



CIRED 2025 Webinar

How are DSOs using flexibility to deliver the low-carbon energy transition now and in the future?





- **Peter Söderström**, CIRED GA Chair and Director, Sweden
- **Marie Cecile Alvarez**, Associate Professor Grenoble INP-UGA and G2Elab, France
- **Fabrizio Pilo**, Full Professor of Power Systems, Università di Cagliari CIRED TC Chair, Italy
- **Alfred Einfalt**, Principal Key Expert, Foundational Technologies, Siemens, Vienna, Austria
- **Mark McGranaghan**, EPRI Fellow ,EPRI Europe
- **Mário Teixeira Couto**, Senior Technical Leader, Electric Power Research Institute (EPRI)





How are DSOs using flexibility to deliver the
low-carbon energy transition?

Live Webinar: 9 December 2024 | 14:30 – 16:00 CET

Network Planning and System Design with Flexibility

Main outcomes of the CIRED working group
Case of France

Marie-Cecile Alvarez-Herault
Associate Professor, Grenoble INP-UGA, G2Elab
SmartGrids chair holder with Enedis



Broader definition of flexibility

Power (P & Q) modulation (↑ or ↓)

Any flexible resources

- Customer devices (heaters, electric vehicles, etc.)
- Assets owned by the DSO (in some countries)



Power system operator or other third parties optimize their operation condition without affecting their security and reliability

Voluntary response to a need (a signal)

- direct (control action)
- indirect (incentives or restrictions on use)



Global flexibility
related to the mission of the TSO



Local flexibility
related to the mission of the DSO



How are DSOs using flexibility to deliver the low-carbon energy transition?

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CIRED working group on flexibility

R&D efforts must support flexibility evolution based on existing and coming policies

- ✓ Development of proper simulation methodology and tools to integrate flexibility into planning
- ✓ Technical and economic enablers



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CIRED working group on flexibility

- ✓ Development of proper simulation methodology and tools to integrate flexibility into planning
 - Cross-sectoral models and tools to integrate other energy sectors
 - Network observability
 - Integration of new metrics related to risk, reliability, uncertainties, hosting capacity and market into planning (for example: availability of flexibility, willingness to accept not to be served for a certain period, willingness to be payed to be flexible, etc.)
 - Prosumer modelling and involvement thanks to collaboration around flexibility with the social science community



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CIRED working group on flexibility

✓ Technical and economic enablers

- Dynamic tariffs could be a game changer
- Compatibility and/or standardization of communication networks and protocols
- Development of a flexibility market to accelerate the integration of flexibility
- The exchange of flexibility must operate across organization boundaries



Case of France

3 main types of flexibility

- **Structural flexibility**: defining the network “as it will be”
- **Operational flexibility** (dynamic and balancing from systems perspective) : operating the network “as it is”
- **Safeguard flexibility** to handle exceptional situations

which can be addressed by 4 economic models

- **Tariff-based**
- **Rules-based**
- **Flexible connection agreements**
- **Market-based**



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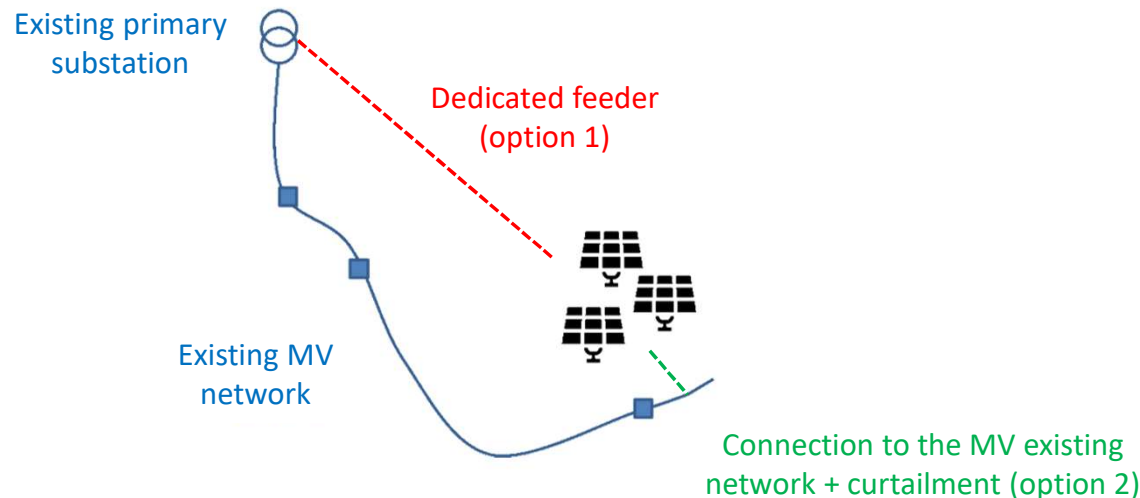
Case of France

	Structural flexibility	Operational flexibility	Safeguard flexibility
Tariff-based	<p>Off-peak time in winter at night (hot water boilers and recharging electric vehicles)</p> <p>“Solar” off-peak time in summer</p>	<p>Dynamic time ToU</p>	X
Rules-based	<p>Definition of limitation quotas in contracts allowing works (eg. S3RENR).</p>	<p>Optimization of the unavailability of assets and the use of quotas.</p> <p>Use of capacity short term reservation contracts (a few months or weeks).</p> <p>Examples:</p> <ul style="list-style-type: none"> • Avoidance of power cuts during works • To get through cold peaks 	<p>Emergency disconnection</p> <p>Rotating outages</p> <p>Example: “temporary power limitation” tested with positive feedback during winter 2023-2024 on 100 000 Linky customers.</p>
Flexible connection agreements	<p>Permanent smart connections, i.e., more customers can be connected to the same structure.</p> <p>Examples in the next slides (ORA-MT & REFLEX)</p>	<p>Activating forward capacity allocation (FCA).</p>	X
Market-based	<p>Flexibility contracts with capacity reservation to postpone the reinforcement date.</p> <p>See example of Enedis flexibility plateforme</p>	<p>Flexibility with or without capacity.</p>	X

