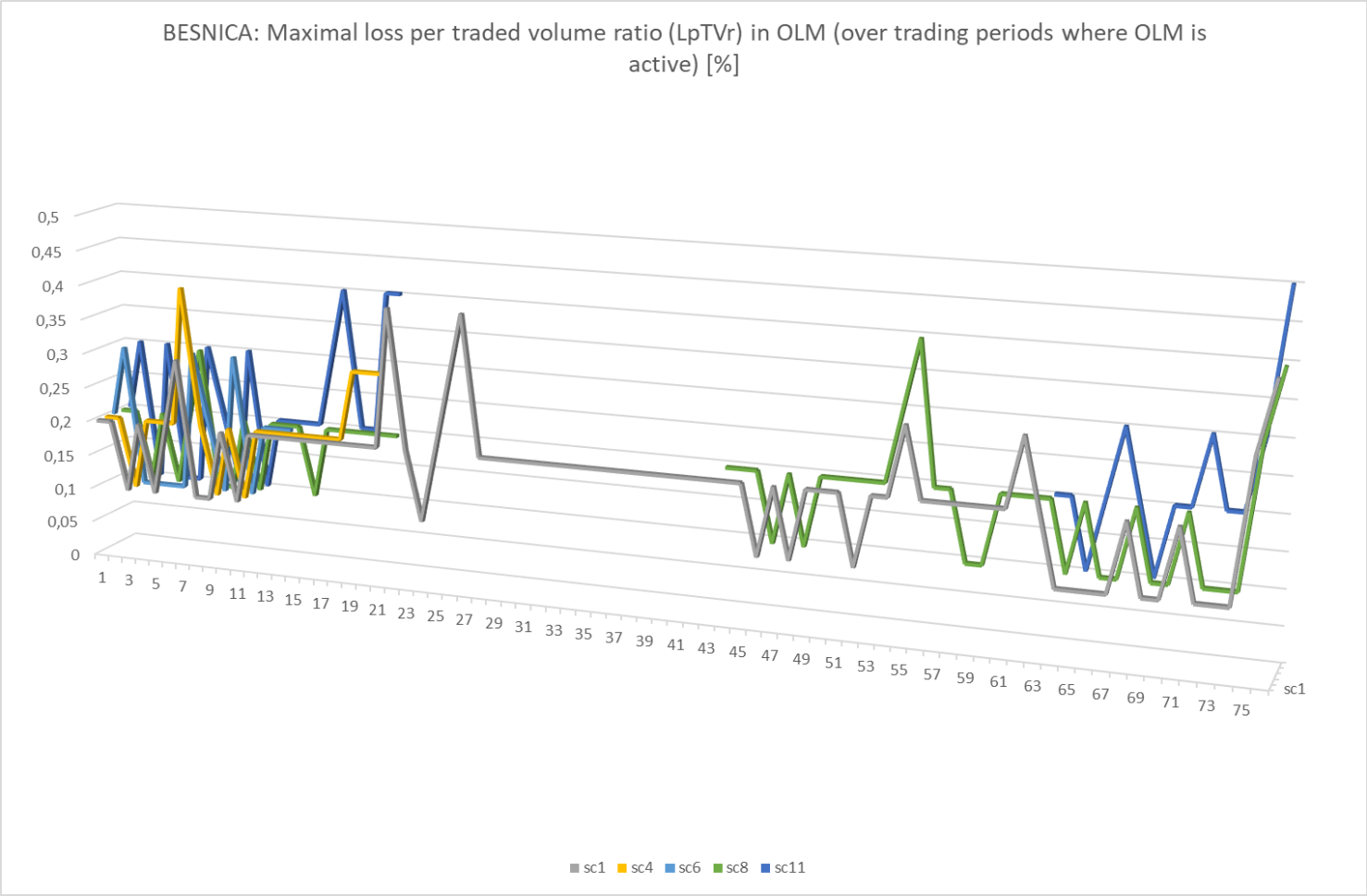
Slovenia, Pilot Site Gradišče

- This Figure shows the maximal voltage deviation (VD) in OLM [V] (over all prosumers and periods) varied between 9,238 V(scenario 8) and 47,37 V (scenario 4 and 11). There are significant differences between the scenarios. This level of voltage deviation could have a significant impact on the network.



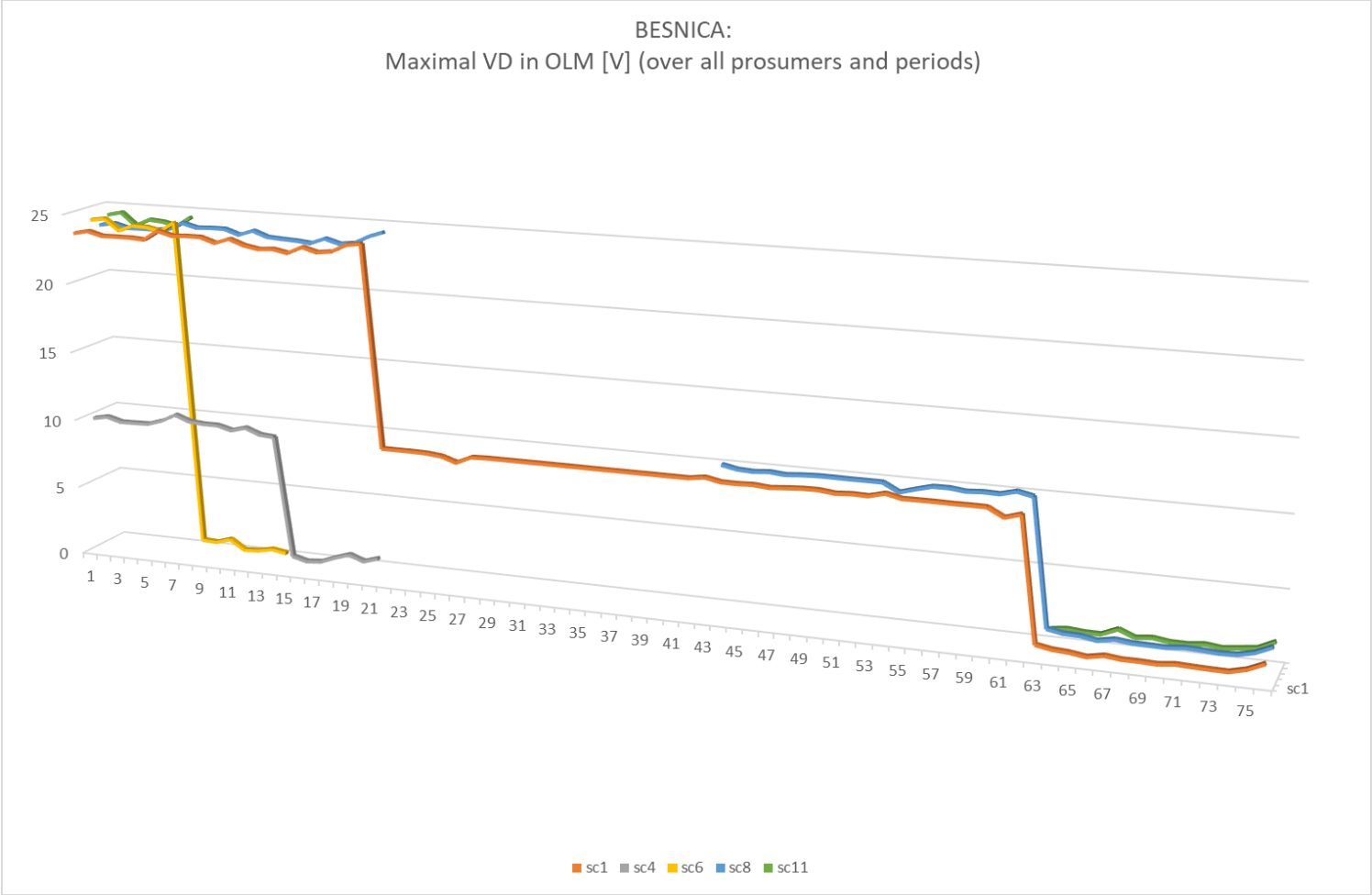
Slovenia, pilot site Besnica

- The maximal loss per traded volume ratio (LpTVr) in OLM (over trading periods where only local market (OLM) is active) varied between 0,1% and 0,5%



Slovenia, Pilot Site Besnica

- This Figure shows the maximal voltage deviation (VD) in OLM [V] (over all prosumers and periods) varied between 0,666 V(scenario 8) and 24,498 V (both in scenario 8). There are significant differences between the scenarios. This level of voltage deviation could also have a significant impact on the network.



Lessons learned and conclusion

- We can imagine that several local P2P markets will be established on the European level. The DSO will be obliged to provide the grid data as neutral entities. Even now, a provision of grid data as open data is required. Grid data will be requested from the Single interface to Market (IEGSA). In case of topology changes, an automatic function should be capable of handling it.
- Even now, electricity distribution companies have their oven “sign-in” web-based solutions. This enables registered grid users one-point access to their data and to communicate with their local DSO (connection, meter, main fuses.., interruptions, electricity quality). Our simulated P2P market also established the user interface, and the local market platform acknowledges or refuses user registration. The registered user is recognized through his grid connection point and other data (e.g., user limit, profile type). The verification process is based on a database provided by the DSO as part of the initialization listing the users with connection points and other parameters stored in the flexibility register of the IEGSA platform.
- The DSOs will upload metering data using the Coordination Platform (Single interface to market) to the IEGSA. The historical metering data will be available in the flexibility register of the IEGSA platform.
- Regarding the DSO’s assets management: for instance, currently implemented sensors provide information to the distribution system operators (operating IACMS) about the status of each phase of the overhead lines. IEGSA will inform TSO about problems identified by the IACMS through the TSO-DSO coordination module.
- The market results will be sent to the IEGSA and stored in the flexibility register. In addition, they will be forwarded to the settlement unit as well.

