



bridge

ENLIT - Session 1

14:00 – 15:30

30th November 2021

Moderated by Manuel Serrano – BRIDGE Regulation WG
Chair and CROSSBOW Coordinator

Flexibility market mechanisms across
Europe

www.h2020-bridge.eu





- ❑ *What is BRIDGE?*
- ❑ *BRIDGE Regulatory WG*
- ❑ *ETIP SNET Vision*
- ❑ *BRIDGE projects*
 - ❑ TRINITY
 - ❑ COORDINET
 - ❑ PHOENIX
 - ❑ INTERFACE
 - ❑ EUNIVERSAL
- ❑ *Q&A Panel discussion*

AGENDA



BRIDGE

• *BRIDGE is a **European Commission** initiative which unites **Horizon 2020** Smart Grid, Energy Storage, Islands, and Digitalisation Projects to create a structured view of cross-cutting issues which are encountered in the **demonstration projects** and may constitute an obstacle to innovation.*

- More than **80 Projects**,
- A live initiative, continuous renovation as project completes their research.
- 4 Working groups.



Data management



Business models



Regulations



Consumer and
Citizen
engagement



European
Commission

2021 objectives Regulatory WG

1. Harmonize **products and services** for system management, including the role of energy communities as service provider.
2. Support **cross-border** and **regional cooperation**.
3. Facilitate **integration** of market-based and non-market based **flexibility mechanisms in a coordinated way**.
4. Continue the design choices for local markets for flexibility

Regulatory WG - workplan 2021

Lead topic
Sub-topic

Track 1: Products and Services

Action 1

- **Product standardisation**
- Product design for congestion management
- Product design for voltage control

Action 2

- **Service provision by energy communities**
- Service provision by E-mobility
- Market incentives to support consumer engagement

Track 2: Cross-border and Regional Cooperation

Action 3

- **System Security**
- Regional Coordination Centres
- Geographical islands
- Network Planning

Track 3: Market integration

Action 4

- **Link between different flexibility mechanisms**
- Dynamic tariff design
- Dynamic connection agreements
- Cross-border market integration
- TSO-DSO coordination

Track 4: Local Markets

Action 5

- **Local markets**
- Multi-carrier markets / sector integration
- P2P energy trading

PANEL Discussion and Project Presentations

Panellists and Project Presented

Antonio Iliceto
ETIP SNET WG1 co-
chair



TRINITY
Álvaro Nofuentes



PHOENIX
Mihai Paun



INTERFACE
Nikolaos Bilidis



EUniversal
Susete Albuquerque



Coordinet
Matteo Troncia

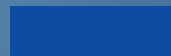




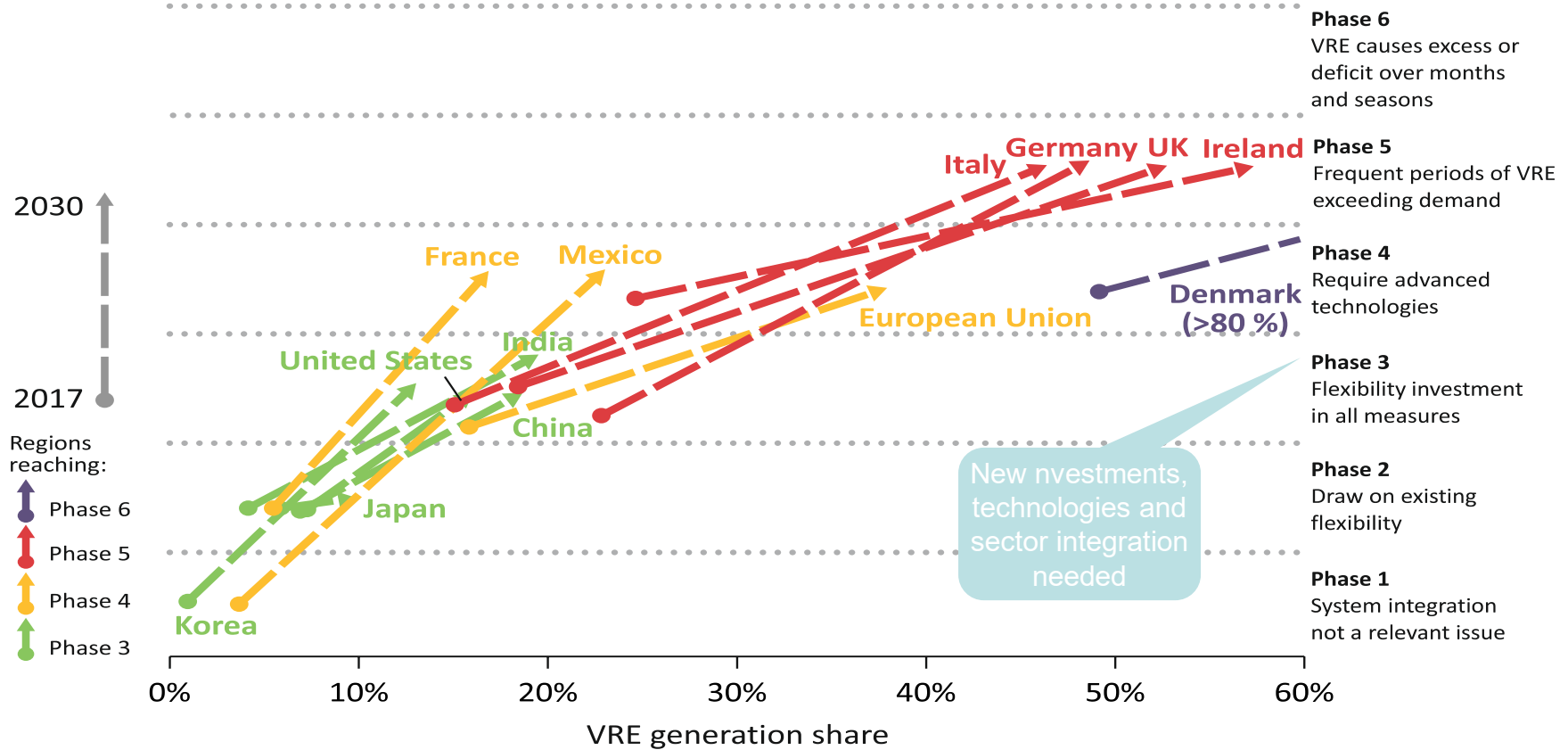
FUTURE FLEXIBILITY NEEDS

ANTONIO ILICETO co-Chair WG1 ETIP SNET

ENLIT panel on Flexibility market mechanisms across Europe – challenges to reach 2030 goals



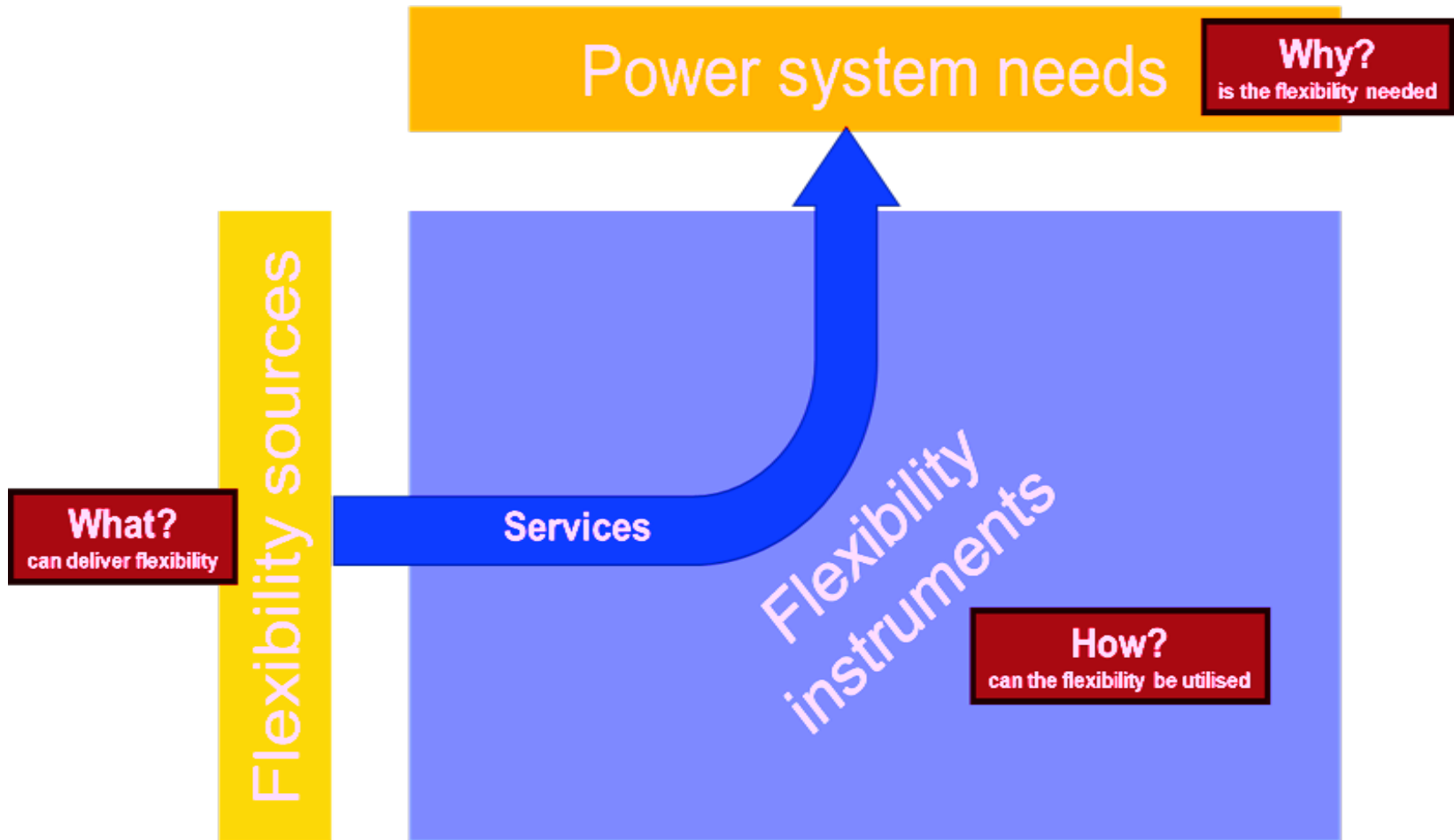
The need of Flexibility increases at step-change pace with increasing vRES