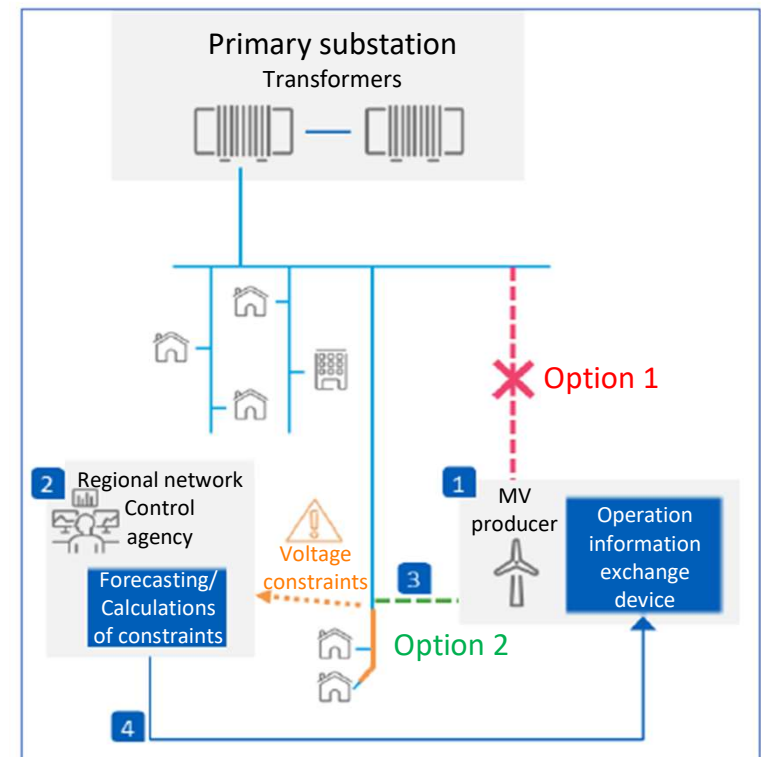
Alternative connection offer with power modulation (ORA-MP) since 2021

Cheaper and faster connection of MV producer

- Curtailment not remunerated
- Power injected by the producer is limited to P_{lim} ($P_{lim} \geq 70\%P_{inj}$)
- Annual energy curtailed limited to 5% of the annual production



Picture from @Smartgrids CRE modified



Picture from @Enedis modified

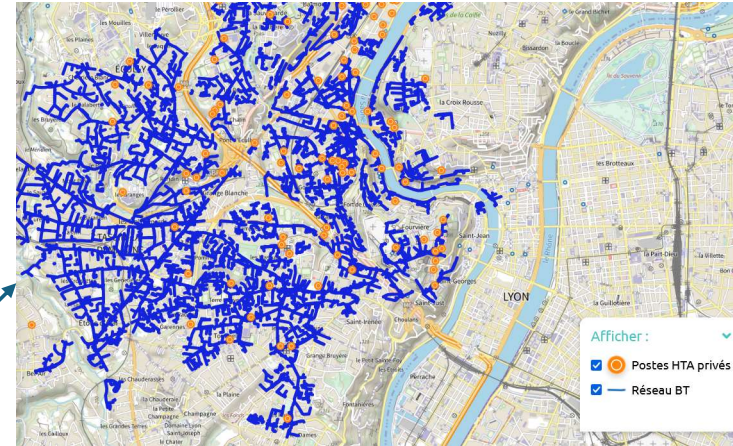
Alternative connection of MV consumer and storage under experiment



Flexibility platform created in 2019

Use cases

- Deferring grid investments
- Increasing hosting capacity



Geographical information

Les flexibilités locales au service de la transition énergétique

Vous êtes raccordé au réseau de distribution d'électricité, ou vous avez un projet de raccordement ? Vous pouvez proposer des flexibilités locales, dans les zones identifiées par Enedis. Ces flexibilités permettront de faciliter l'insertion des ENR et d'optimiser la gestion du réseau de distribution au bénéfice de la collectivité.

Cliquez sur la zone correspondant à votre situation géographique.

Les appels au marché :

- Offre à la hausse
- Appel au marché terminé [Voir les zones](#)
- Offre à la baisse
- Reflux - Appel au marché en cours [Voir les zones](#)
- Reflux - Appel au marché potentiel [Voir les zones](#)
- Reflux - Appel au marché terminé [Voir les zones](#)

ENEDIS

Documentation
CGU
Mentions légales
Restez informé
Enedis.fr

Contactez-nous

Vérifier son éligibilité

Rentrez votre Point de Livraison (PDL) ou Point de Référence Mesure (PRM)

Pays-Bas

PDL ou PRM (10 à 14 chiffres)

Vérifier plusieurs PDL ou PRM

Recevoir les résultats par mail

Afficher :

- Appel au marché en cours
- Appel au marché potentiel
- Appel au marché terminé
- Somme des opportunités dans la zone

Type de besoin à afficher :

- Offres à la baisse
- Offres à la hausse

Enedis flexibility needs

Dates de début et de fin

Monday 01 July 2024

Wednesday 31 May 2025

Type de contrat

Sans réservation de capacité

Type de rémunération

Rémunération variable

Produit attendu par Enedis en puissance et en durée

A partir de 500kVA

A partir de 30min

Période d'activation

Jan. Feb. Mars **Avril** Mai Juin Juill. Août Sept. Oct. Nov. Dec.

Lun Mar Mer Jeu Ven Sam Dim

0 3 6 9 12 15 18 21 24

08h00 à 13h00

18h00 à 20h00

Technical information

In 2024 : 51 contracts awarded (~ 46 MW of flexibility) which will be provided by 3 FSPs* no later than June 2025

*FSP : flexible service provider

REFLEX project

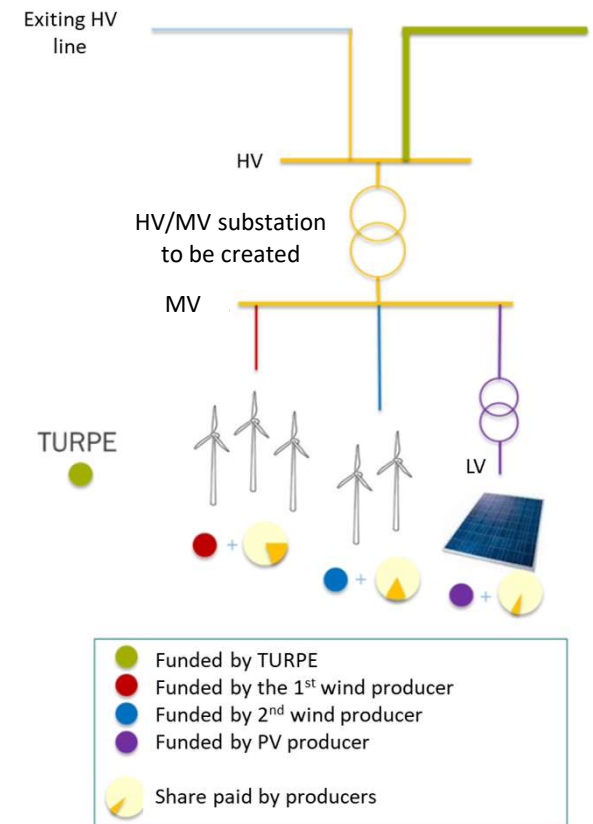
S3RENR : Hosting capacity maps at the level of primary substations