Demo 6.2
“Blockchain-based TSO-DSO flexibility platform”

Main Focus

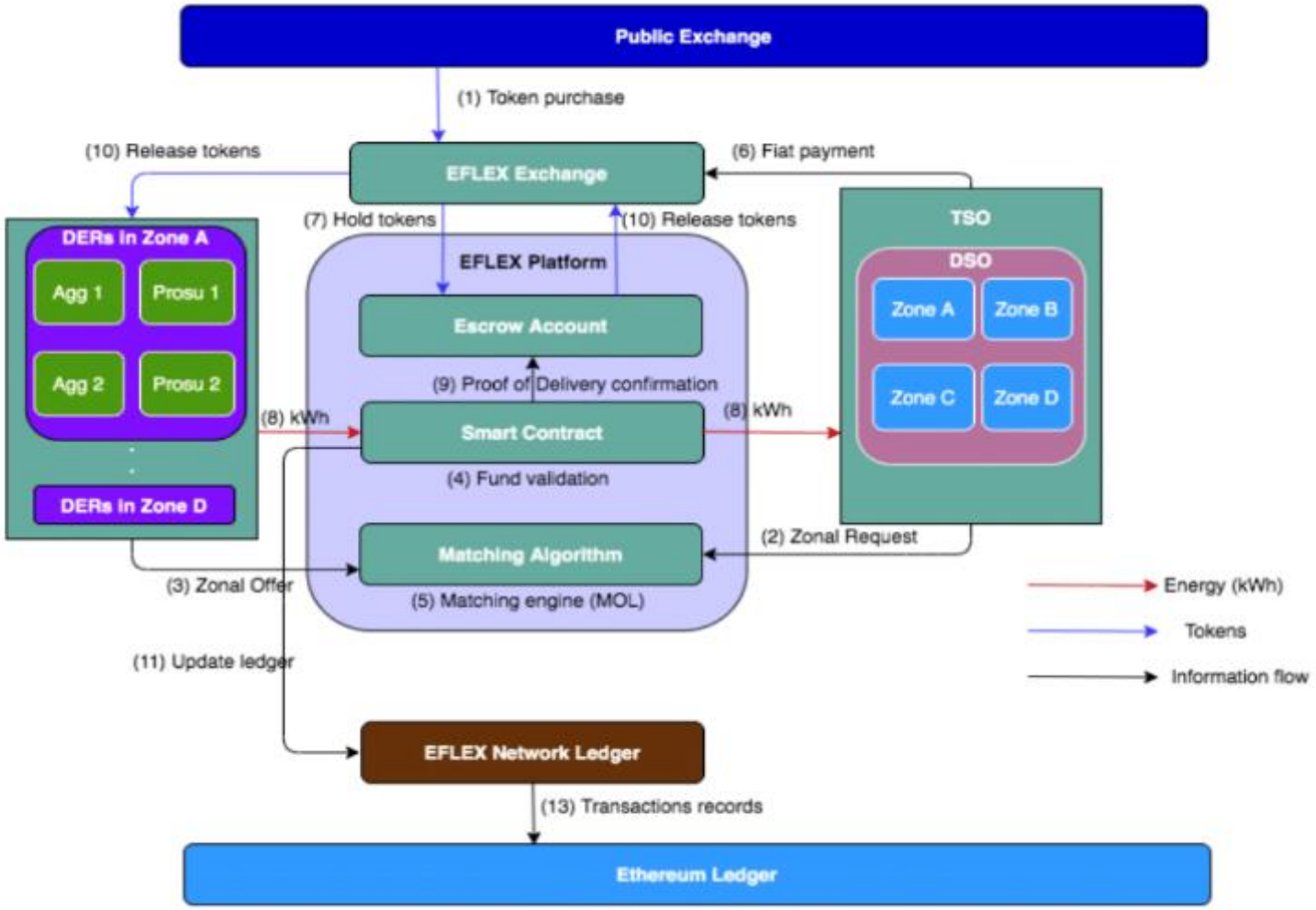
Congestion Management

- Provide solution to **reduce network overload**
- Reduce investment in **costly hardware**/network upgrades
- Enable **participation** of flexibility assets on the distribution grid level to ensure **system stability**

TSO-DSO Coordination

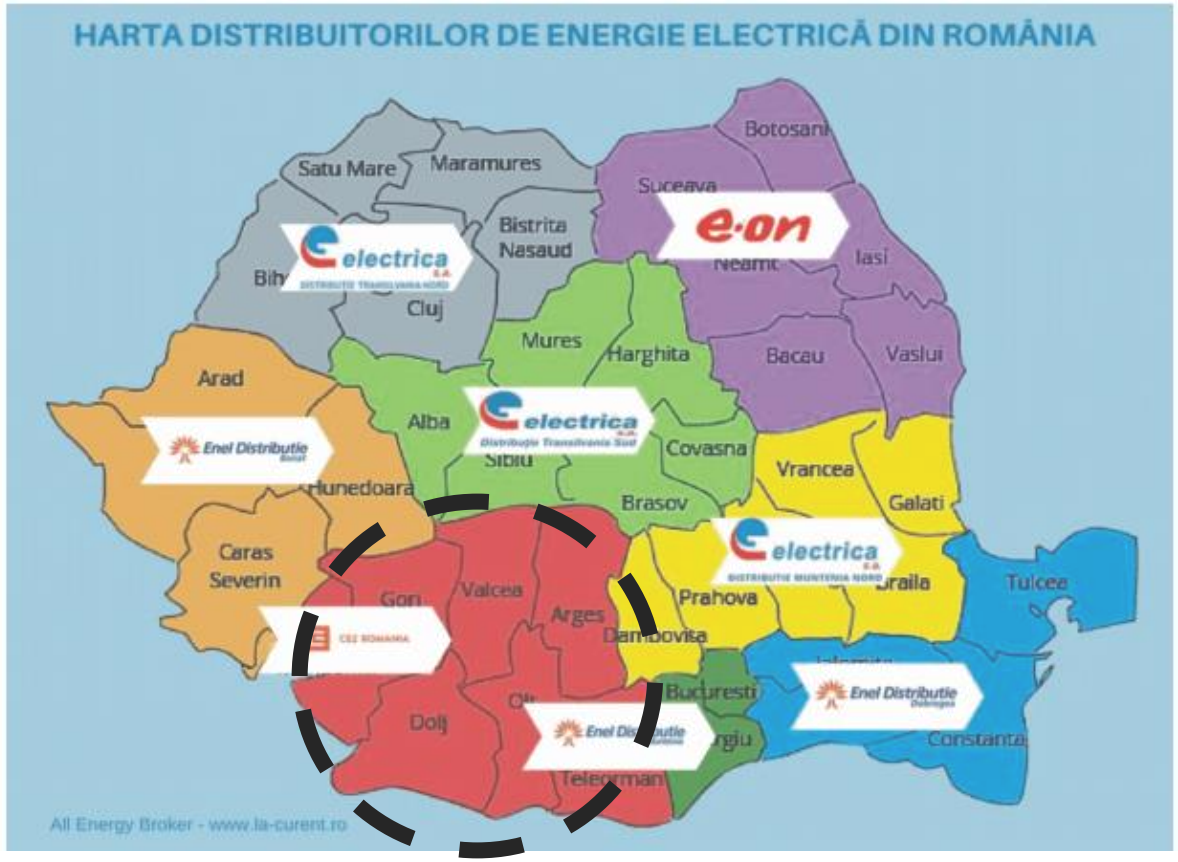
- Validate the viability of **data transfer** between TSO and DSO
- Avoid **double activation** of flexibility asset through sound coordination and effective signaling

EFLEX architecture incorporating blockchain



- ✓ Authenticated
- ✓ Transparent yet secure
- ✓ Avoids double activation
- ✓ Automated matching
- ✓ Easy to use