General framework for Power system flexibility



ETIP SNET
EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM
SMART NETWORKS FOR ENERGY TRANSITION



European Commission

Many flexibility means are available, inside AND outside the electricity system



ETIP SNET
EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM
SMART NETWORKS FOR ENERGY TRANSITION

Flexible Grid

Flexible generation

Flexible loads

Storage within electric system

Storage in other energy systems

Shift energy in locations

Shift energy in time (of production)

Shift energy in time (of consumption)

Shift energy in time (of transport)

Shift energy in physical form



European Commission

Many flexibility means are available, inside AND outside the electricity system

Traditional means, under consolidated control of grid operators

Flexible Grid

Flexible generation

Flexible loads

New means and new logic/conditions with indirect or no control by grid operators

Storage within electric system

Storage in other energy systems

Shift energy in locations

Shift energy in time (of production)

Shift energy in time (of consumption)

Shift energy in time (of transport)

Shift energy in physical form

Direct impact on grids / direct interaction

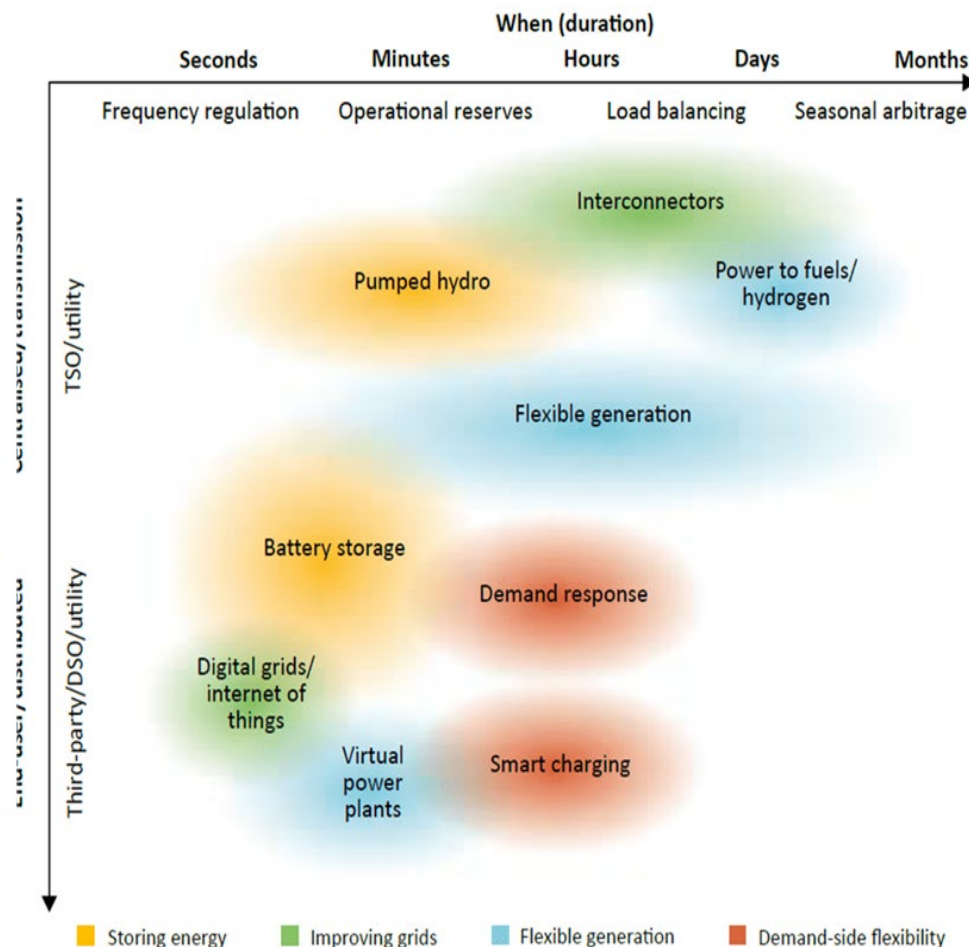
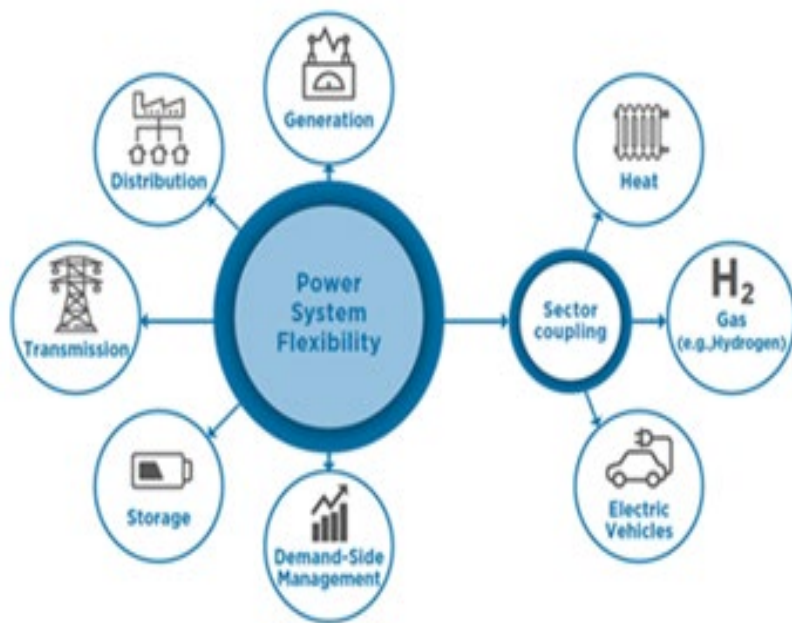
with grid operators

Converted energy is managed by other operators



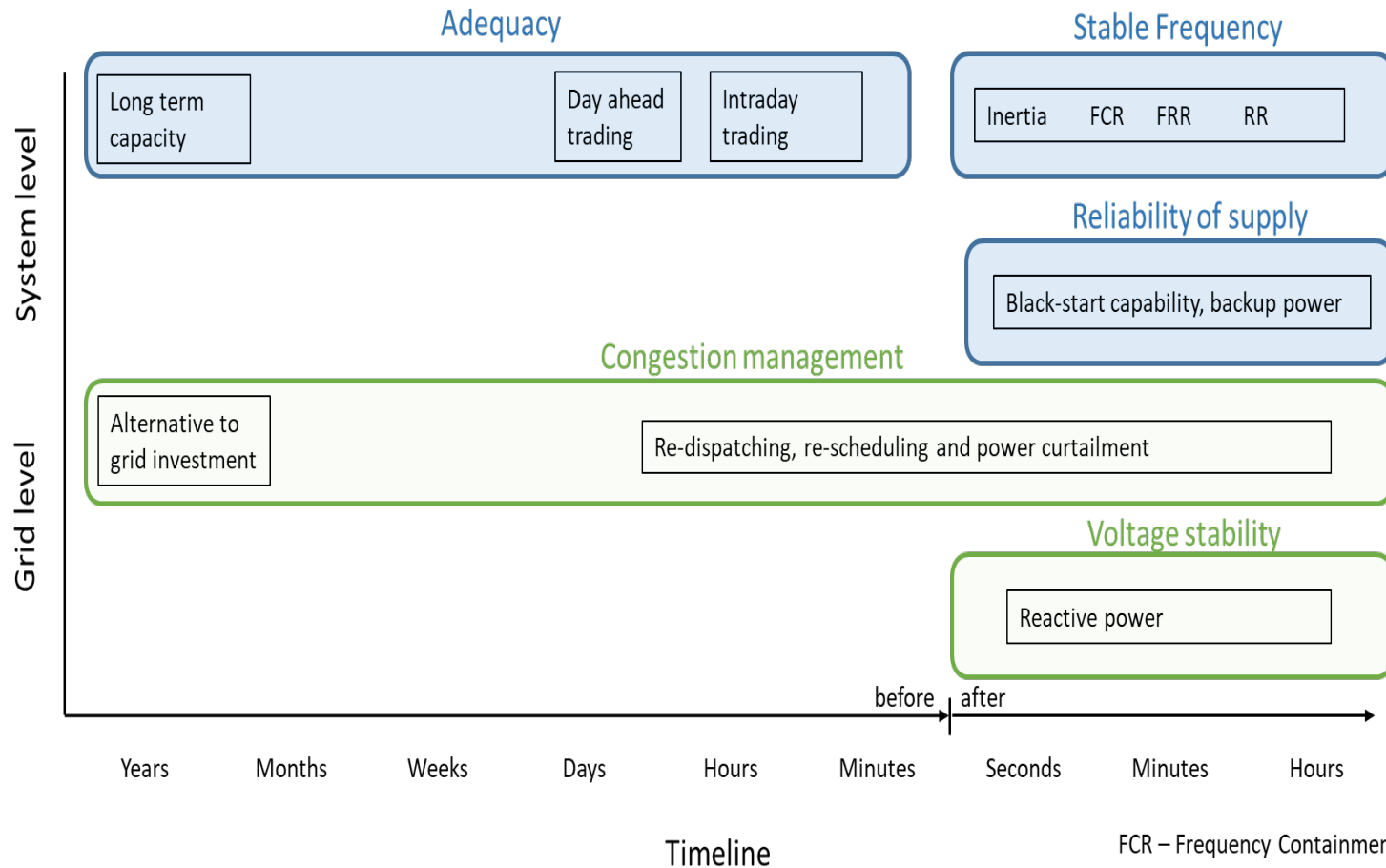
Investments versus flexibility

- Expected services and related flexibility products proposed for ancillary services
- Trade-off between grid investments and use of flexibility from Non Wire Solutions
- Time response, capacity and siting in the supply chain are main determinants