- Definition of a reserved capacity for producers
- Evaluation of the cost of reinforcement or creation of new assets
- Computation of a share between producers

REFLEX project : On-going experiment

- Extend the capacity of primary substations to
- Period : 2021-2024
- Renewable producers are remunerated to be curtailed to avoid network reinforcement
- Tested on 10 primary substations, increase of 210 MW of production capacity expected

Curtailement of renewable productions will be added in the S3RENR if positive feedback of the experiment



@CRE (French regulator)



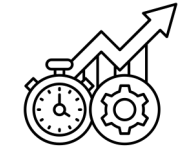
The Role of Flexibility in the Italian Distribution networks: some considerations from research and pilot projects

Fabrizio Pilo – CIRED TC Chair
Università di Cagliari, Italy

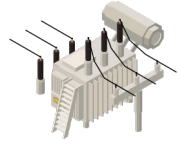


Planning and Flexibility

- Feasibility and cost-effectiveness of flexibility versus "copper and iron" investments
 - DER
 - Forecast
 - Uncertainty and related risks
- Regulation and market?
- CAPEX vs OPEX?
- Resilience?



Optimised investments



Asset reinforcements



Maintenance planning, and connection work



Quality of supply



Network extension timescales



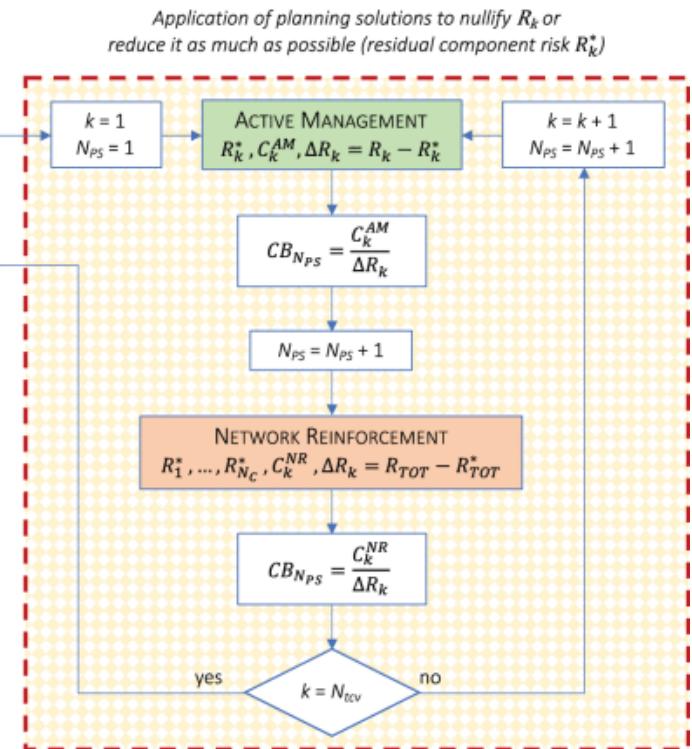
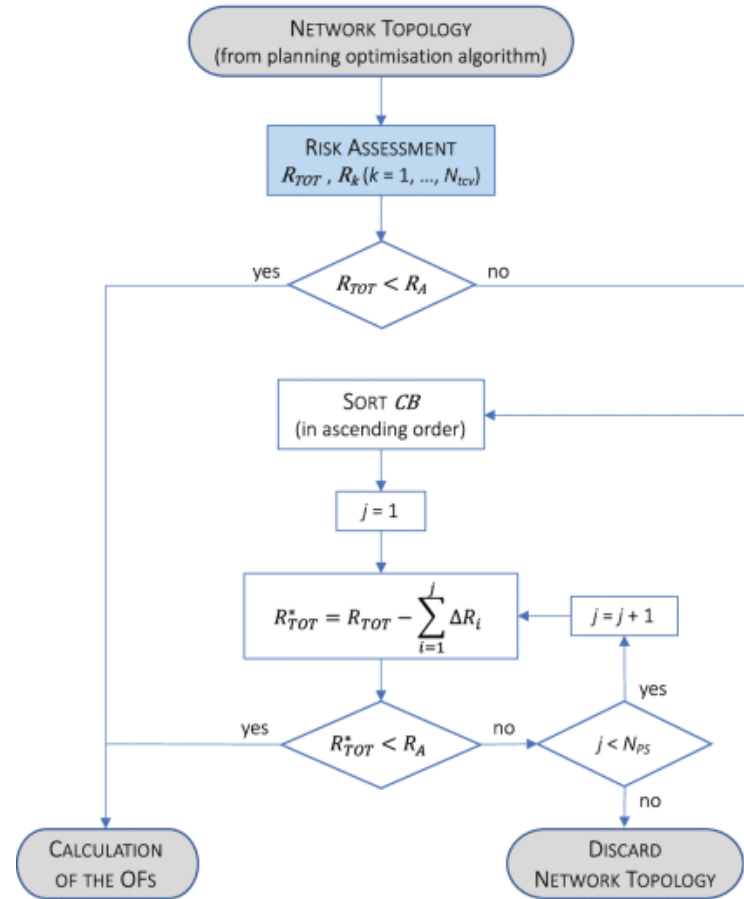
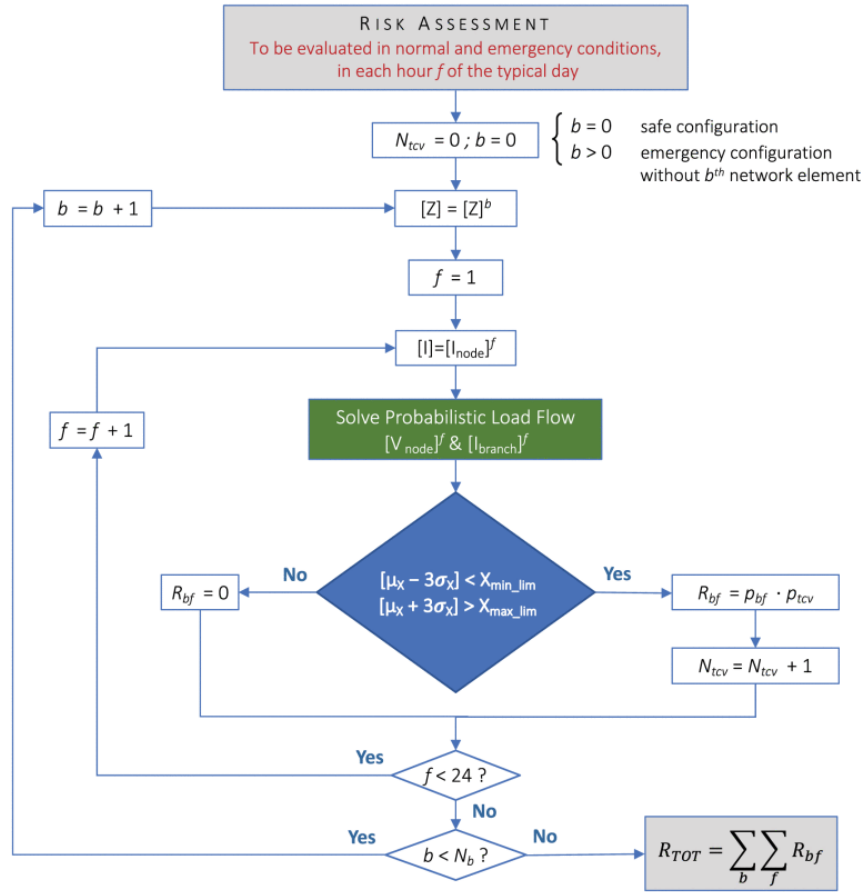
Capability / loadability of assets