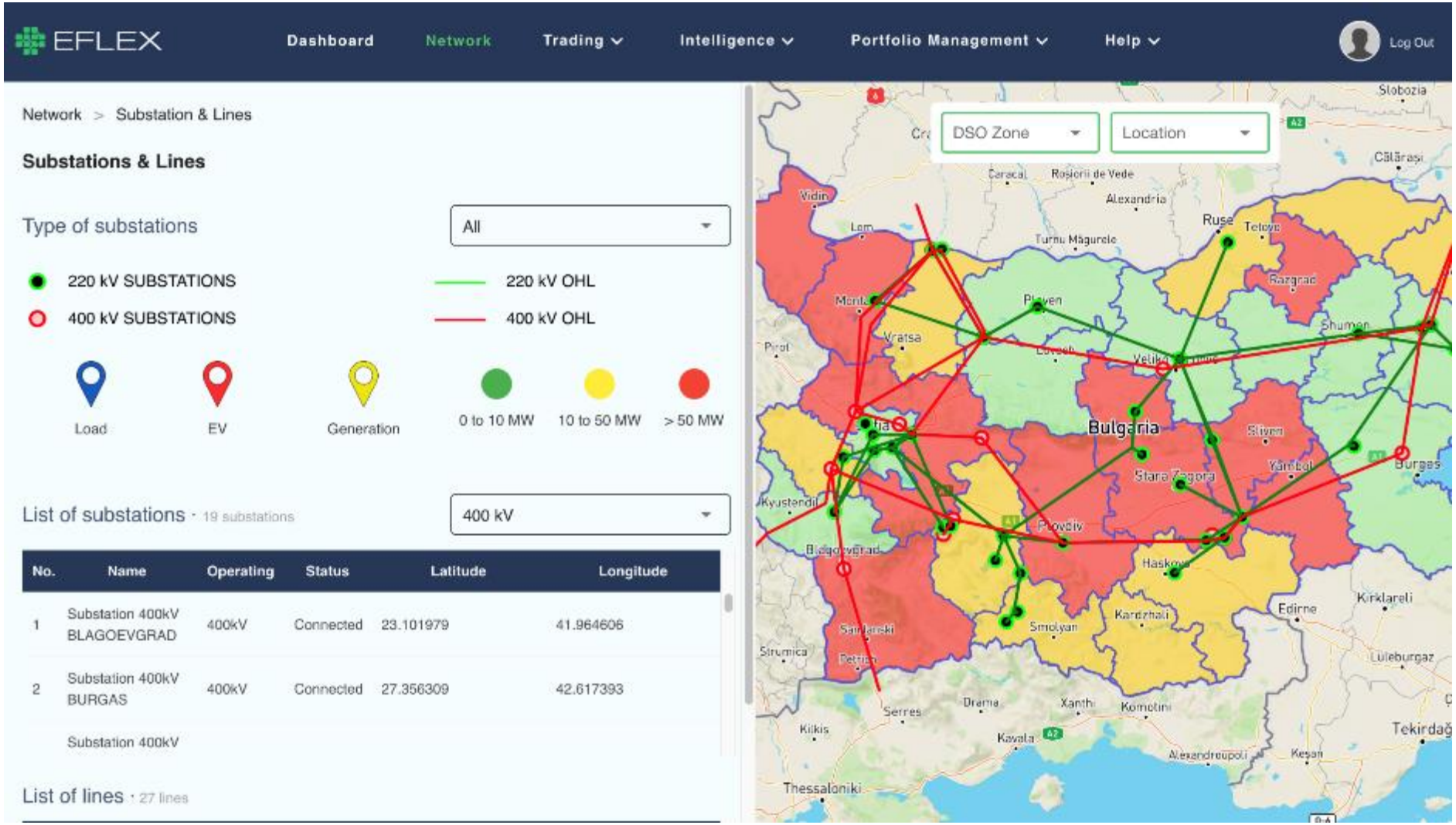
Test-sites



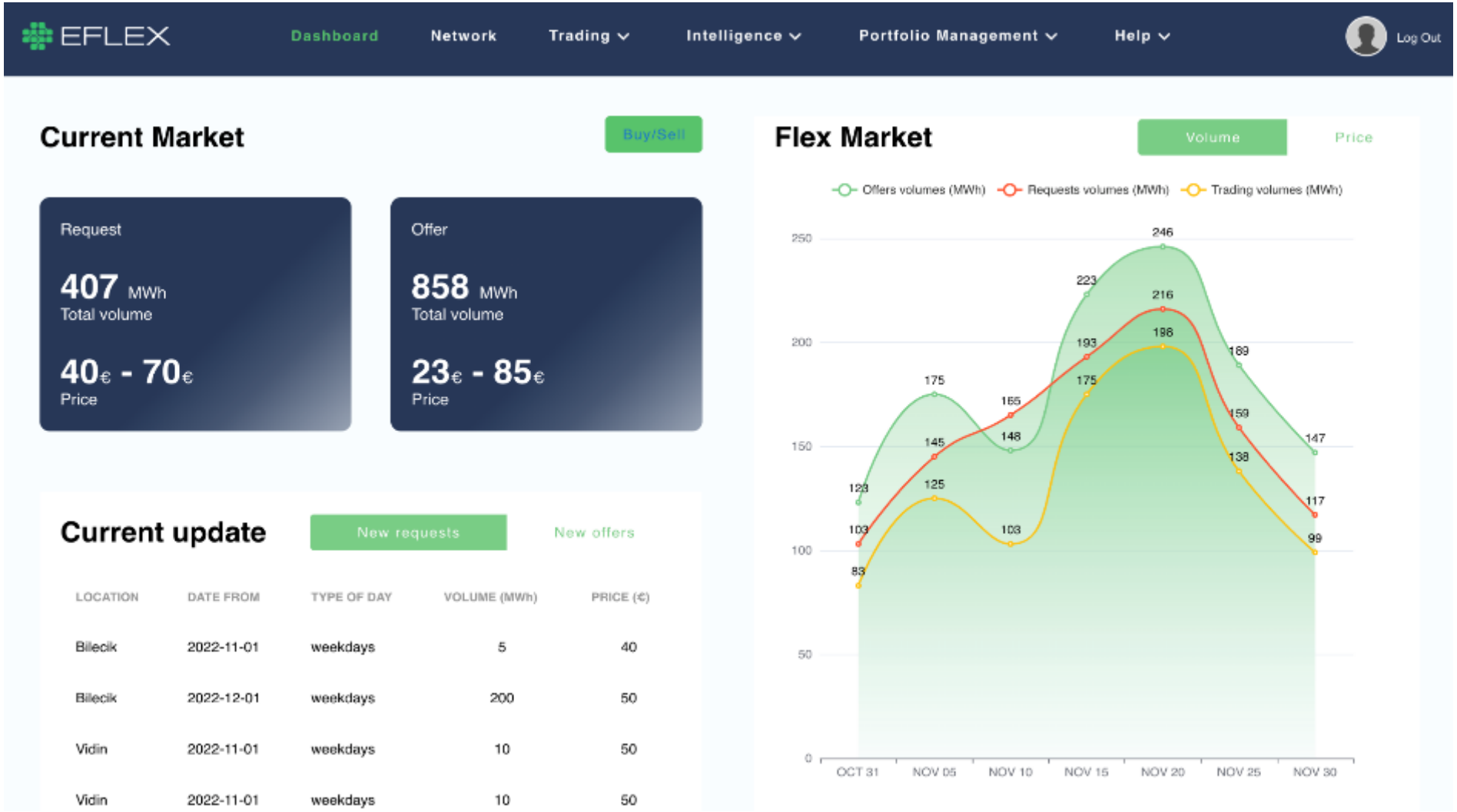
Partner DSO region, Romania

Sofia region, Bulgaria

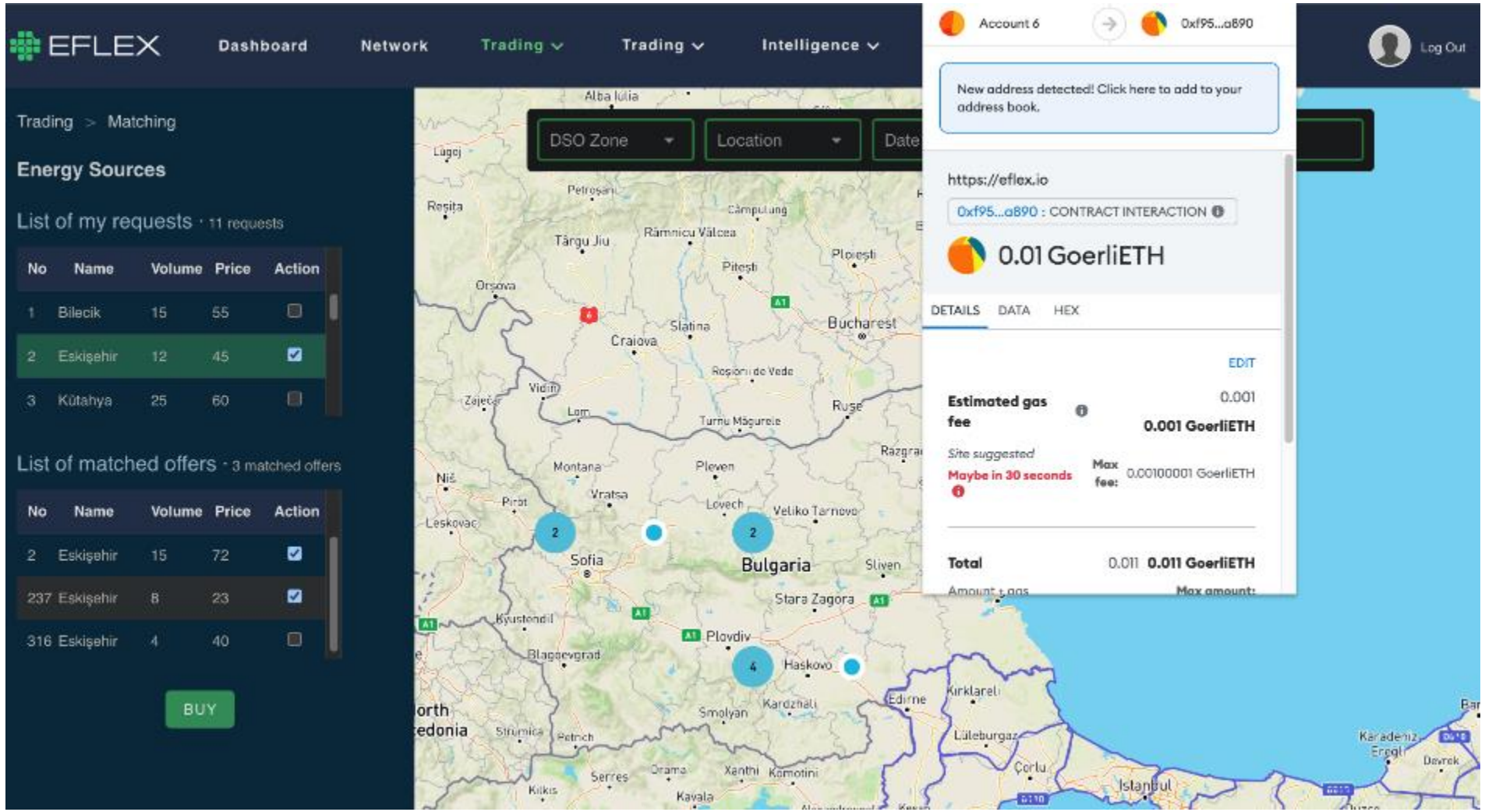
Visualization



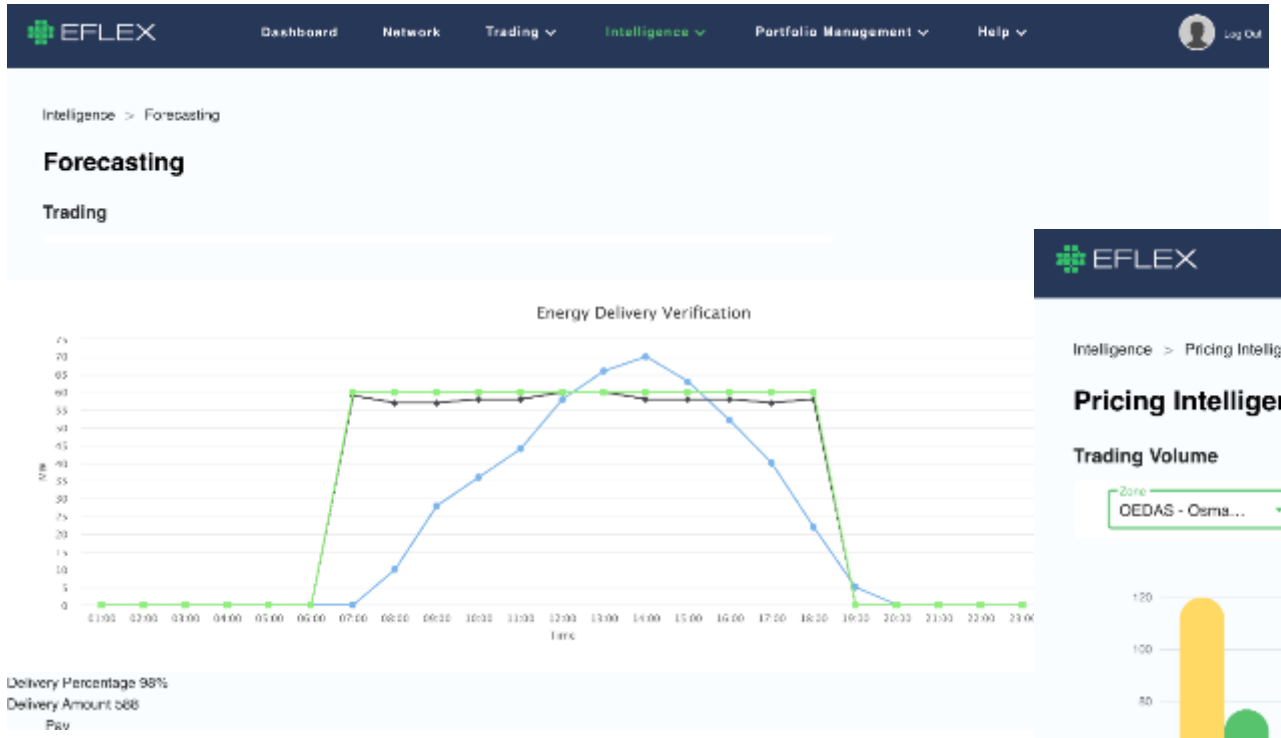
Market Statistics

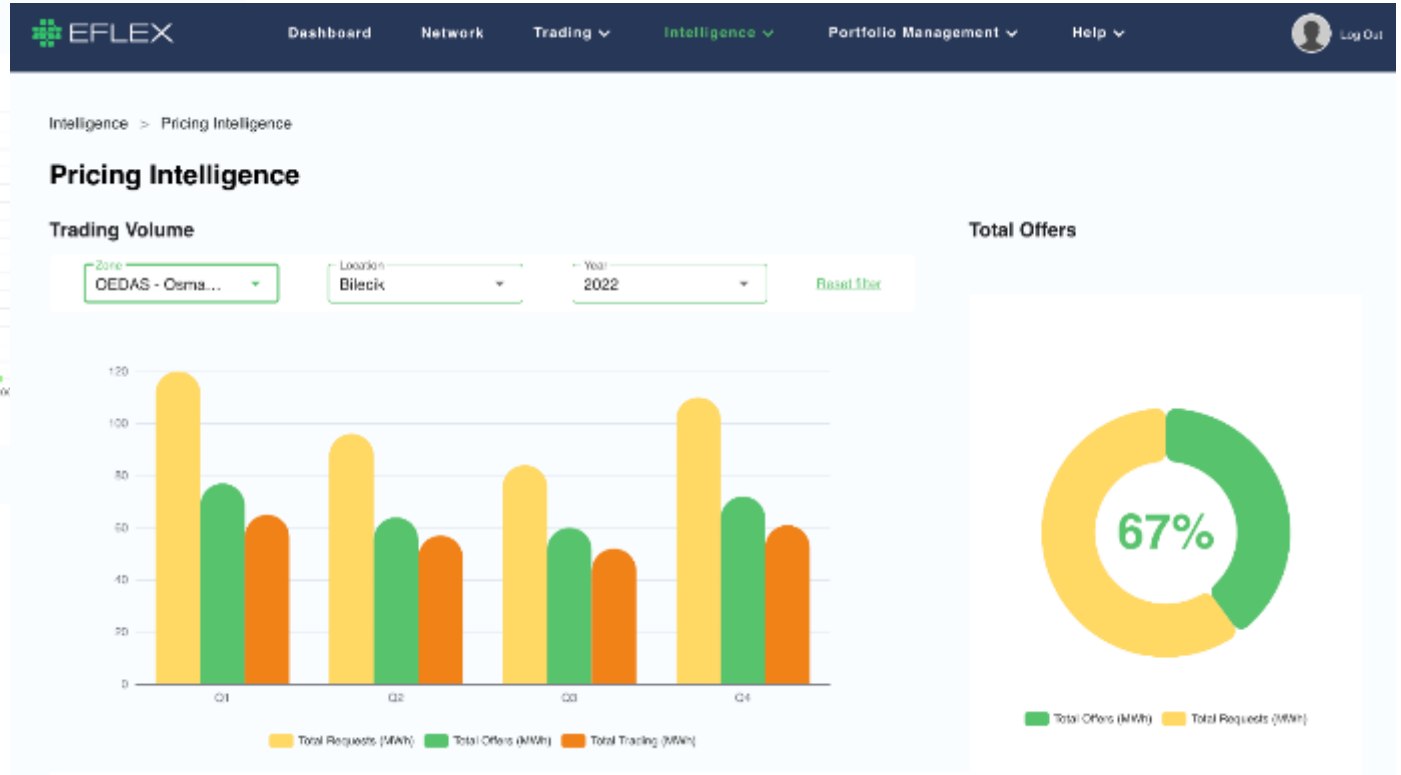


Automatic and manual matching



Settlement and forecasting





Achieved Results

- Transparency in data communication which helps in better coordination between entities
- Better visualization to forecast demand and supply which aids in congestion management and balancing
- Faster transaction settlement and avoid double auction with the help of blockchain
- Inexpensive and faster due to the elimination of intermediaries and inefficient back office process
- Helps prosumers to be active participants in the market and earn revenue while also helping reduce grid load

Highlights

- Optimized transaction time from minutes to <10 seconds
- Easy to use UI which is accessible to all and privacy preserved with authentication
- Automatic matching of requests and offers with the help of in-house powerful matching algorithm
- Easy book keeping since all transactions are automatically recorded on blockchain network
- Secure, reliable and scalable

Lessons learnt

- Special attention to understand the needs and users before designing the trading platform encourages

- Define simple trading rules which allow non-expert users to understand and enjoy trading

- On a larger scale, when there are more users and **thousands** of **transactions** happen, the platform should be capable of handling significant amount of grid users with sufficient **efficiency** and **security levels**

- For a **P2P** platform to be **successful**, it is crucial that people must be **educated** and given **awareness** about new technologies and provided incentives to accommodate devices such as smart meters

Thank you for your kind attention!

Ursula Krisper

István Vokony

Demo 7.2 leader INTERRFACE

Budapest University of Technology

Demo area #3: DERs into wholesale market

INTERRFACE

The main objectives of WP7

The objectives of this work package are:

- ✓ Demonstrate **innovative market platforms** based that promote DERs participation in wholesale electricity markets.
- ✓ Illustrate **market coupling scenarios** among Romania Bulgaria and Greece of **clear price signals and DER flexibility potential.**
- ✓ Simulate effects of DSO-usage of **local flexibility resources** on bidding zone market outcomes, by **using shadow-prices** to determine order clearing prices **and EUPHEMIA algorithm.**
- ✓ **Evaluate the proposed market platforms** to provide recommendations for the evolution of EU electricity markets a picture layout.

The origin of both demonstrators is the proven and succesful day-ahead market integration algorithm.