Flexibility is needed short term & long term, as well as grid level and system level

- Short term for grid operation, stability, congestions, dispatching
- Long term for resources adequacy, energy efficiency, infrastructure optimisation

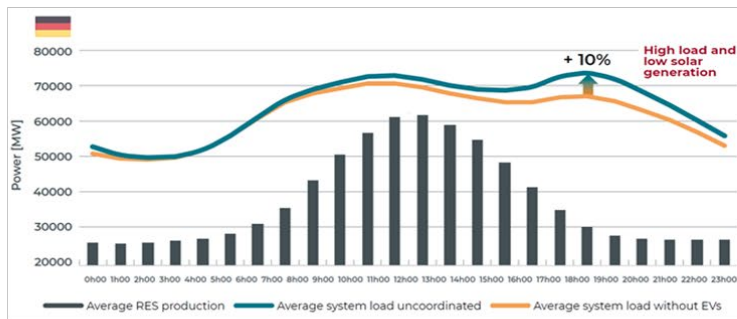


FCR – Frequency Containment Reserve
FRR – Frequency Restoration Reserve
RR – Replacement Reserve

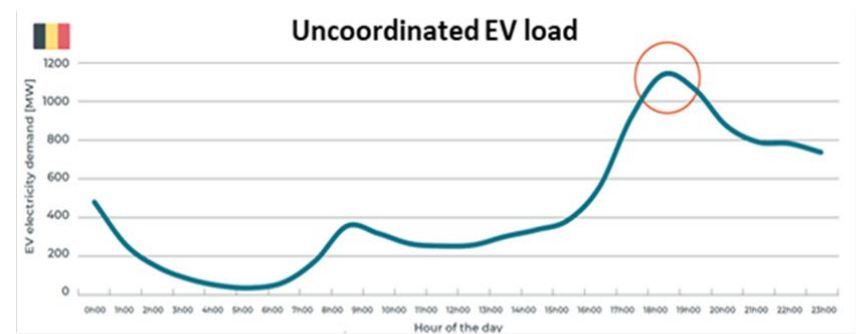
EV for electric system are both demand response (V1G) and storage (V2G)

- Impact on energy consumption is limited on peak demand can be significant
- Smart Charging smoothes demand peaks and avoid generation curtailment
- V2G turns EV in system batteries, diffused and at marginal cost

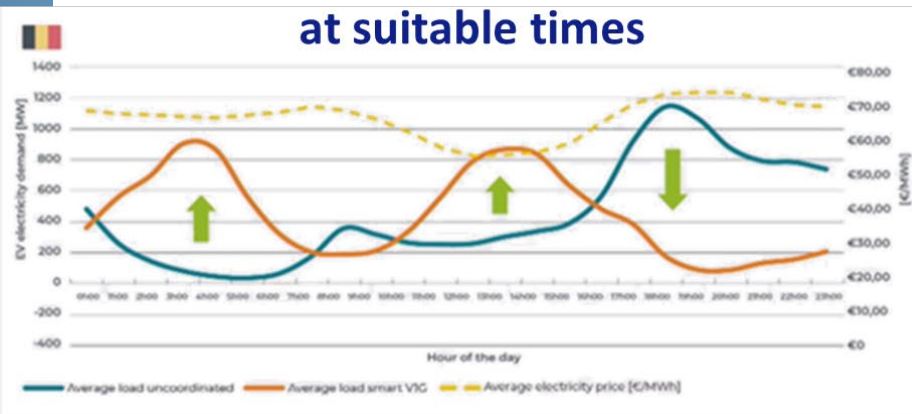
Not an energy deficit issue



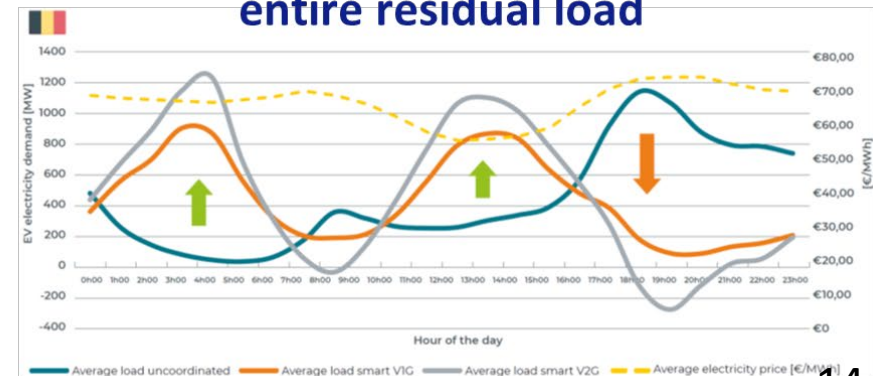
But a peak power issue



V1G (Smart charging) shifts power request at suitable times

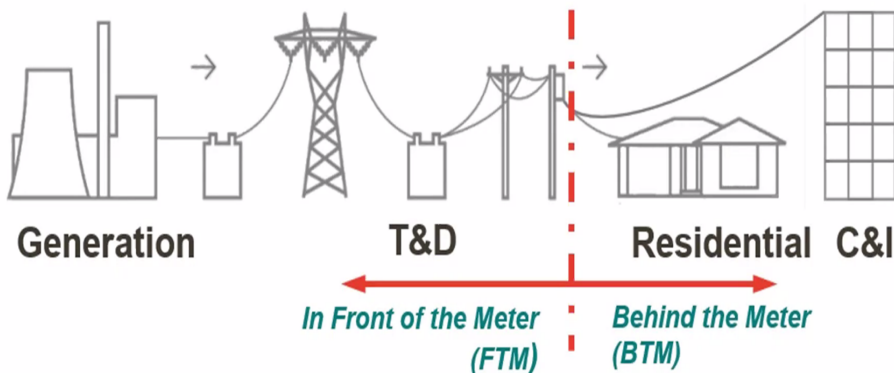
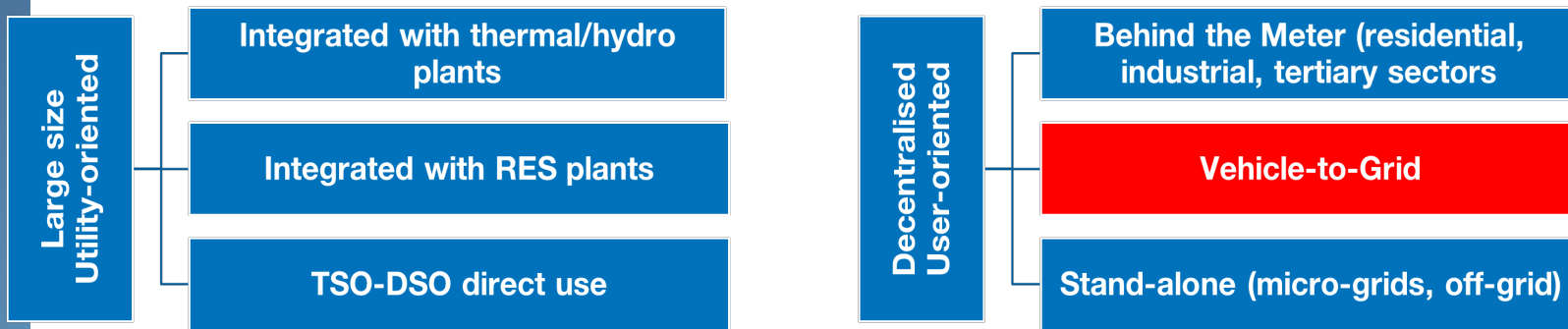


V2G extends the reshaping effect to the entire residual load

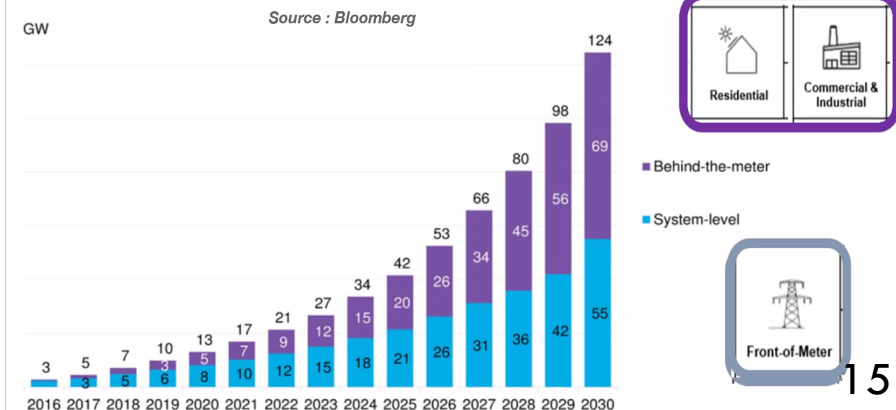


Local and Regional integration, especially for storage

- Storing energy cheaply and efficiently shall be the key for a decarbonized system of system
- Even in a highly distributed scenario, grid scale storage shall be necessary
- Batteries: all locations and use cases shall be necessary



Cumulative energy storage deployments by segment



Enablers and recommendations

- Flexibility by design and enhanced resilience
- Deep electrification will open more flexibility options, to be internalized already in planning phase
- In particular power - to - gas, through large scale electrolysers allows both modulation of production (short term flexibility) and seasonal storage (hydrogen and its derivatives stored in caverns / depleted gas fields)
- Need of new methods and metrics for valorisation of flexibility, especially cross-sector
- With a zero cost energy generation, competition and remuneration shifts to capacity and to flexibility
- Consumer centric mechanisms and user involvement are essential key factors
- New roles in system of systems; for example, who will be paid for long term storage, and how? Where market mechanisms need to leave way to administrative tariffs (strategic reserve)?