Resilience

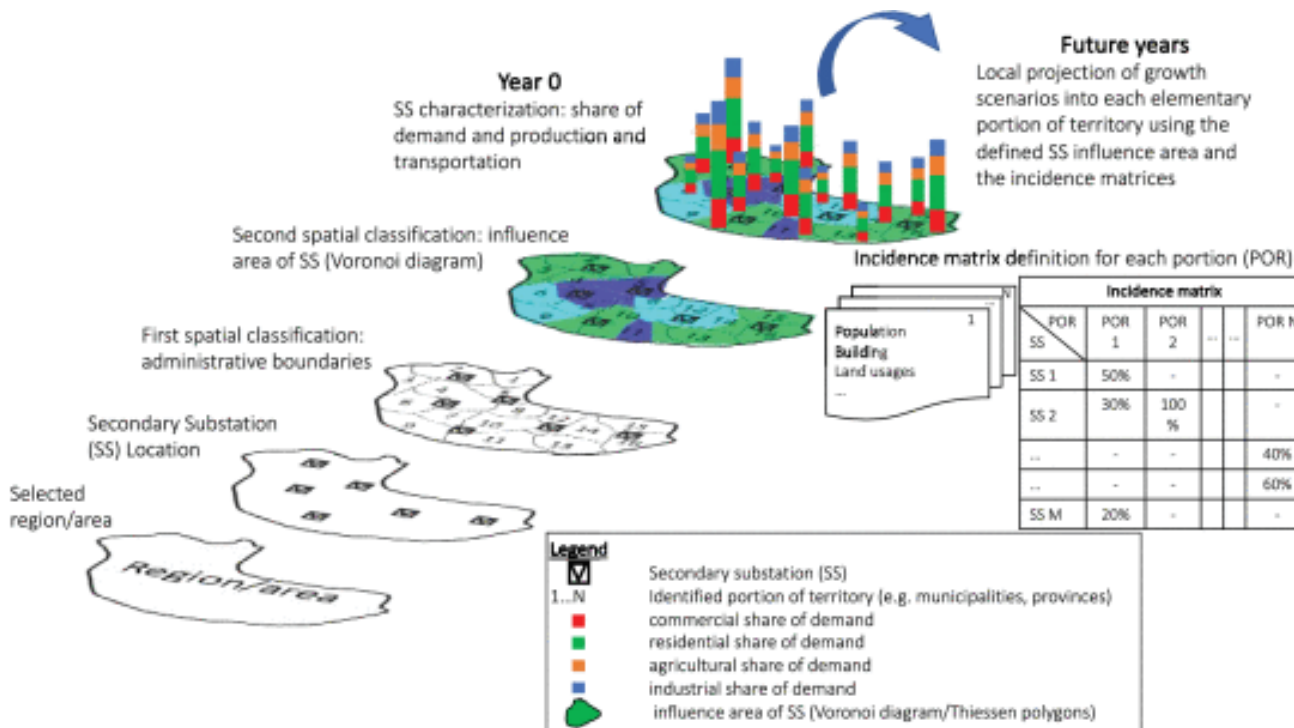


Flexibility and Risk Management





Geospatial Forecasting – From Scenarios to Networks



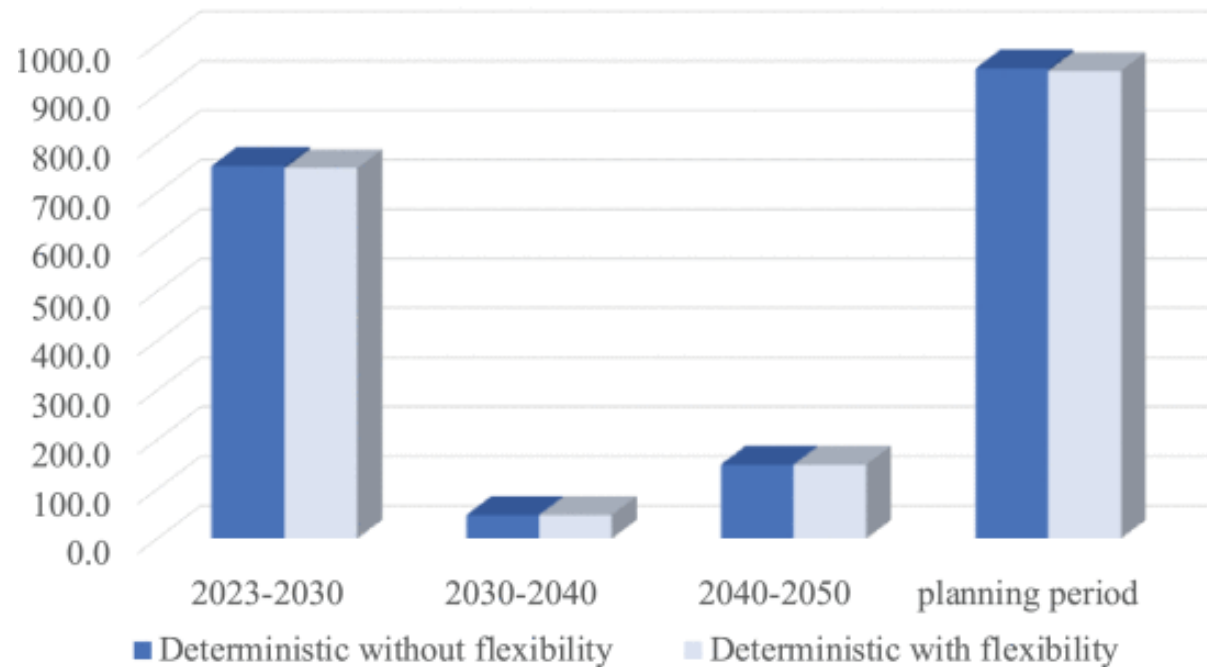
Sector	2030	2050
Residential	+14 %	+37 %
Industrial	+7 %	+79 %
Tertiary	+14 %	+25 %
Agriculture	+6 %	+25 %
Transport	144%	930%