Demo 7.1 – DERs into wholesale market

- ✓ **Demo objective:** methodological framework: Day-Ahead Market (DAM) model, Balancing Energy Market (BEM) model, while including the participation of DERs taking into consideration forecasting outputs for PV, wind, and demand forecasting tools.
- ✓ **Pilot demonstrator:** 2030 SEE power system (Greek, Bulgarian, Romanian power systems)
- ✓ **Uncertainties:** net demand, CO_2 price, natural gas fuel price, and interconnection capacities (low, medium, and high scenarios for each)
  - 81 scenarios on three different market design options

- ✓ **Market design #1** | **No TSO-DSO coordination**
- ✓ **Market design #2** | **TSO-DSO coordination – Integrated Operational congestion management services at both TSO and DSO levels**
- ✓ **Market design #3** | **TSO-DSO coordination – Integrated mFRR and Operational congestion management services at both TSO and DSO levels**

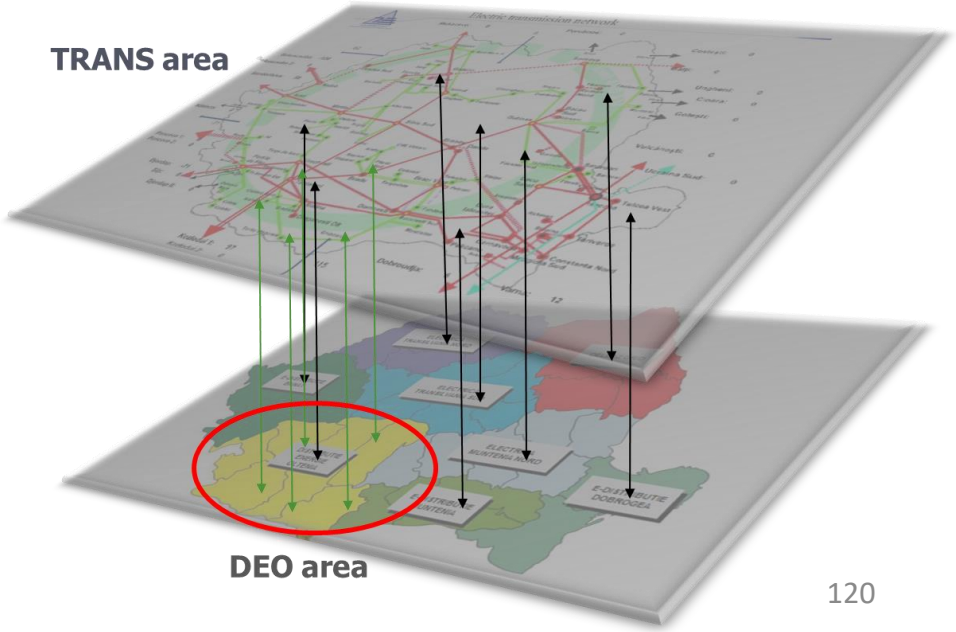
Demo 7.2 – Spatial Aggregation of Local Flexibility

- **Flexibility**
  - **Capacity:** local, DSO level (mFRR like)
  - **Energy:** flexibility too – liquid energy based product
- **Local vs global flexibility**
  - Not local resources are already on balancing market
  - Local for DSO needs…
- **Aggregating for wholesale market**
  - … can be offered in aggregated on appropriate platforms. The demand for DSO alone does not represent sufficient power for the appearance of the supply, we need a predictable, liquid wholesale. market!
- **Pricing: PUN pricing scheme**

Objective: Develop and demonstrate a platform for marketing local flexibility on wholesale markets

- **Spatial aggregation dimension**
  - The copper-plate, capacity-free model is wholesale can also be used on a limited basis in the market
  - The existing zonal congestion management of energy markets can be extended to the DSO network

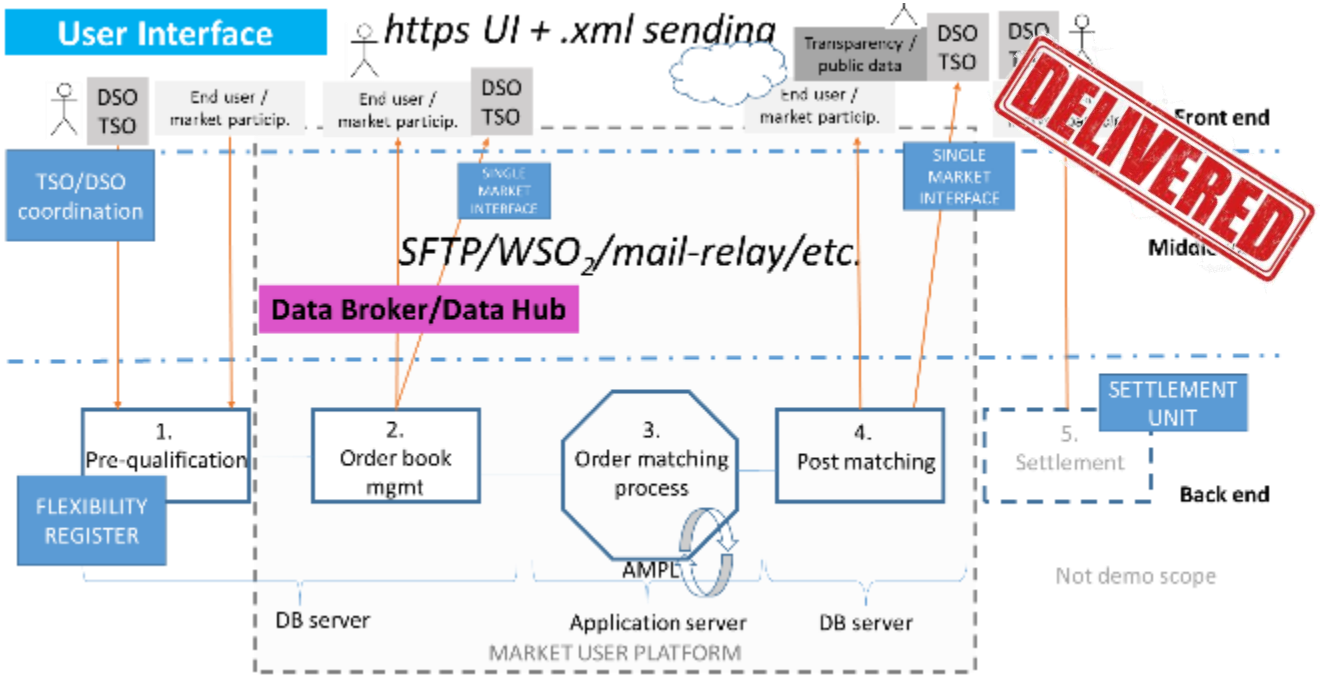
TSO-DSO hierarchy and bidding zones



The demo 7.2 innovation – standardized wrapper demonstrated for the specific local market - specialized intraday auction

Main steps of the demonstrated market:

- **Grid prequalification –**
  DSO specific assets – local parameters
- **Product prequalification –**
  energy and mFRR-like capacity bids
- **Daily auction process**
  - Local and TSO FSP bidding
  - Bid prequalification with Flexibility Register
  - Compiling order book
  - Bid matching (auction based optimization)
  - Publishing auction results
- Settlement



The advantages of the common IEGSA platform:

- **Prevents overbooking of flexibile resources even if it participates in multiple markets (e.g. DAM, IDM)**
- **Flexibility providers have a single system to report their availability**
- **TSO/DSO have a single access point to reach the market platform for market-based congestion management services**
- **Provides a standardized data exchange interface for the market messages**

Demo Area 3: Lessons learned and recommendations

- ✓ The preferred method to include spatial dimension and its resolution:
  Zonal representation is favoured to **align the local flexibility and DER focused markets' algorithm to the existing, single day-ahead market auction framework (EUPHEMIA-type market optimization)**.
  - The resulting single market framework is sensible and **intelligible for all market players** and includes the DSO specific congestion management services with well-known energy trading auctions.
- ✓ Consideration of **congestion management services as additional market product**, compatible with a multitude of use cases: **single product – multiple (grid) services**
- ✓ Increased DERs participation at a pan-European level - requirements for **harmonise product definitions** and effective inter-operability among different markets **to unlock DERs full flexibility potential**
- ✓ **Market algorithm scalability:** leverage of existing auction platforms – additional technical constraints can be introduced
- ✓ **IEGSA scalability**: computational performance and data handling capabilities - operational processes will compute significant amount of data – suitable data plaforms are critical element of energy markets.

The existing, single and integrated European day-ahead auction framework is demonstrated to be suited as a base platform for solving further power system challenges.

Panel discussion #2
Impact & value creation

INTERRFACE

Moderator:

George Paunescu
Policy Officer
DG ENER

Kris Kessels
Work Package leader
CoordiNet

Antonello Monti
Project Coordinator
OneNet

Norela Constantinescu
Exploitation Manager
INTERRFACE

Active poll

0

2) What are the top challenges for maximizing impact in EU RDI projects? (in terms of unlocking distributed flexibility sources?)