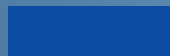


ANTONIO.ILICETO@TERNA.IT

co-Chair WG “Grids & System View” in ETIP SNET

Convenor “Future Energy System” in ENTSO-E

Chairman “System Development & Economics” CIGRE





TRINITY

Álvaro Nofuentes



TRansmission system enhancement of regIoNal borders by means of Intelligent market technology

WHAT

A project with a budget of €550 million will enhance cooperation and coordination among the Transmission System Operators (TSOs) in the Southern and Western

The adoption of a new electricity market design to address the challenges faced by the Southern and Western

HOW

TRINITY's goals will be achieved through the deployment in the region of four independent but complementary TRINITY products:

WHERE

TRINITY technologies will be demonstrated in 8 different countries:

Serbia, Greece, Montenegro, Bosnia and Herzegovina, Croatia, Macedonia, Bulgaria and

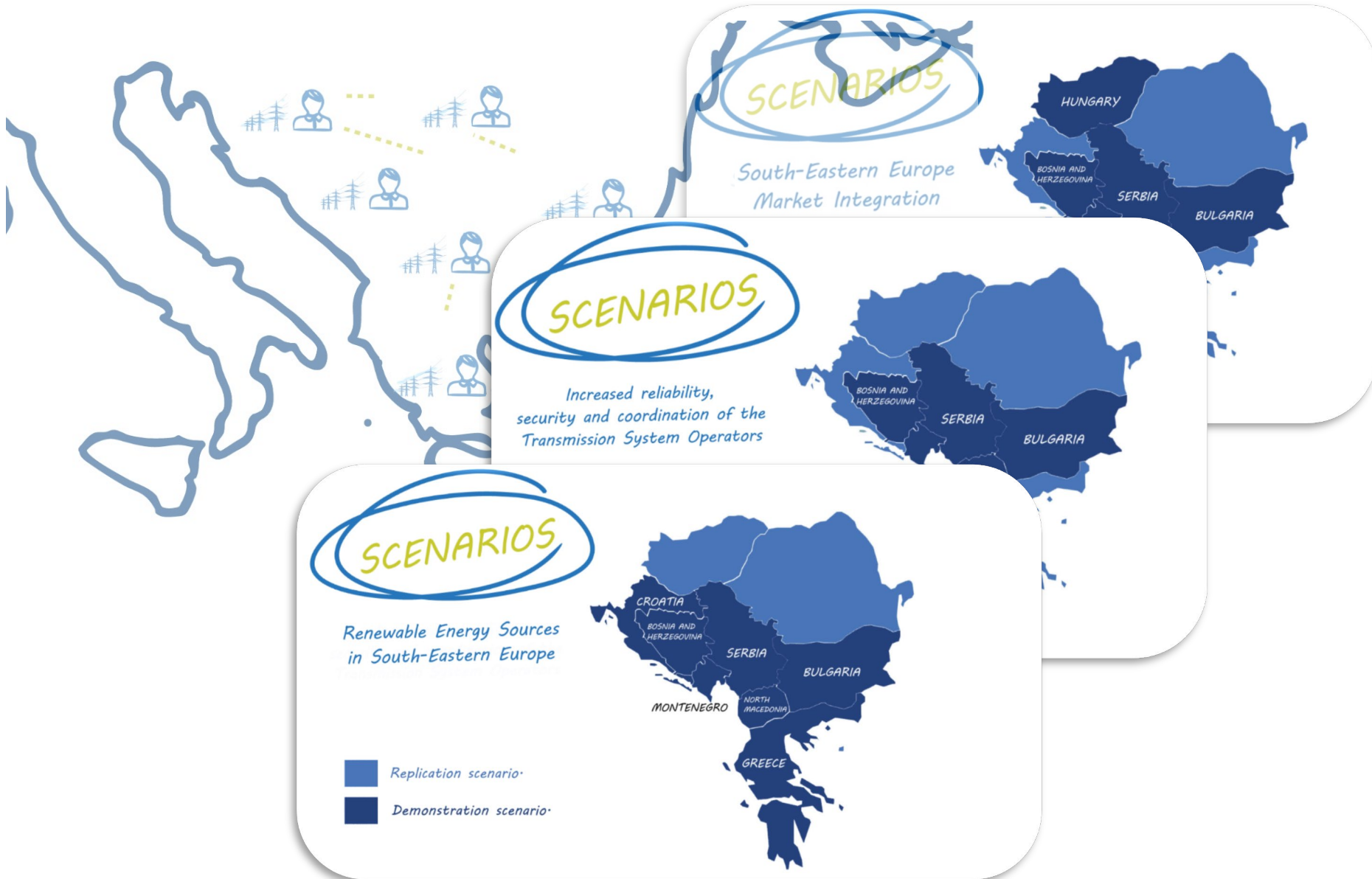
WHEN

48 months starting in October 2017

WHO

TRINITY will be demonstrated by the end-users of the project (5 TSOs, 5 PXs, 1 RSC and 2 RES promoters) with the support of the technical partners. In total, the consortium is formed by 19 partners led by ETRA I+D

Regional integration



Next steps





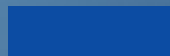
@Trinity_H2020



TRINITY H2020



TRINITY H2020





CoordiNet

Matteo Troncia

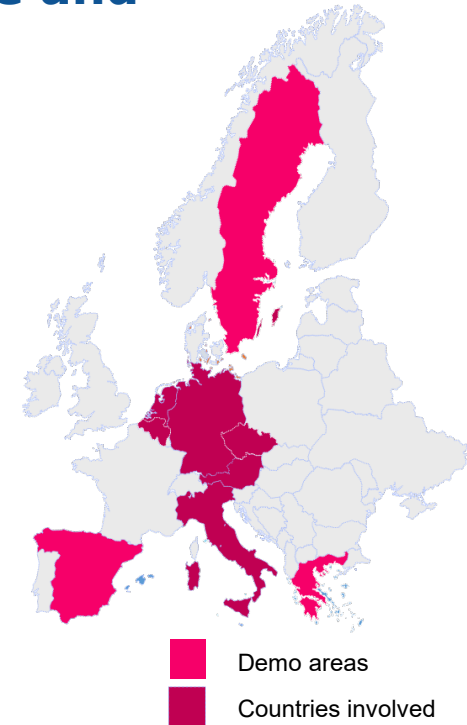


CoordiNet



Large-scale TSO-DSO-Consumer demonstrations of innovative system services through demand response, storage and small-scale DG

- *Objectives:*
 - **Demonstrate** the activation and provision of services through a **TSO-DSO-customer coordination**.
 - Define and test **standard products** that provide services to the network operators.
 - Develop a **TSO-DSO-consumer collaboration platform** in demonstration areas to pave the way for the **interoperable development of a pan-European market**.



- *Timeline: 01/01/2019 – 30/06/2022*
- *Project Budget (funding): 19.2M€ (15.1M€)*
- *23 partners + 10 Linked Third Parties*

CoordiNet project current status

Conceptual Phase

Technical Phase 1

Technical Phase 2 & Conclusions

Concept Framework

- Regulation
- TSO & DSO Needs
- DER Capabilities
- Business Uses Cases
- KPI definition

Demo implementation

Demo 1 results

Demo 2 execution

Demo 2 results

Markets and platforms developments

- Analysis of **market participation** (D2.3) and **market dimensions & requirements** (D2.1), including definitions of products, architecture and validation methods
- **Demo functionalities and requirements** (using inputs on operation and monitoring tools) in D2.2
- **Innovative solutions adopted** (D2.5)

- Demo evaluation
- Market simulations
- Scalability and replicability
- Economic assessment
- Integrated ICT architecture
- Consumer engagement

Roadmap,
Conclusions
and
COORDINET
recommendations

Investments versus flexibility

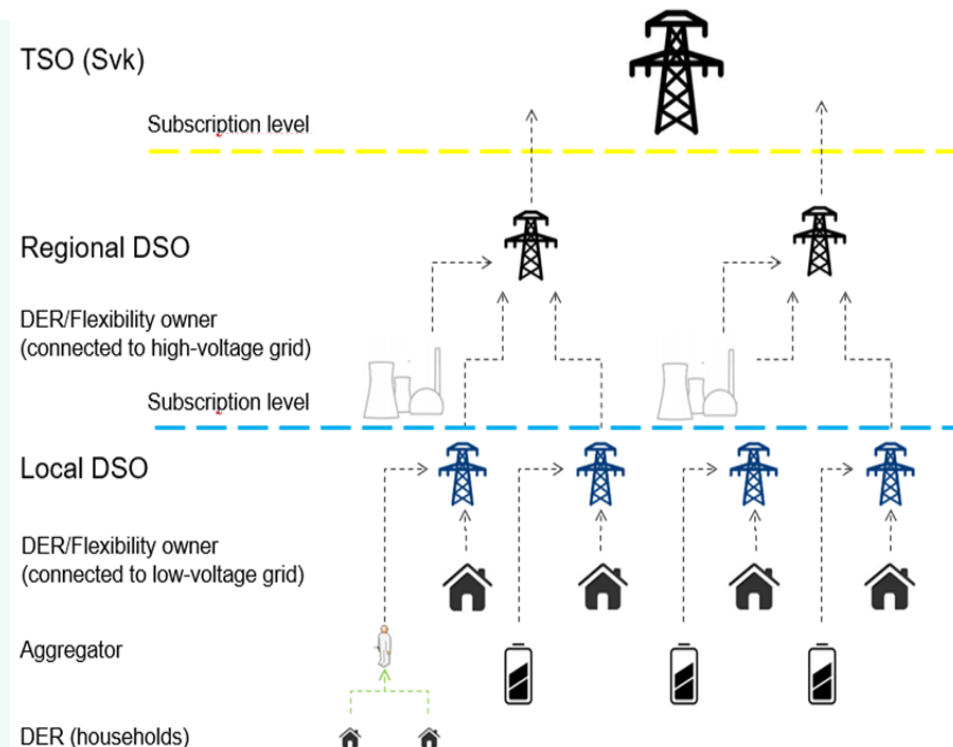
Swedish demo: business case congestion management