	2030	2050
Wind expected capacity [%]	8%	112%
PV expected capacity [%]	471%	658%



The model is crucial – Development plans are affected by models – Standardisation? How to standardise? How to compare development plans?

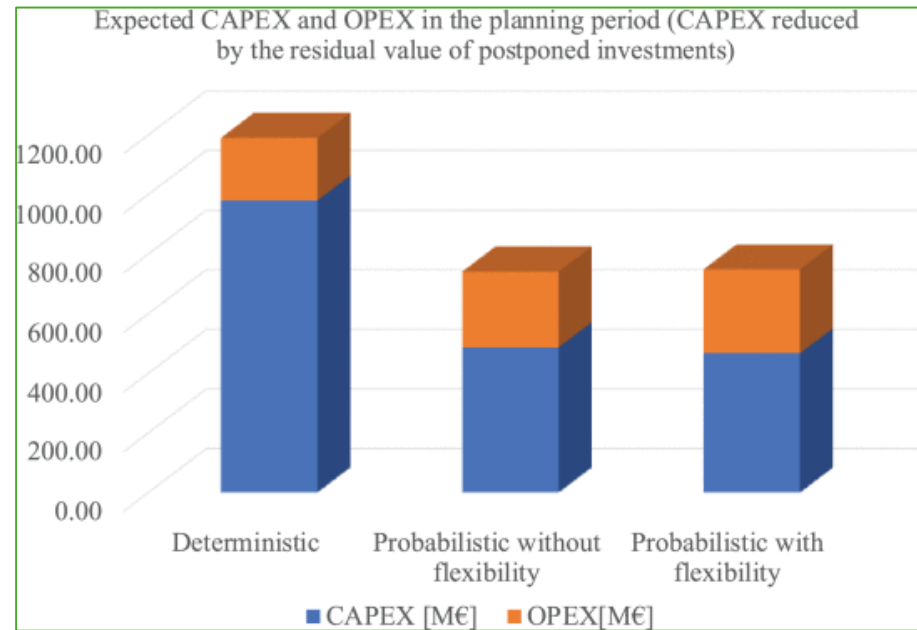
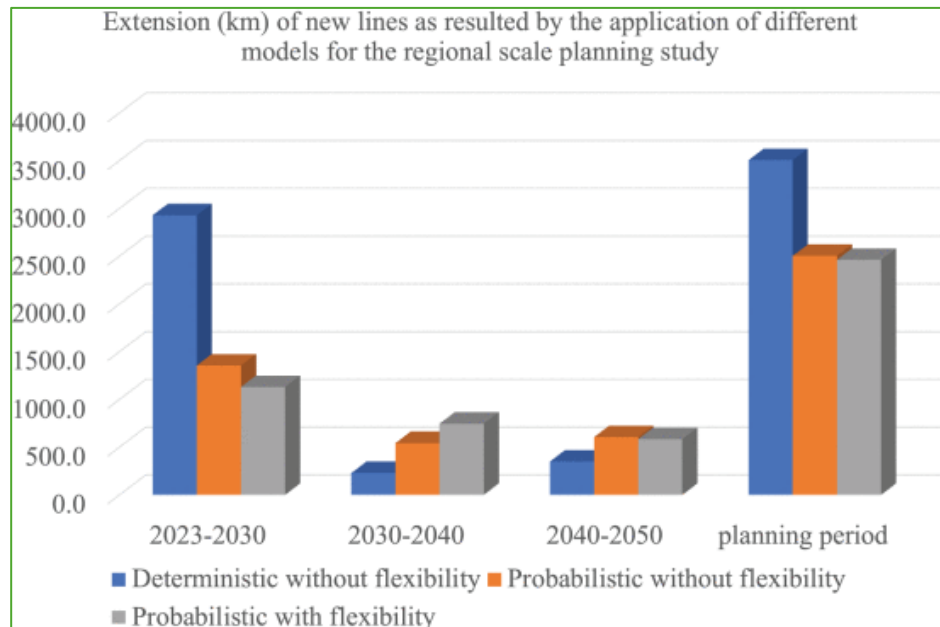
Extension (km) of new lines with and without flexibility services as resulted by the application of deterministic models for the regional scale planning study



- To face the expected growth of demand and generation, the kilometres of new or renovated lines are almost the same (maximum variation 0.6 %) with or without flexibility if deterministic models are used.
- The deterministic model cannot capture flexibility's worth



The worth of flexibility



- Faster electrification and RES connection
- Acceptable scheduling of work-in-progress in cities and villages
- Postponing investment reduces risk
- 30% new lines reduction
- 50% less CAPEX