Join at

slido.com

#INTERRFACE

Panel discussion #2
Impact & value creation

INTERRFACE

Moderator:

George Paunescu
Policy Officer
DG ENER

Kris Kessels
Work Package leader
CoordiNet

Antonello Monti
Project Coordinator
OneNet

Norela Constantinescu
Exploitation Manager
INTERRFACE

Omar Huarcaya
Task leader INTERRFACE

ENTSO-E

The way forward: INTERRFACE Roadmap

INTERRFACE

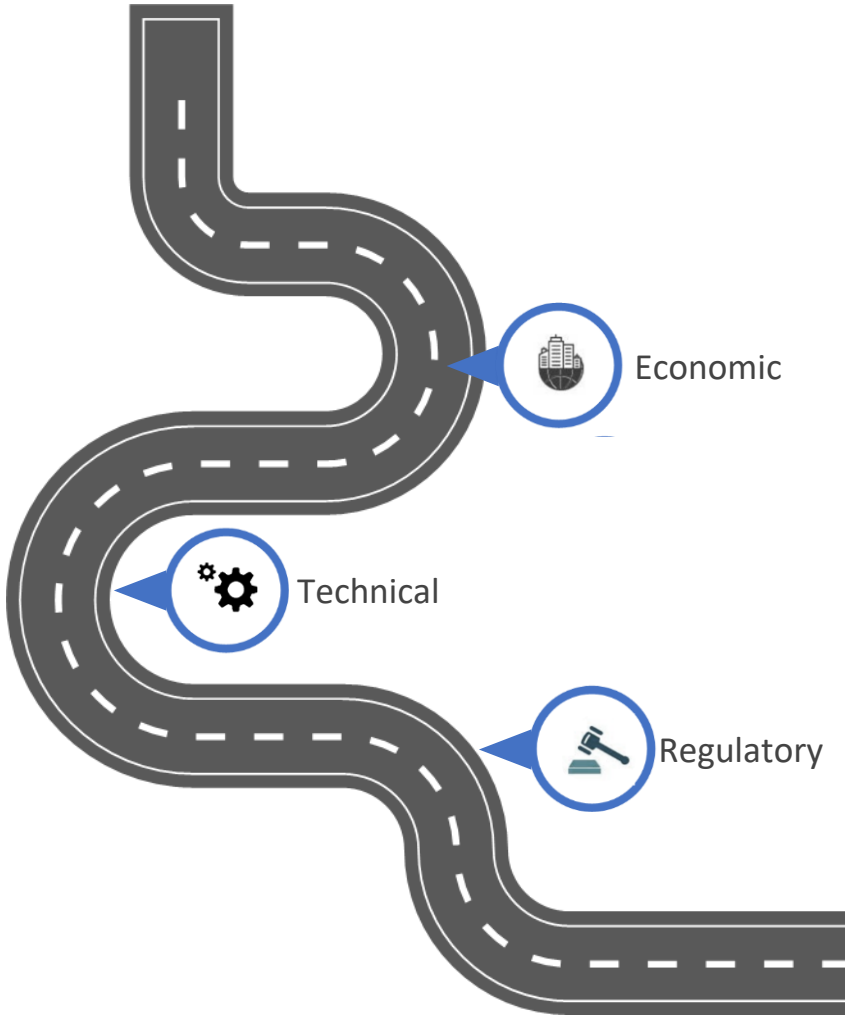
Introduction and Scope

Roadmap overview

- Roadmap serves as a guidance on how IEGSA IT architecture could became a fully integrated architecture across Europe, focusing from the IEGSA's standpoint towards its replicability and scalability.
- In the future, IEGSA will operate in a European electricity system capturing a complex range of local specificities in a highly interconnected ecosystem.
- Pilot demonstrators helped us in the understanding of these local particularities and explored the potential of flexibility services in a realistic manner.

Two main definitions:

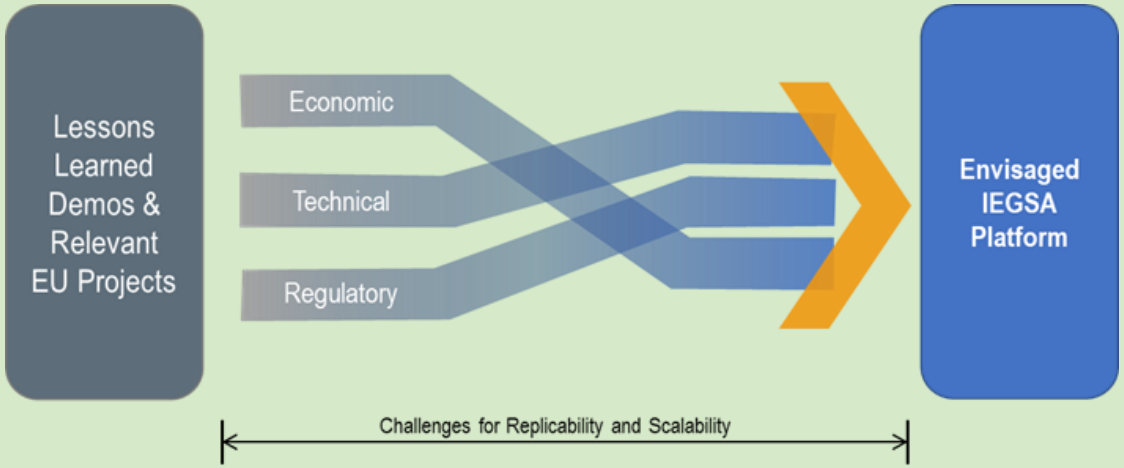
- **Replicability -> propagation of concepts**
- **Scalability -> increase scope and usage**



Replicability & Scalability Methodology

Project methodology and dimensions

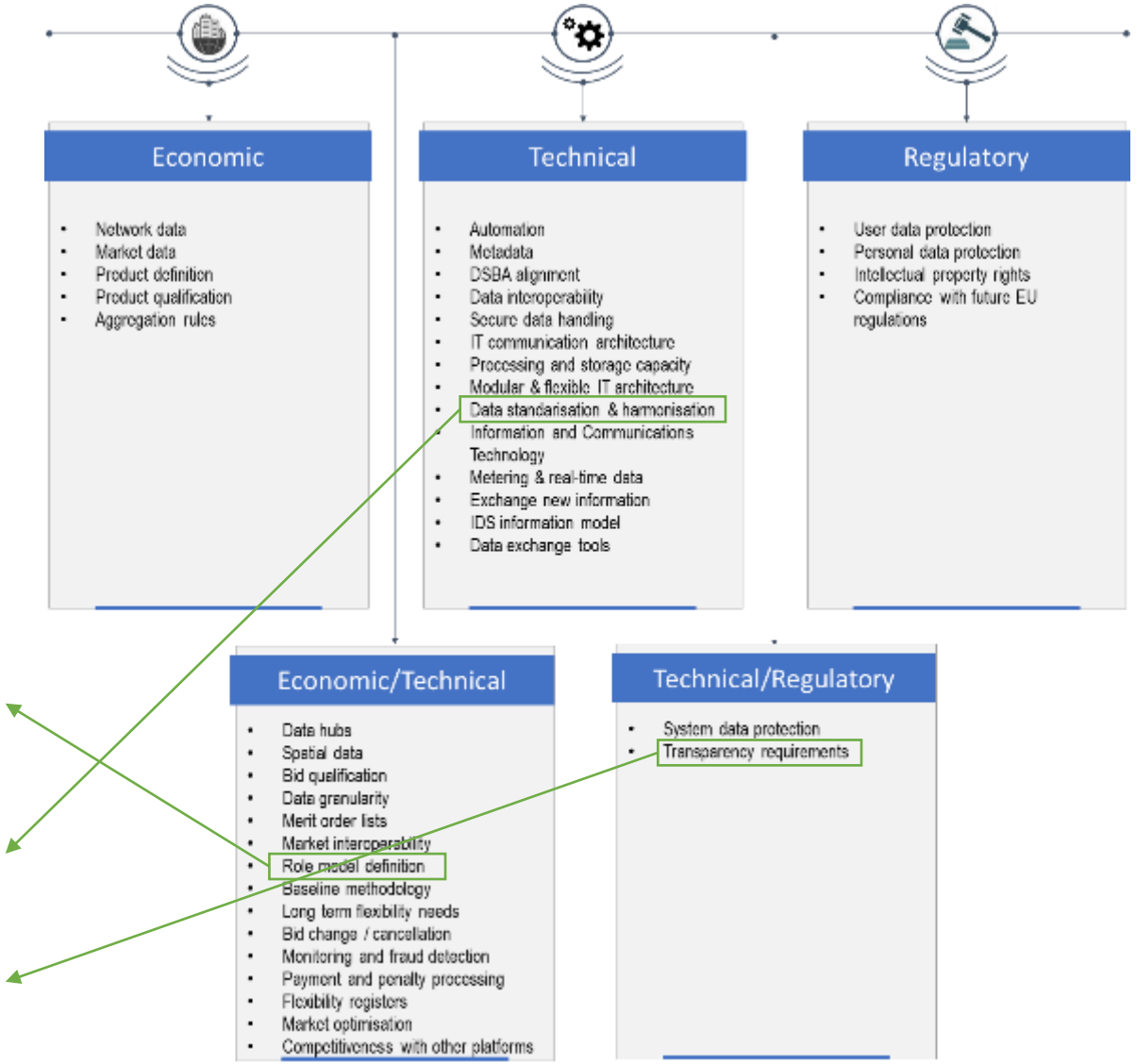
- Three steps methodology: Lessons learned, gap assessment, and replicability & scalability pathways.
- Foundations coming out of lessons learned from pilot demonstrators and relevant EU projects (EU-SysFlex, CoordiNet, OneNet and TDX-ASSIST)
- Gap assessment identifying major bottlenecks towards a pan-European IT platform
- Challenges and recommendations categorized in three dimensions:
  - **1st Dimension:** Explores the economic viability of an up-scaled IEGSA IT architecture enabling flexibility services deployed across different market structures.
  - **2nd Dimension:** Focused on technical aspects related to software, hardware and ICT architecture.
  - **3rd Dimension:** Aspects ensuring a wider use of IEGSA under different regulatory settings across countries.



Gap Assessment

Identification of Challenges

- Qualitative assessment towards an envisaged IEGSA IT architecture at pan-EU level.
- ~40 different challenges encountered across dimensions. Some challenges have correlations on two different dimensions.
- Examples:
  - Role model definition:
    Improving cooperation and system interoperability. It considers the evolution of new roles.
  - Data harmonisation and data standardisation:
    Both help system interoperability but also foster the integration of new participants and market players.
  - Transparency requirements:
    Aims at ensuring a fair playing field for competition. Supports monitoring the performance and use of flexible resources.