Limits exist for the **power subscription levels** between the **local DSO** and **regional DSO** and between the **regional DSO** and **TSO**

Subscription limits violation are subject to **cost**, and may be denied

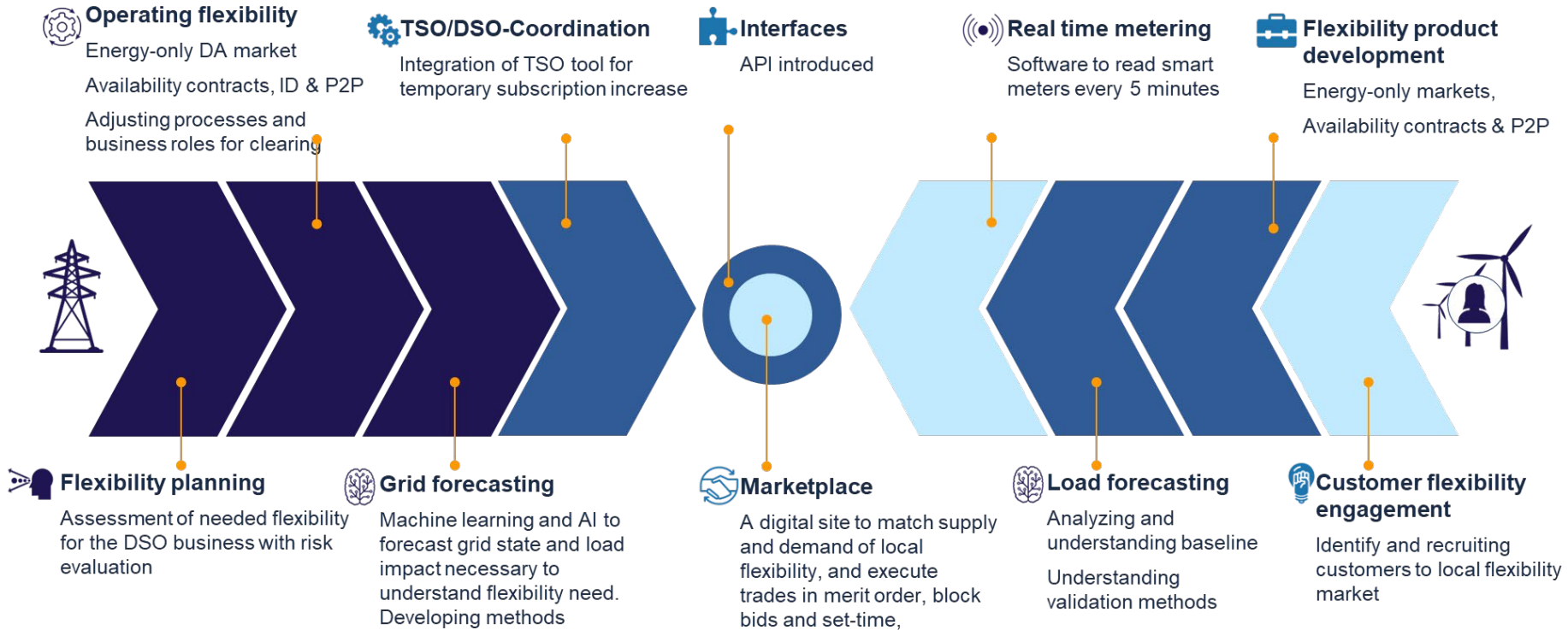
The DSO **utilizes flexibility services** to **lower peak demand** of its grid during the winter season November to March

A **grid state forecast** makes it possible to call for **flexibility day-ahead** working proactively to **alleviate grid congestion** that has strong correlation with temperature



Local Flexibility Markets

Swedish demo



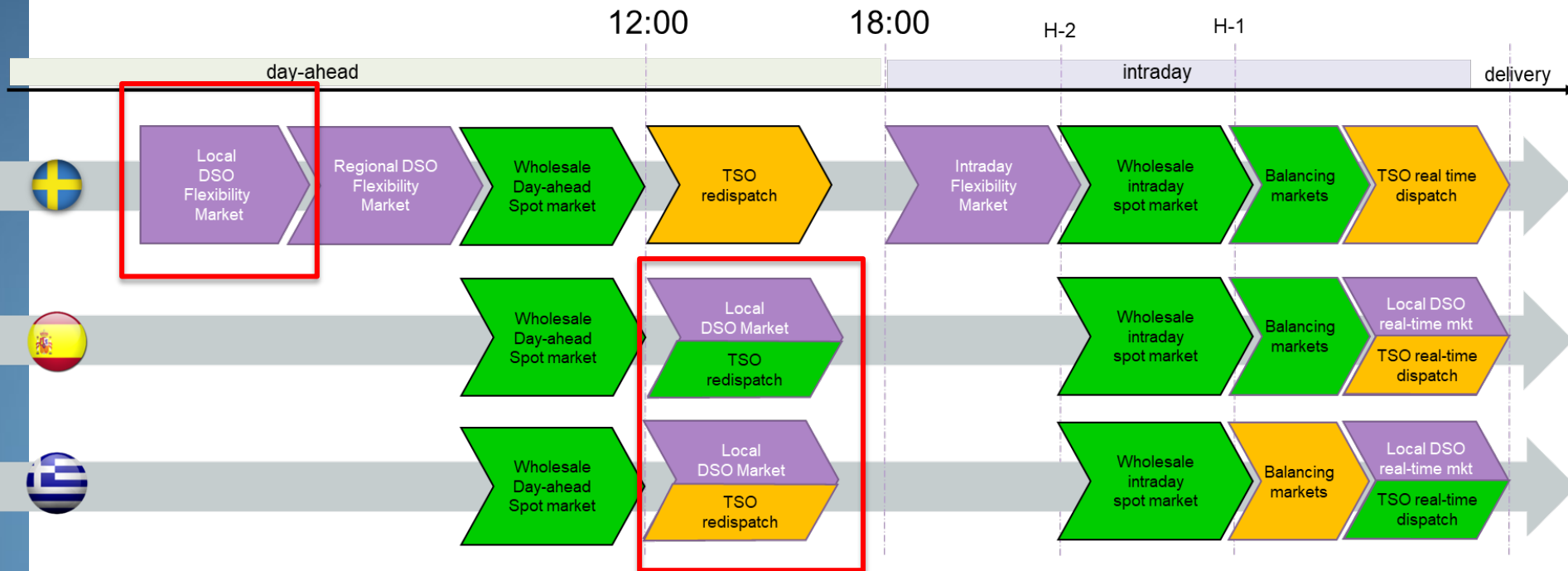
e-on

VATTENFALL



Local Flexibility Markets

Time-integration with actual wholesale and balancing markets



First barriers identified

Timing aspects of the market and its integration with other markets

- Challenging to **align the timing** of local flexibility markets with EU wholesale and balancing markets
- DSO and TSO: gate closure time close to real-time makes it difficult to **evaluate grid status and flexibility needs**
- FSPs: gate closure time close to real-time - better forecasts, but technical constraints can **limit participation**
- Risk for **gaming** between markets

Aggregation

- **Validation of flexibility**
Independent data management to validate flexibility delivery
- **Imbalance penalties**
Who will be financial responsible?

Level of product standardization

- **Coordinate products between DSO and TSO**
Challenging to fulfill the stricter requirement of the TSO
- **Few standard products with ranges for values of attributes**
Gives flexibility to TSOs or DSOs to better adapt to their needs and FSPs.

Consumer engagement

- **Inversion required in management and control**
 - Difficulties with small FSPs
 - Long term engagement
 - Technical requirements
 - Clear business model
- **Long and complex prequalification process**



PHOENIX

Mihai Paun



PHOENIX - Electrical Power System's Shield against Complex Incidents and Extensive Cyber and Privacy Attacks

PHOENIX is a Horizon 2020 collaborative project, co-funded by the European Union.

The Romanian Energy Association - CRE is a direct partner in PHOENIX Project together with its two members TRANSELECTRICA, DELGAZ (RO) as well as TELETRANS.

PHOENIX Project focuses on the protection of the European end-to-end European Electrical Power Energy systems (EPES) via early detection and fast mitigation of cyber-attacks against their assets and networks from human activities, while protecting the utilities and end-users' privacy from data breaches by design.

The consortium is coordinated by Capgemini Technology Systems and brings together 24 partners from 11 EU Countries.

The challenge of the project is to provide a cyber-shield armour to European EPES to survive coordinated, large scale cybersecurity and privacy incidents; guarantee the continuity of operations and minimize cascading effects in the infrastructure itself, the environment and the end-users at reasonable cost.

- *Start Date: 01/09/2019*
- *End date: 31/08/2022*

Energy Grid Flexibility and CyberSecurity

Being flexible with how and when we consume and produce energy means we can make sure the power generated and delivered to us always matches the amount we use.

Increasing flexibility implies growing the number of managed grid participants, producers and managed consumers

Growing the grid management implies growing and opening data network, control network, and Operational Technology network (OT).

All this networks can be targets of cyberattacks and increasing the cyber resilience is a vital task.

Investments versus Flexibility

Phoenix is a Cybersecurity project that is targeting of increasing cyber resilience of EPES. The Phoenix tools are targeting in the same time the new and developing operational trends and also old, legacy operational technology tools and market tools. By securing the data networks and OT networks and allowing secure access to increased number of Flexibility providers the reliability of the grid is increasing.