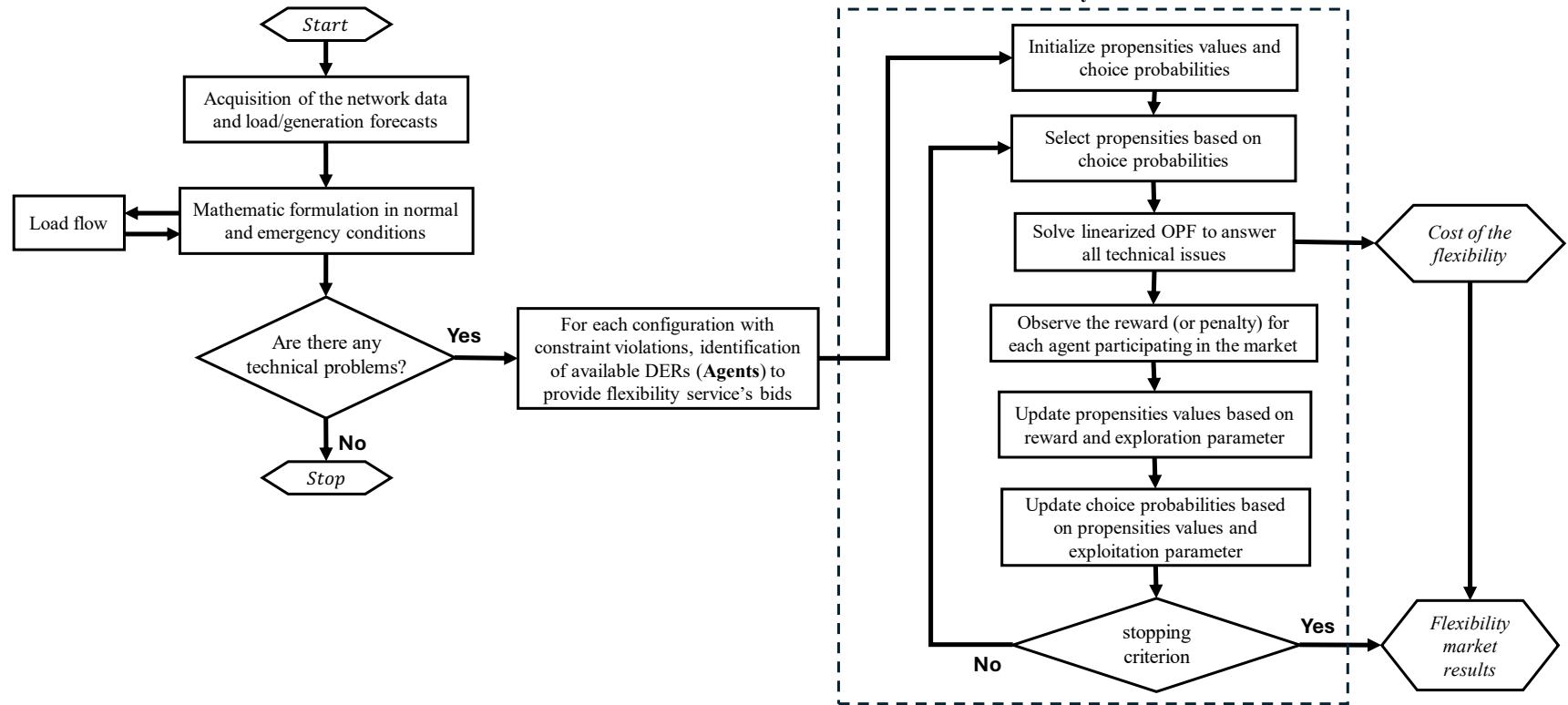
Italian Pilot Projects for Local Ancillary Services

- EDGE (e-distribuzione)
 - Flexibility for MV grids
 - Amount of Flexibility (downward or upward) calculated with Risk approach
 - No devices for communication between customers and DSO
 - Strict cooperation with academia
 - Four regions involved (Campania, Puglia, Piemonte, Veneto)
 - Local market for flexibility (PLICO like)
 - First-year of auctions completed
- ROMEFLEX (areti)
 - Mostly on LV grids and MV/LV transformers
 - Rome involved
 - Customers connected with a device
 - Local market through a customised platform
- MINDFLEX (unareti)
 - Mostly on LV
 - Milan
 - Customers connected with a device
 - Local market through a customised platform



First Results and Market Issues

- Managing markets with small LV customers aggregated is critical
- Market liquidity is not enough
- Some local markets are too small (congestions)
- Most of the flexibility in the short term is for post-fault reconfiguration, which is very convenient
- How can other DSOs manage large areas of auctions without interfering with markets?
- **What is good for transmission cannot be simply applied to distribution**





Flexibility does not come only from customers

Flexible contract

Individual or group

Fully flexible
(operational)

Time-based TSO*
(from 2025)

Time-based DSO**
(from 2025)

Group only

Group capacity agreement
(under preparation)

Cable pooling
(operational)

Closed distribution systems
(operational)

Tariff incentives

ToU TSO
(operational)

ToU DSO
(under preparation)

FIT
(under preparation)

Tariff for small Consumers***
(under preparation for 2027/28)

Scarcity management

Use it or lose it
(operational)

Frozen contracted capacity
(under preparation)

Social priority lanes
(operational)

Connection deadlines for large users
(from 2025)

Congestion management

CM tools

Redispatch
(operational)

Capacity reduction contracts
(operational)

Congestion studies
(operational)

Mandatory participation
(operational)

Standardised contracts
(under preparation)

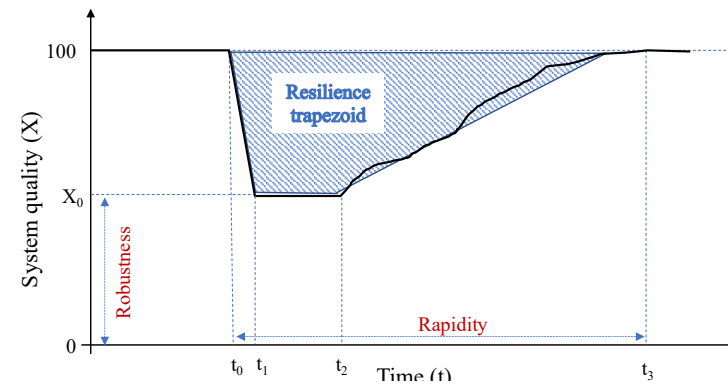
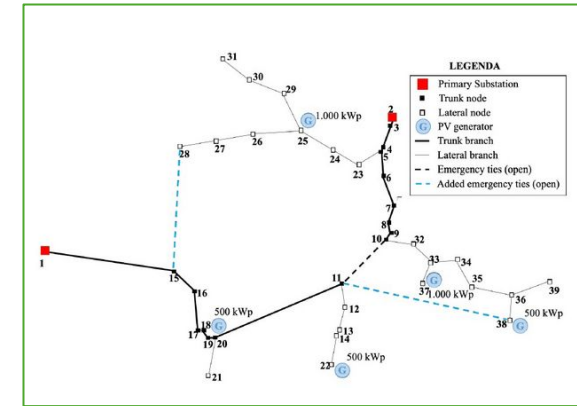
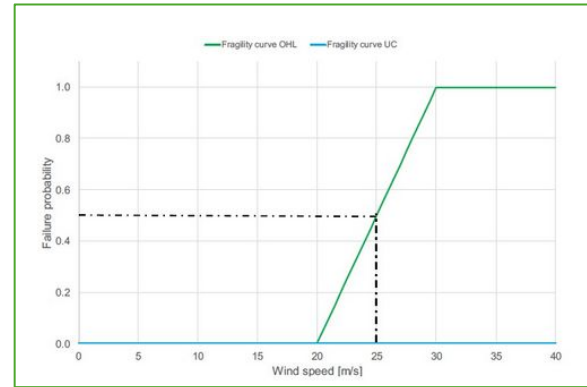
The Dutch Regulator – ACM