Recommendations for Replicability and Scalability of IEGSA

Roadmap provide **key recommendations to challenges** for IEGSA's replicability and scalability

- **Key messages:**
  - Further adoption of role description as defined by Harmonised Electricity Market Role Model.
  - Guarantee IEGSA's flexible design, adaptability and robust algorithms coping with future market arrangements.
  - Ensure interoperability by aligning with standarisation activities and initiatives such DSBA architecture, metadata and IDS information model.
  - Integration with distributed data exchange platforms across EU member states and sectors.
  - Consider ICT scalability aspects during the implementation phase of a pan-European IEGSA IT architecture.
  - Full compliance with existing and future regulatory frameworks.

Valerie Reif
Task leader INTERRFACE

Florence School of Regulation, EUI

Foundations for the adoption of new network codes

INTERRFACE

Two generations of network codes & other EU rules

REGULATION (EC) No 714/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 13 July 2009

on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003

Article 8

Tasks of the ENTSO for Electricity

6. The network codes referred to in paragraphs 1 and 2 shall cover the following areas, taking into account, if appropriate, regional specificities:

(a) network security and reliability rules including rules for technical transmission reserve capacity for operational network security;

(b) network connection rules;

(c) third-party access rules;

...

The code families

Connection

- Demand Connection Code
- Requirements for Generators
- High Voltage Direct Current Connections

Market

- Forward Capacity Allocation
- Capacity Allocation & Congestion Management
- Electricity Balancing

Operations

- Emergency and Restoration
- System Operations

REGULATION (EU) 2019/943 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 5 June 2019

on the internal market for electricity

Article 59

Establishment of network codes

Florence Forum 06/19

New acts under consideration

The Commission services are currently assessing the need for new acts based on empowerments in the CEP. The need for new acts appears to be most pertinent for the following three acts. Other empowerments may need to be used in the future but appear less pressing at the current stage:

- Demand side response (Art. 59 of the Regulation), to be adopted as an implementing act
- Cybersecurity (Art. 59 of the Regulation), to be adopted as a delegated act
- Interoperabilty requirements and procedures for the data (Art. 24 of the Directive)

11

COMMISSION IMPLEMENTING DECISION (EU) 2020/1479

of 14 October 2020

establishing priority lists for the development of network codes and guidelines for electricity for the period from 2020 to 2023 and for gas in 2020

ACER European Union Agency for the Cooperation of Energy Regulators

Framework Guideline on Demand Response

02 June 2022

(Draft for public consultation)

EUROPEAN COMMISSION

Brussels, XXX
[...](2022) XXX draft

COMMISSION IMPLEMENTING REGULATION (EU) .../...

of XXX

on interoperability requirements and non-discriminatory and transparent procedures for access to metering and consumption data

2009 | 2017 | 2019 | 2020 | 2022 | 2023

INTERRFACE

Initial regulatory gap analysis

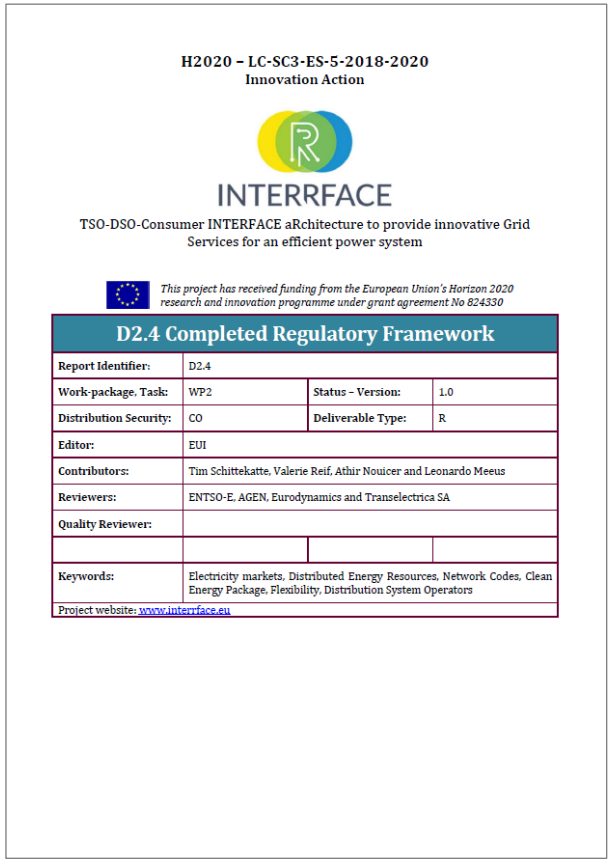
INTERRFACE Research streams:

Demand-side flexibility

Interoperability and data access

Table 1: Overview of identified research domains ('State of play matrix')

New research domain	Relevant CEP articles (most important in bold)	Relevant network code areas	Potential research topics (non-exhaustive)
Flexibility mechanisms	E-Directive, Art. **32** E-Regulation, Art. 18, 30, 51, 57	E-Regulation, Art. 13(1-3,5,7), 59.1(a-e) and 59.2(b)	- Market-based procurement of flexibility for distribution grids ('flexibility markets') - Smart connection agreements - TSO-DSO cooperation, including exchange of and access to relevant data
Framework for Aggregators	E-Directive, Art. **13**, **17**	E-Regulation, Art. 59.1(c-e) and 59.2(a)	- Baselines methodologies for aggregators - Market rules between aggregators and suppliers
Consumer Data Management	E-Directive, Art. 3, 13, 15, 17,20, **23-24**, 34, 59 E-Regulation, 30, 51	E-Regulation, Art. 59.1(e) and 59.2(b)	- Level of harmonisation of data management models and/or data exchange processes - Scope and interoperability of data exchange platforms - Level of access to consumer data
Peer-to-peer and Community-based Energy Trade	E-Directive, Art. **15**-16 REDII, Art. **21**-22	E-Regulation, Art. 59.1(e) and 59.2(a,c)	- Regulation around metering of consumers with multiple energy supply contracts - Roles of responsibilities of alternative energy suppliers (e.g. community, P2P exchange,..) versus traditional retailer - The market design and transparency requirements of P2P exchanges
Electro-mobility	E-Directive, **33**	E-Regulation, Art. 59.1(c-e) and 59.2(a,c)	- Electro-mobility energy and grid services provision rules, incl. type of service, product definition



H2020 – LC-SC3-ES-5-2018-2020
Innovation Action

INTERRFACE

TSO-DSO-Consumer INTERFACE aRchitecture to provide innovative Grid Services for an efficient power system

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824330

D2.4 Completed Regulatory Framework

Report Identifier:	D2.4		
Work-package, Task:	WP2	**Status – Version:**	1.0
Distribution Security:	CO	**Deliverable Type:**	R
Editor:	EUI		
Contributors:	Tim Schittekatte, Valerie Reif, Athir Nouicer and Leonardo Meeus		
Reviewers:	ENTSO-E, AGEN, Eurodynamics and Transelectrica SA		
Quality Reviewer:			
Keywords:	Electricity markets, Distributed Energy Resources, Network Codes, Clean Energy Package, Flexibility, Distribution System Operators		
Project website: www.interrface.eu			

Research streams

Demand-side flexibility

- Economics of mandatory DSF
- Voluntary DSF
- Voluntary vs. mandatory DSF

Public debate initially more advanced

Contribution focused on specific implementation issues

Desktop research, qualitative assessments, stakeholder interactions, quantitative modelling

Interoperability and data access

- Exploring the fundamentals
- Contribution to the implementing acts
- Smart metering & cross-sectoral interoperability

Public debate initially less advanced

Focus on raising awareness & making an informed contribution to policy and regulatory debate

Desktop research, qualitative assessments, stakeholder interactions

Modeling demand-side flexibility

Mandatory, exogenous compensation

Upper Level
DSO: maximizing welfare

Decision variables:
- Network investments
- Flex in kWh
- Network tariff

Lower Level
Consumers (i) : maximizing individual welfare each

Decision variables:
- Energy withdrawals
- DERs investments, battery usage

Voluntary

Upper Level
DSO: maximizing welfare

Decision variables:
- Network investments
- Flex Compensation
- Network tariff

Lower Level
Consumers (i) : maximizing individual welfare each

Decision variables:
- Flex in kWh
- Energy withdrawals
- DERs investments, battery usage

Mandatory, endogenous compensation

Upper Level
DSO: maximizing welfare

Decision variables:
- Network investments
- Flex in kWh
- Flex Compensation
- Network tariff

Lower Level
Consumers (i) : maximizing individual welfare each

Decision variables:
- Energy injection/withdrawals
- DERs investments, battery usage

Results

- **The cost-reflectivity of distribution network tariffs**: Explicit demand-side flexibility schemes in combination with cost-reflective capacity-based network tariffs lead to higher welfare gains than when combined with partly cost-reflective network tariffs.
- **Flexibility compensation levels**: It is difficult for the regulator or the DSO to set the correct level of compensation in the presence of active and passive consumers. For low compensation levels, passive consumers will be only partly compensated for the electricity load curtailment. However, for high levels of compensation, it becomes too attractive for prosumers who will game it to be curtailed more.
- **Voluntary versus mandatory demand-side flexibility**: The results suggest that regulators and DSOs should consider introducing a mandatory scheme for demand-side flexibility, i.e., mandatory demand-side connection agreements for its customers. The realized welfare gains are higher than when the customers opt voluntarily for such schemes. The applied load reductions take place only during the non-frequent high consumption events and represent a small fraction of the consumers' annual electricity demand.