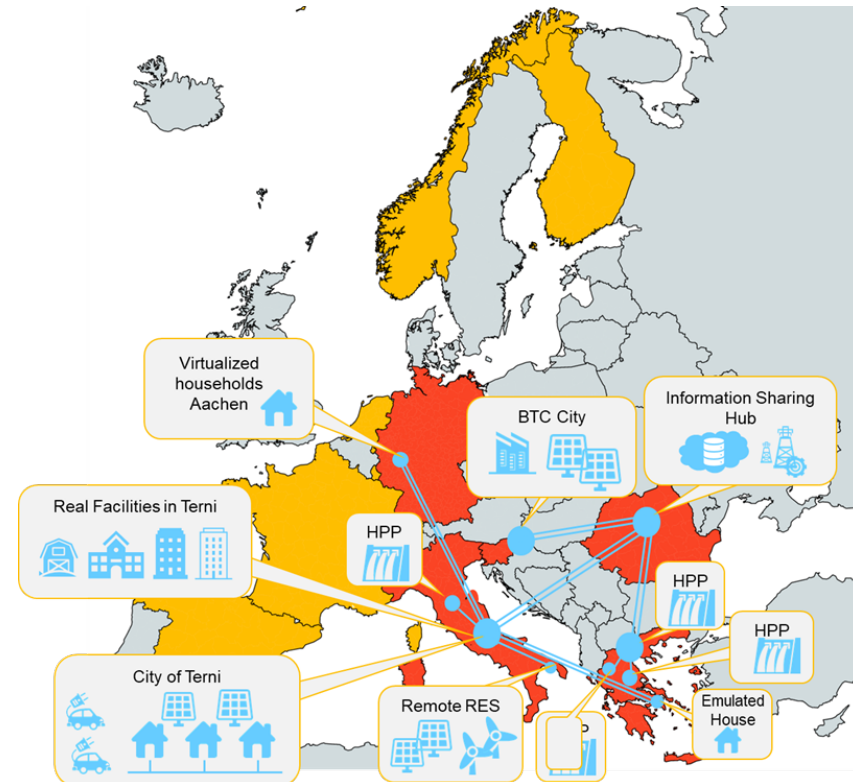
The top layer of Phoenix Project is the Incident Information Sharing platform providing Cybersecurity incidents information to all Energy stakeholders connected to the system.

By enlarging the number of flexibility providers, outside of system operators, the investments of system operators can be reduced

PHOENIX Demo Sites

5 diverse Large-Scale Pilots:

- *Multi-utility/Multi-owner RES cyberthreats and data breach detection (Italy).*
- *National-wide cooperative remotely controlled HPP (Greece)*
- *Collaborative Microgrid-enabled cyber risks mitigation (Slovenia)*
- *Collaborative / DSO flexibility vs cybersecurity and privacy (Italy, Germany, Greece)*
- *National vs Pan-European cooperative cyber threat information sharing (Romania)*



Local Flexibility Markets

Phoenix Project aims to increase the resilience of the data networks used in the Market access.

In terms of the impact on the roles and responsibilities of system operators, Phoenix Project targets to increase the Cybersecurity responsibilities of the system operators.

Regional Integration

The regional integration has two layers one is the grid integration the other is the data and the Operational Technology network integration. Phoenix is focusing on data and OT integration increasing the cyber resilience of regional integration.

Lesson learnt from PHOENIX Project

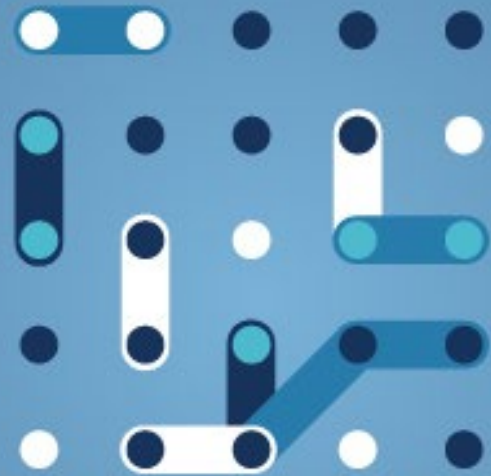
PHOENIX will involve real-world scenarios to validate the effectiveness of PHOENIX across 5 European Large Scale Pilots (LSP) in Italy, Germany, Slovenia, Greece and Romania involving the complete end-to-end generation, transmission, distribution to the entire value chain.

Beyond the individual Large Scale Pilots, cascading effects even to other critical infrastructures will be simulated and cross-border security and privacy sites will be tested and validated.



INTERFACE

Nikolaos Bilidis



INTERFACE - TSO-DSO-Consumer

INTERFACE aRchitecture to provide innovative grid services for an efficient power system



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

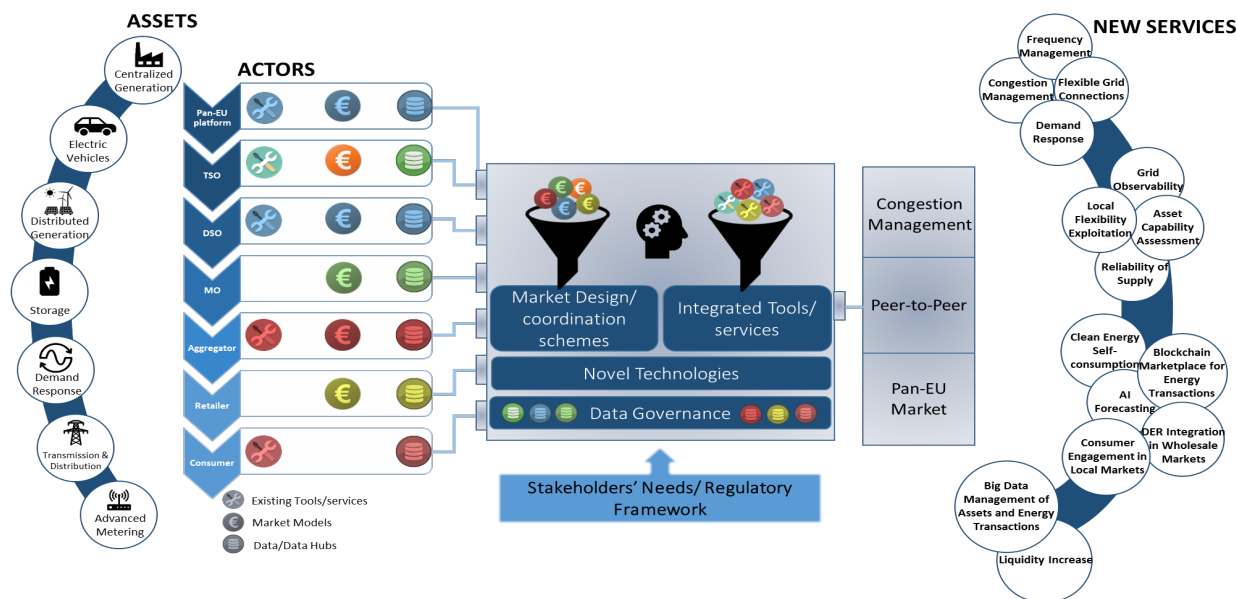
- Project Grant Agreement No. 824330
- Budget: 20.9 M Euro
- Grant: 16.8 M Euro
- Duration: 4 Years



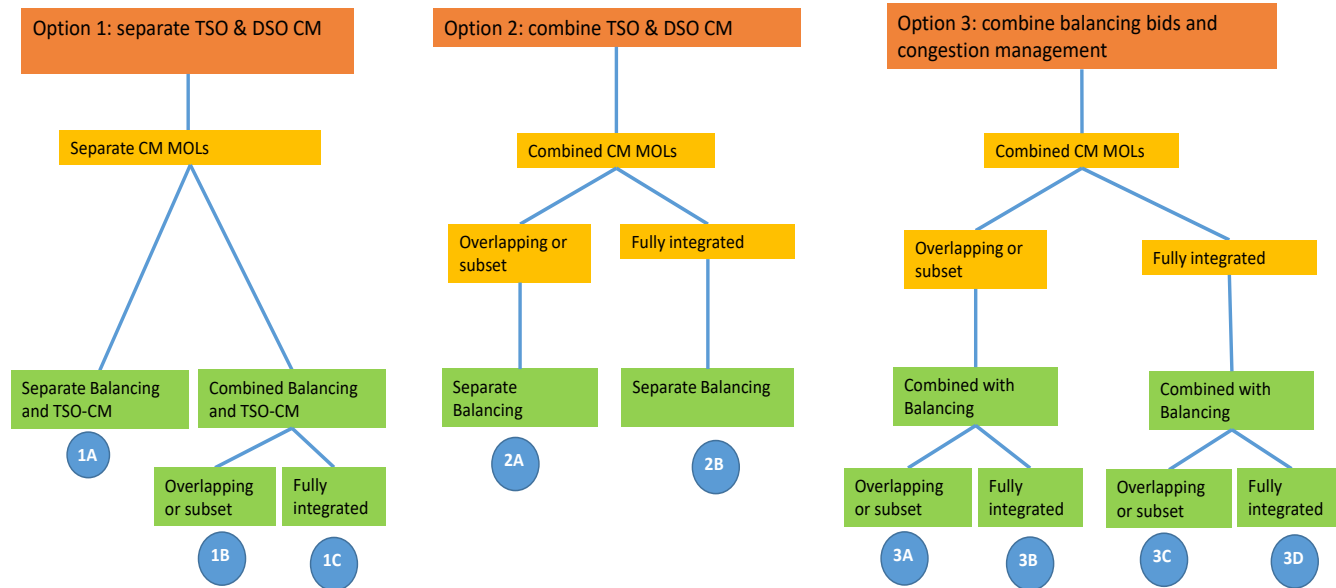
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824330

INTERFACE – Objectives & IEGSA

- To create a common architecture connecting market platforms to establish a seamless pan-European electricity exchange linking wholesale and retail markets and allowing all electricity market players to trade and procure energy services in a transparent, non-discriminatory way.
- To define and demonstrate standardised products, key parameters, and the activation and settlement process for energy services.
- To drive collaboration in the procurement of grid services by TSOs and DSOs, and to create strong incentives to connected customers, by improving market signals and allowing them to procure services based on specific locations and grid conditions.
- To integrate small scale and large scale assets to increase market liquidity for grid services and facilitate scaling up of new services which are compatible across Europe.
- To promote state-of-the-art digital technologies that consumers are familiar with in other everyday transactions (i.e. e-auctions, e-commerce, e-banking, social networks), into the electricity value chain engaging end-users into next generation electricity market transactions, creating incomparable economic benefits by deferring conventional energy infrastructure investments.