Courtesy Prof. Delfanti - PoliMI



Flexibility is not only from customers

- Sector coupling
- MVDC and LVDC
- Soft-open points
- Capacity management
- Flexible connections
- Microgrids and other innovative solutions



G. Pisano et al., Impact chains' analysis for making resilient the distribution system, *CIRED Science and Engineering*, Vol. 26, November 2022

Conclusions

- Flexibility in grid operation is crucial for Energy Transition
- Flexibility gives rapid response capabilities and distributed black start solutions.
- **Future planning must incorporate flexibility**
- The distribution grid can provide higher flexibility
- Sector coupling





Thank you!

Questions?

Fabrizio.pilo@unica.it



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The value of data and flexibility in low voltage

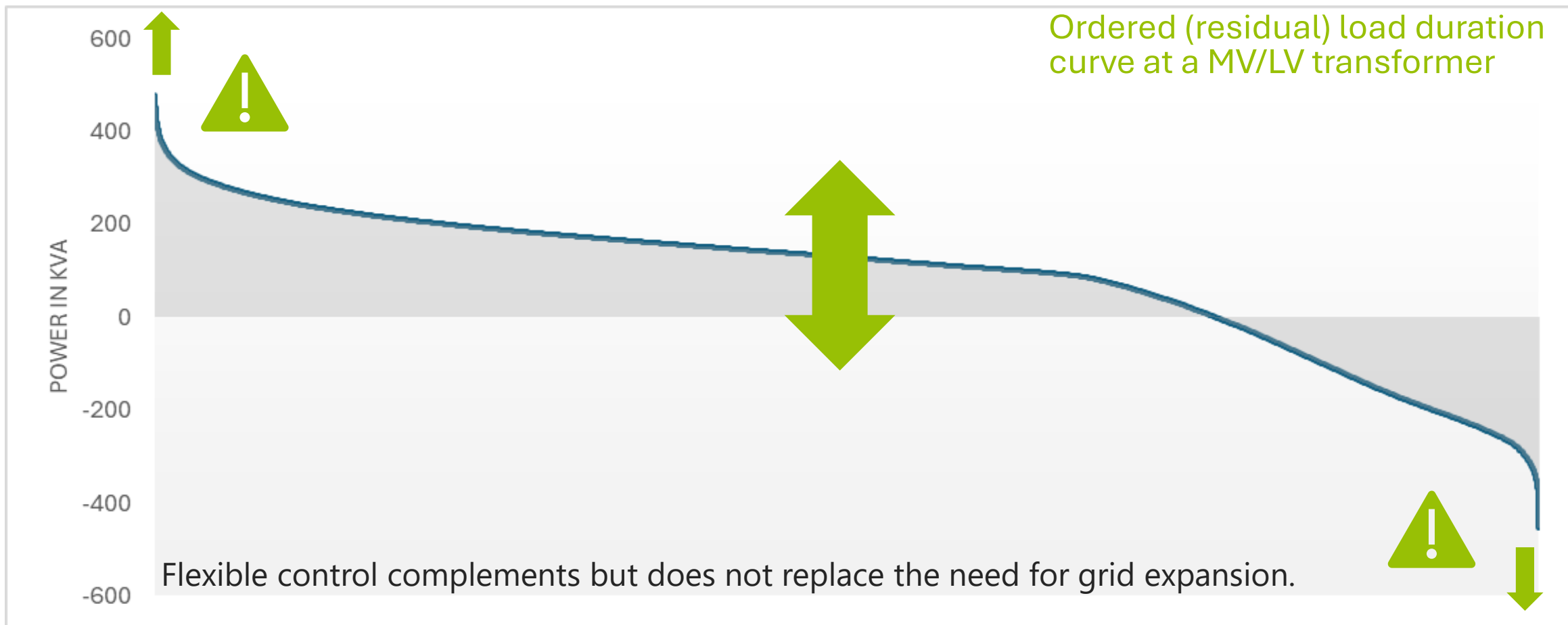
Dr. Alfred Einfalt

Principal Key Expert

Foundational Technologies – Siemens AG Austria

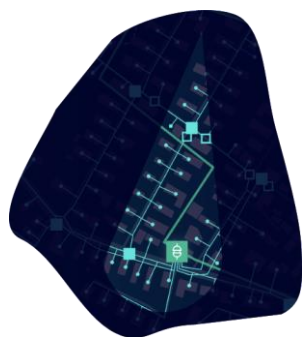


Motivation

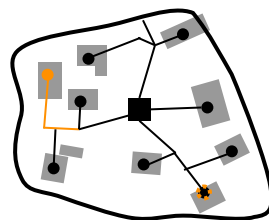




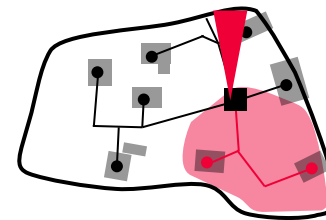
Technical challenges



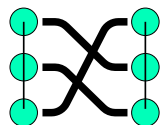
Get **LV grid transparency** based on existing/new instrumentation



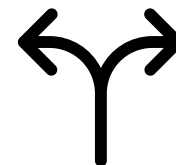
Increase **hosting capacity** by utilization of flexibilities



Avoid overloading, limit violations and outage times



Create and manage full low voltage **grid data model including DERs**



Interaction with DERs owned by prosumers



Organisational Challenges



The framework is well defined

- ✓ **Purpose §14a EnWG (Energiewirtschaftsgesetz):**
Allows **control of flexible** consumption **devices** to distribute grid load efficiently and avoid congestion.
- ✓ **Classification:**
Devices classified as controllable (**Heat pumps, EV charging stations, and certain storage technologies**) can be managed by network operators to maintain grid stability.
- ✓ **Control Mechanisms:**
Network operators can send **signals to adjust** device performance.
Intelligent metering system (iMSys) (Smart Meter + Smart Meter Gateway + Switchbox) is used for monitoring and control.
- ✓ **Benefits for Prosumers:**
Potential access to flexible and power related grid tariffs.
- ✓ **Grid Benefits:**
Reduces peak loads, relieves congestion, and promotes efficient grid use.