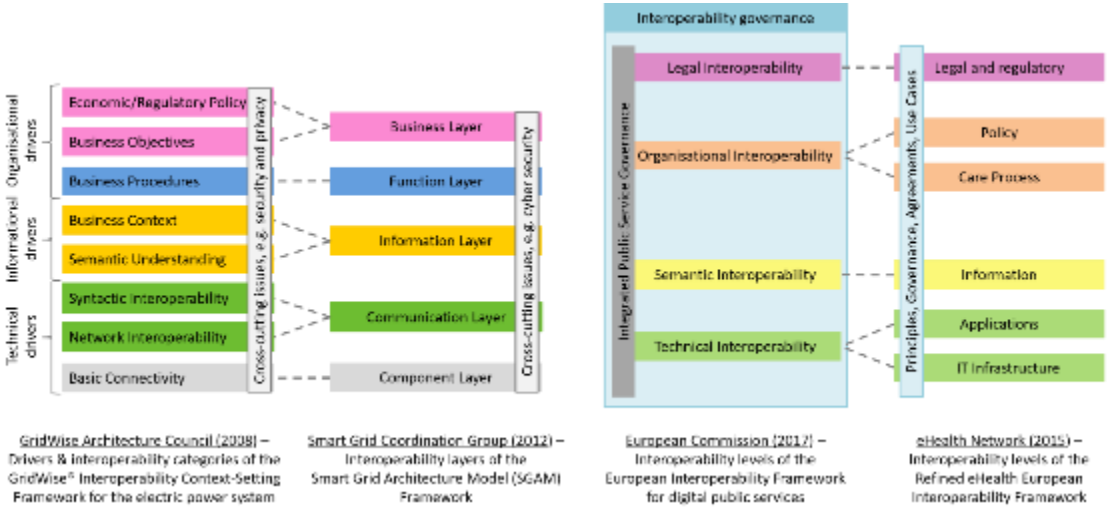
Policy recommendations

Different regulatory choices impacting the development of demand-side flexibility

	Short term use cases (congestion management, balancing and voltage control)	Long term use case (network deferral)
High ambition scenario	-Harmonizing products definition and integrating the different technologies in one marketplace -Establishing an optimal level of data granularity -Enforcing the use of flexibility resource register	-Differentiating demand-side flexibility compensation between customers categories -Introducing mandatory demand-side connection agreement schemes. -Allowing DSOs to contract different levels of flexibility from electricity residential consumers -24h ahead notification of the demand-side flexibility event
Low ambition scenario	-No harmonisation of flexibility products. Products is left to the Member States. Flexibility can be traded in different market places No common principles on data exchanges	-Establishing a uniform compensation for flexibility providers (consumers). -Keeping demand-side connection agreements as a voluntary options for consumers Pro-rata procurement of flexibility between all types of consumers

Interoperability and data access

- Analysis of interoperability frameworks and experiences in
  - electricity (ENTSO-E, North American Green Button),
  - other ecosystems (electromobility and buildings),
  - other sectors (healthcare, public administration),
  - at EU level and at national level (the NL, the UK).



Next steps for Smart Data

Recommendations: EU implementing acts

- The interoperability acts should be ambitious in addressing the **multiple dimensions of interoperability.**
- Inspiration can be drawn from **existing interoperability experiences** in the electricity (ENTSO-E, North American Green Button) and the healthcare (IHE) sector.
- **Governance** is a key issue in achieving interoperability:

c	Stakeholder dialogue (existing)	European standardisation (existing)	EU entity for interoperability management (new)
High ambition scenario	Centralise discussion at EU level & set up an **interoperability stakeholder committee** (ex.: network codes committees) DoEAP	Formally require ENTSO-E, ENTSOG and the new EU DSO Entity to contribute to **standardisation activities, including testing and profiling**	Set up an EU entity for interoperability management with 3 groups of tasks: 1) **Formalisation of best practices** & make them accessible in common "**interoperability repository**", 2) (National) **implementation monitoring and reporting** 3) Interoperability **testing** IAs
Low ambition scenario	**Renew the mandate of the European Smart Grids Task Force** DoEAP	Integrate customer data exchange and access into the annual Union **standardisation work programme**	

Recommendations: smart metering and cross-sectoral interoperability

- Consider **broadening the perspective onto interoperability** (incl. in the definition of Directive (EU) 2019/944 & Implementing Acts) to reflect the multi-level characteristics of interoperability.

- When looking for EU-level solutions, **take inspiration from successful interoperability solutions** applied in more advanced sectors. Examples could be to
  - set up an **EU monitoring and reporting scheme for national interoperability progress** (public administration).
  - set up a **scheme for different types of interoperability testing** (healthcare).

- **Exploit synergies between sectors** in light of a future energy system integrated with sectors such as buildings and electro mobility. Take inspiration from the national level, e.g.
  - set up a **governance framework for interoperability covering cross-sectoral & sector-specific aspects** (the Netherlands).
  - enhance **sector convergence in standardization** to avoid duplications of efforts (the UK).

Publications and stakeholder engagement activities

The tables include a selection of the performed activities. The complete list will be available in the final deliverable *D9.4 Foundations for the adoption of new network codes 2*.

Demand-side flexibility	
Type	**Details**
Publications	• Nouicer, A., Meeus, L., and Delarue, E., (2020). The economics of explicit demand-side flexibility in distribution grids: the case of mandatory curtailment for a fixed level of compensation, RSCAS Working paper, accepted in The Energy Journal (2023). • Nouicer, A., Meeus, L., and Delarue, E., (2022). A bilevel model for voluntary demand-side flexibility in distribution grids, RSC Working Papers. • Nouicer, A., Meeus, L., and Delarue, E., (2022). Demand-side flexibility in distribution grids: voluntary versus mandatory contracting, RSC Working Papers, submitted to Energy Policy Journal. • Schittekatte, T. and Meeus, L. (2020). Flexibility markets: Q&A with project pioneers. Utilities Policy, Volume 63, pp. 101017. • Schittekatte, T., Reif, V., and Meeus, L (2021). Welcoming New Entrants into European Electricity Markets. Energies 2021, 14, 4051. DOI: 10.3390/en14134051. • Schittekatte, T., Deschamps, V., and Meeus, L. (2021). The regulatory framework for independent aggregators. EUI Working Papers. RSC 2021/53.
Stakeholder engagement	• Nouicer, Athir (2022), Distributed resources and flexibility. FSR Topic of the Month. • Online event "Welcoming new entrants in electricity markets" (Feb 2021). • Online event "Enabling flexibility in electricity markets and networks" (Sept 2020). • Presentation at the Energy Infrastructure Forum organised by the European Commission (23-24 May 2019)

Interoperability and data access	
Type	**Details**
Publications	• Reif., V. and Meeus, L. (2021). Smart metering interoperability issues and solutions: taking inspiration from other ecosystems and sectors. EUI RSC Working Papers. 2021/69; also published in Utilities Policy, Volume 76, 2022, 101360, ISSN 0957-1787, DOI: 10.1016/j.jup.2022.101360. • Reif, V. and Meeus, L. (2020). Getting our act together on the EU interoperability acts, FSR Policy Briefs 2020/30. • Schittekatte T., Reif. V. and Meeus, L. (2020). The EU Electricity Network Codes. Chapter 9 Data and Data Exchange. Technical Report.
Stakeholder engagement	• Online event "Interoperability related to smart metering, electro mobility and buildings under the Green Deal" (June 2021). • Online event "Digitalisation of energy infrastructure and data interoperability: what can we learn from other sectors?" (Jan 2021). • Online event "Facilitating interoperability of energy services in Europe" (July 2020).

INTERRFACE

Thank you.

valerie.reif@eui.eu

Panel discussion #3
Flexibility network code & beyond

INTERRFACE

Moderator:

Victor Charbonnier
Flexibility Team Manager
ENTSO-E

Helena Gerard
Co-chair
BRIDGE WG Regulation

Luis Cunha
Member of Board
EU DSO entity

Valerie Reif
Task Leader
INTERRFACE

Active poll

0

Join at

slido.com

#INTERRFACE

3) On a scale of 1-5, how important do you perceive the role of EU RDI projects and their results for the development of new EU rules?

1 - Not important 5 - Extremely important

Score: 0.0

1	2	3	4	5
0%	0%	0%	0%	0%

Panel discussion #3
Flexibility network code & beyond

INTERRFACE

Moderator:

Victor Charbonnier
Flexibility Team Manager
ENTSO-E

Helena Gerard
Co-chair
BRIDGE WG Regulation

Luis Cunha
Member of Board
EU DSO entity

Valerie Reif
Task Leader
INTERRFACE

The Market Design Challenge

Flexibility products and services

- ✓ Need for **new and adapted products/services** for TSOs and DSOs
- ✓ **Market access** and **value stacking** drive innovations in product design
- ✓ Balance between **harmonization** and addressing local needs

Cross-border cooperation

- ✓ **Cooperation between TSOs and DSOs is a corner-stone** in the energy transition
- ✓ From network **planning** to network **operation** and **real-time emergency measures**
- ✓ Tooling to support **grid observability**, **grid monitoring**, information provision and flexibility resource sharing

Market Design

Market Integration

- ✓ Flexibility can be activated using both **direct** (markets) and **indirect mechanisms** (tariffs, connection agreements)
- ✓ Innovations for smart up-scaling of flexibility markets should address **coordination aspects for prequalification, procurement, activation and settlement**

Local Markets

- ✓ The potential of **multi-energy systems** is increasing with the emergence of new technologies (**sector coupling)**
- ✓ New market models, business models are necessary to take into account the **specifics of the LV grid** and the consumer

These initiatives are funded by

George Boultadakis

Project Coordinator INTERRFACE

European Dynamics

Closing remarks

INTERRFACE

Follow INTERRFACE:

/ InterrfaceH

/ interrface-h2020

/ www.interrface.eu

INTERRFACE

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 824330