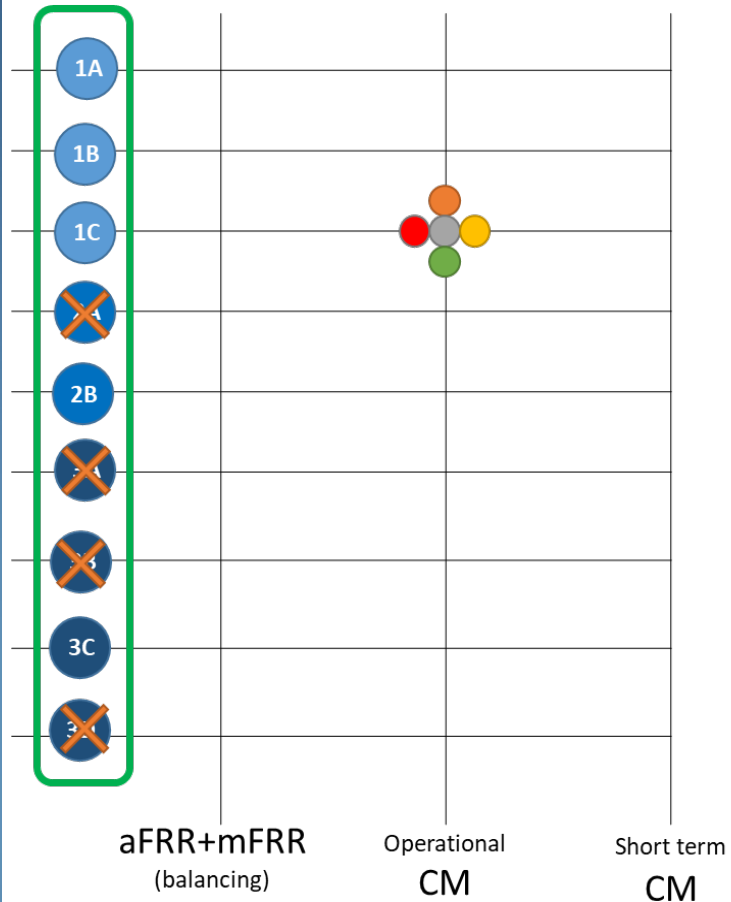


Coordination Schemes & Market Designs



	CM separated from other markets	CM combined with other markets by overlapping or subset MOLs	CM fully integrated in other markets
TSO	1A	1B	1C
DSO	1A	---	---
TSO & DSO Combined by subset or overlapping	2A	3A	3B
TSO & DSO fully integrated	2B	3C	3D

Coordination Schemes & Market Designs



● 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

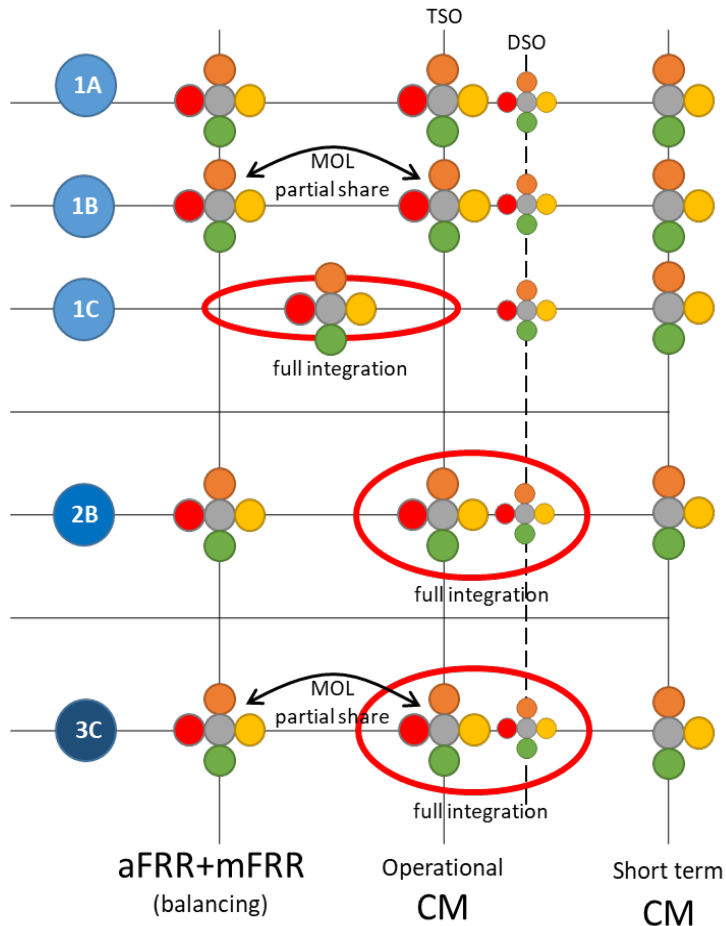
● Activation

- 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

Coordination Schemes & Market Designs



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

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Procurement of energy products

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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

Local Flexibility Market Concept

- **Continuous peer-to-peer trading** platform in the **intraday** timeframe
 - 15min (and maybe 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)
 - Anonymized trading is not obligatory
 - DNUT calculation is based on load-flow like calculation
 - DNUT can have different tariff elements 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

Lessons learnt

- Importance of markets for ancillary services and especially for congestion management markets is expected to rise
- The rising interest of small consumers and producers to participate on markets and to trade electricity locally while maintaining independence might lead to new local markets concepts.
- Local p2p markets can be a possibility to increase consumer participation on markets. These markets can incorporate additional decision criteria like regional, or ecological parameters.
- Market integration allows **the same flexibility** to be offered **to different markets**, thus **increasing the effectiveness of flexibility usage** and **creating more opportunities for TSOs and DSOs** for network control and optimal grid management as well **as increased balancing market for TSOs.**



EUniversal

Susete
Albuquerque





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864334

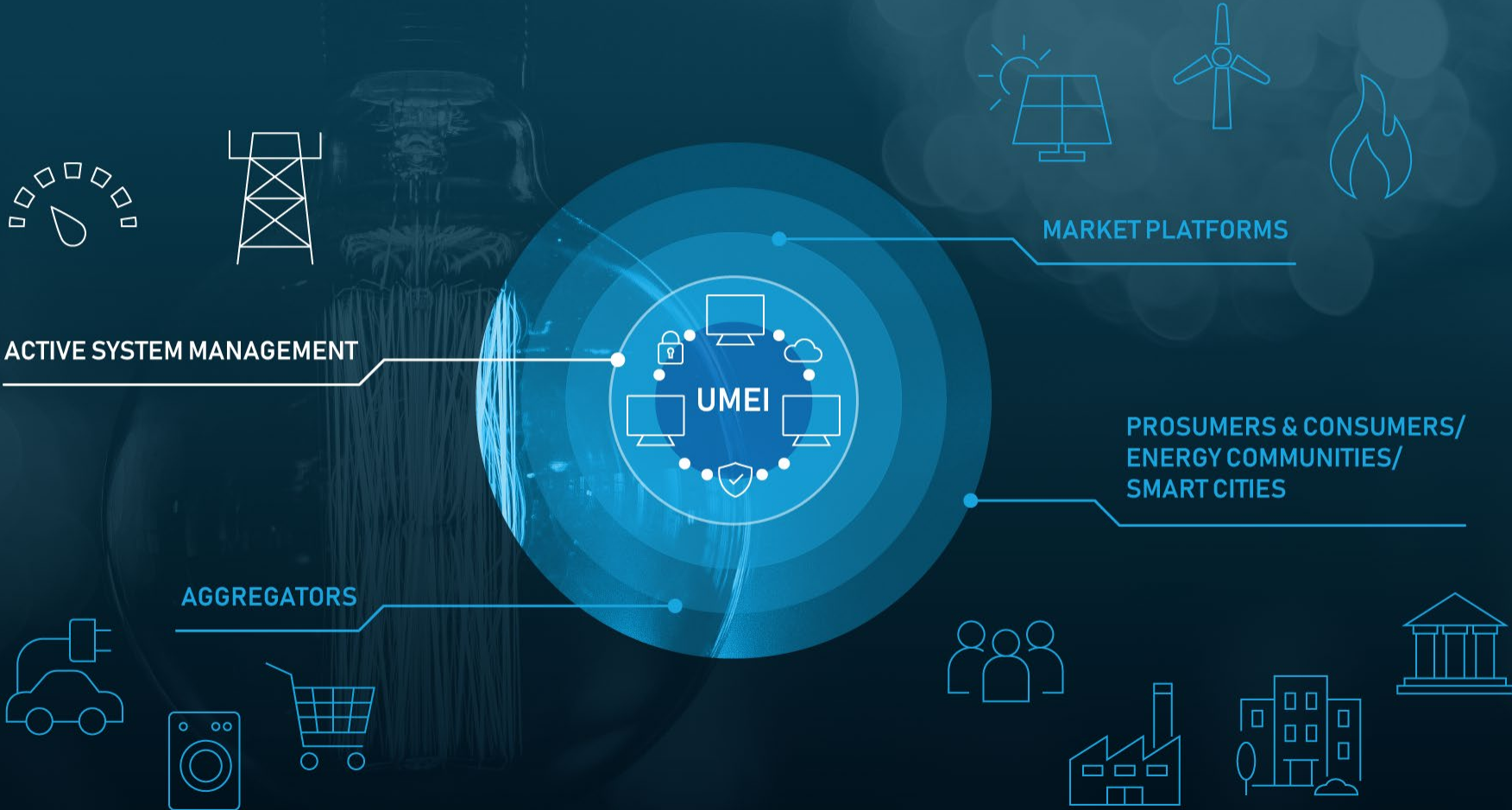


EU Universal

UMEI

Linking active system management to flexibility markets

Universal Market-Enabling Interface



DSO



(including:



westenergias LTP)

Market/aggregator



Research



Association



Solution provider

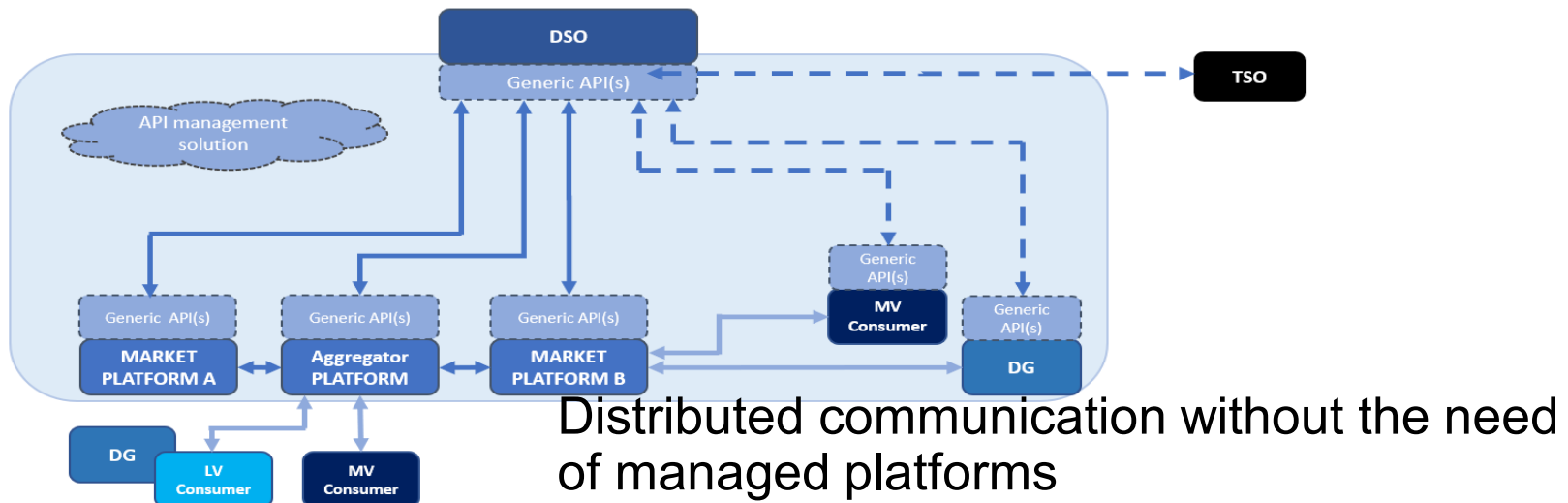


Consulting






















The EUniversal project aims to develop a universal approach on the use of flexibility by DSO and their interaction with the new flexibility markets, enabled through the development of the concept of the Universal Market Enabling Interface (**UMEI**) – a unique approach to foster interoperability across Europe.

The **UMEI** will materialize in the conceptual architecture design and the implementation of a **standard, agnostic, adaptable and modular** REST API to link DSOs and market parties with flexibility market platforms, in coordination with other flexibility users.



	DSO Needs	 Flexibility Service
	Physical congestion	Corrective and Predictive Congestion Management
	Control of voltage violation	Corrective and Predictive Voltage Control
	Support to network planning	Support to Network Planning
	Phase balancing	Corrective and Predictive Voltage Control
	Support to planned and unplanned operations	Corrective and Predictive Congestion Management, Corrective and Predictive Voltage Control, Islanding, Emergency Load Control and Mobile Generation Capacity
	Support to extreme events	Corrective and Predictive Congestion Management, Corrective and Predictive Voltage Control, Islanding, Black Start and Mobile Generation Capacity
	Support to islanding	Islanding

Mechanism	Service	Buyer	Auction type	Product	Timeline	Aggregation	Demo	Platform	
							 DE  PL	NODE S <input checked="" type="checkbox"/>	N- SIDE <input checked="" type="checkbox"/>
Flexibility market	Corrective Congestion management and voltage control	DSO only	Continuous market	AP	Day-ahead intraday	Yes	 DE  PL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						No	 DE  PL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						Yes	 DE  PL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						No	 DE  PL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Flexibility market	Corrective and Predictive Congestion management and voltage control	DSO only	Continuous market (NODES) Call market (N-SIDE)	AP/RP	Day(s)-ahead Weeks-ahead	Yes	 PT3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						Yes	 PT4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						Yes	 PT1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						Yes	 PT2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Flexibility market	Corrective Congestion management Corrective Voltage control	DSO only	Continuous market (NODES) Call market (N-SIDE)	AP	Day(s)-ahead	Yes	 PT1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						Yes	 PT2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Flexibility market	Corrective Congestion management via flexibility of the line capacity	Producer		>RES generation than connection agreement limit	Day-ahead	No	 PL DLR	<input checked="" type="checkbox"/>	<input type="checkbox"/>
						No	 PL FS	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bilateral contract	Corrective Voltage Control		Flexstation solutions				 PL FS	<input checked="" type="checkbox"/>	<input type="checkbox"/>

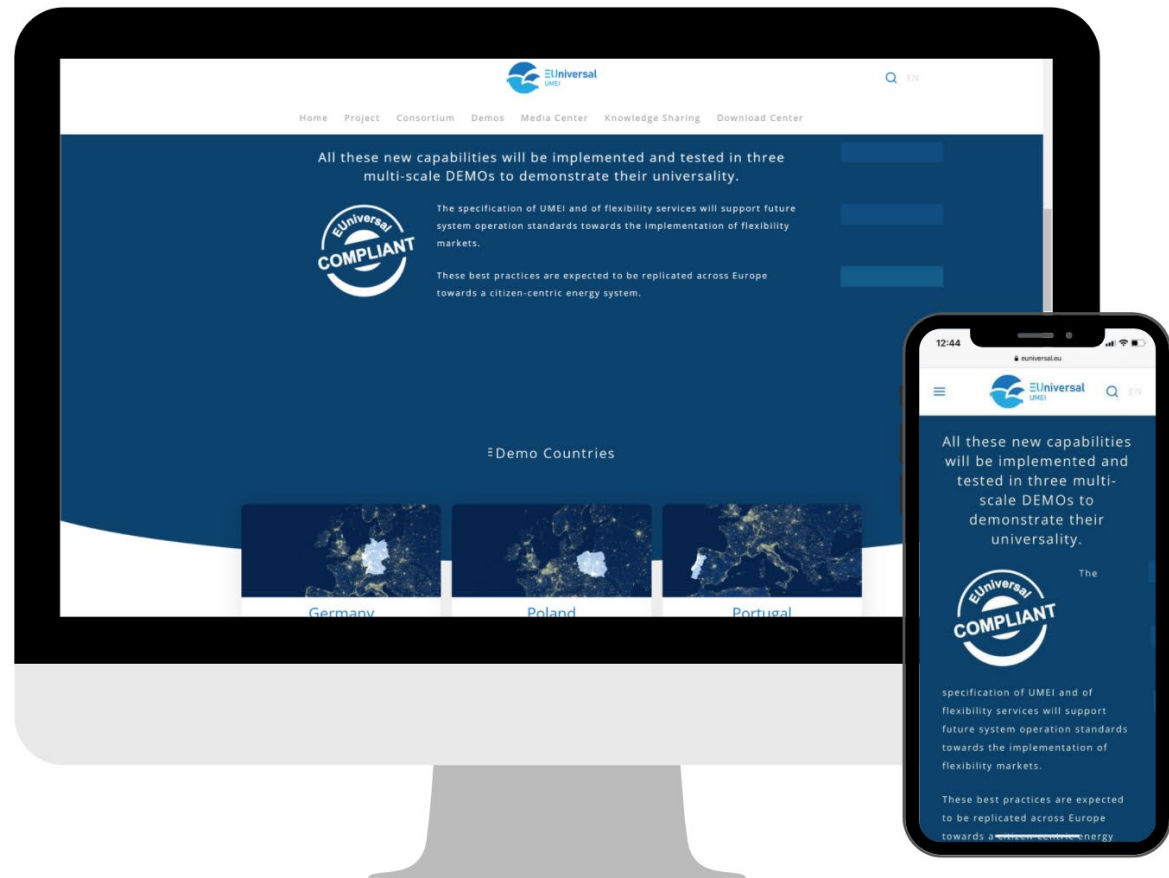
- *Identifying the relevant **market mechanisms** for the procurement of flexibility needs and grid services*
- *Aligning the specifications of the **market platforms** with the market mechanisms;*
- *Designing of a methodology for **dynamic distribution grid tariffs**, matching the preferences of the flexibility providers with the needs of the DSOs;*
- *Analysing the impact for the delivery of innovative products and services from a **peer-to-peer market** perspective;*
- *Evaluating the proposed market mechanisms from a **multi-stakeholder perspective**.*

- **Improve network observability**, including the integration of MV load allocation and LV state estimation tools to characterize the LV network status, in terms of voltage.
- **Predictive grid applications**: anticipating potential network restrictions, ensure optimized use of network assets, quantifying flexibility needs and validating flexibility market results both in day-ahead and intraday.
- **Coordinated control framework between grid voltage levels.**
- Improve grid operational resilience, **including flexibility in operation and maintenance planning**, increasing the capacity to deal with unexpected events, considering for example self-healing capabilities.
- **optimize network investment planning** considering available flexibility from market-based services



Coming soon:

UMEI public available specification





EU Universal UMEI

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Conclusions



Manuel Serrano – Moderator



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