...but Smart Meter roll-out at about 14% and transparency is still a big issue!

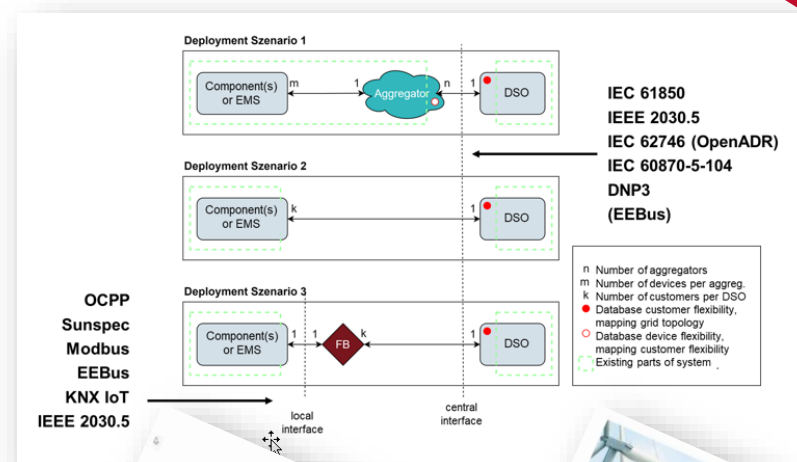


Organisational Challenges

The Framework is still undefined!

- ⊘ **EIWG (Elektrizitätswirtschaftsgesetz)** Proposal in parliament, still pending due to elections
 - ✓ Legal framework for the **temporary reduction** of flexible consumers
 - ✓ Permission for **usage of 15-min** smart meter data
 - ✓ Draft for **flexible grid tariff** (nearly) aligned
- ⊘ **Agreement on technical infrastructure is missing**
 - ✓ **Pilot** projects for references started
- ✓ **Smart Meter roll-out**
 - ✓ Close to 95% by the end of the year

...but DSOs, regulation authority and technology provider are very motivated!



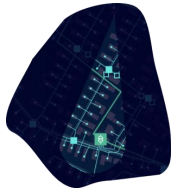
working group 2022

working group 2023



A technology provider perspective:

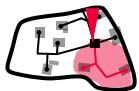
We are ready to start the journey!



- Speed and agility** will be crucial. Transparency is only the first but a very important step.



- A well thought-out and future-proof **data model** for grid assets and interconnected DERs is the basis.



- Increased hosting capacity** due to utilization of flexibilities enabled by transparency and new insights.



- A mix of centralized and decentralized intelligence increases **resilience**.



- The **regulatory framework** plays a key role in implementing the role of flexibility.



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Enabling DER Services in Distribution Grids

Where Did We Come From and Where Are We Going?

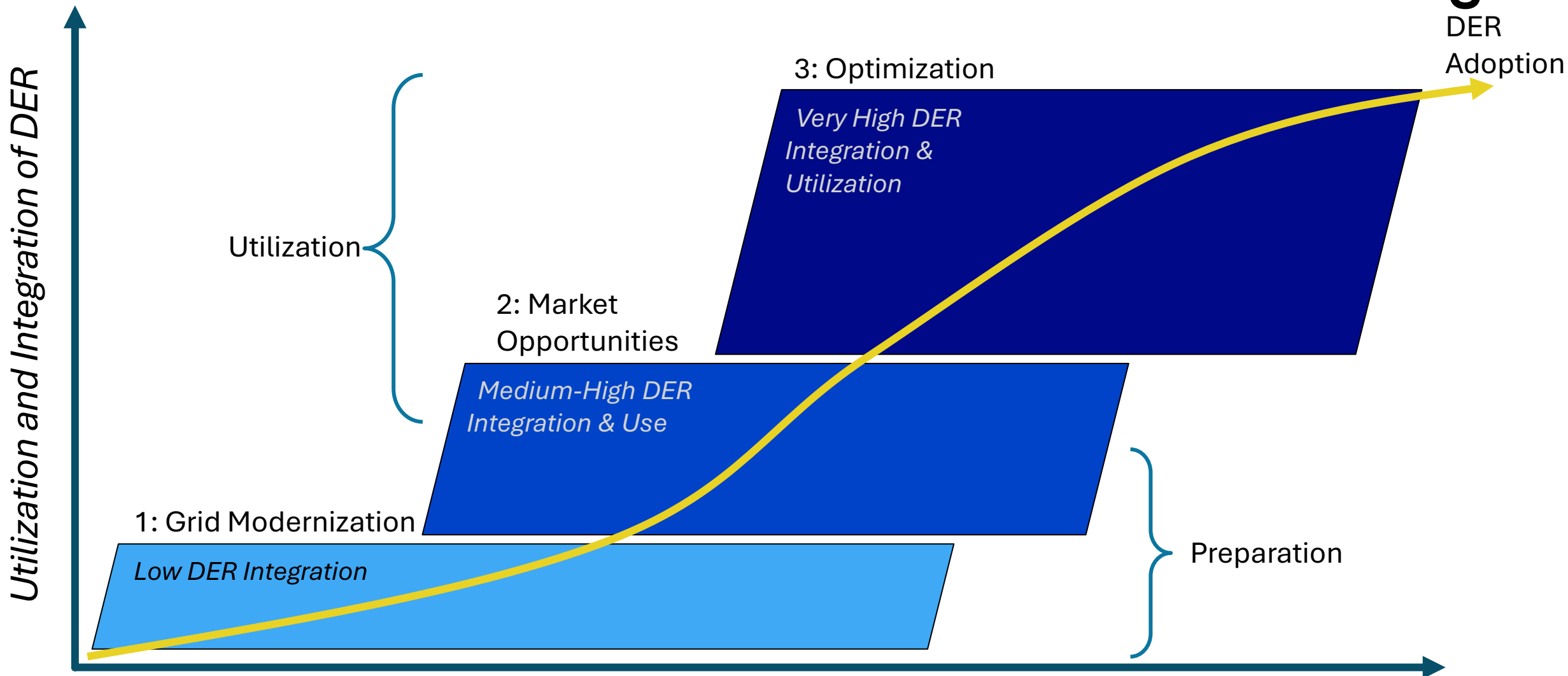
Mark McGranaghan

Mário Couto

EPRI Europe



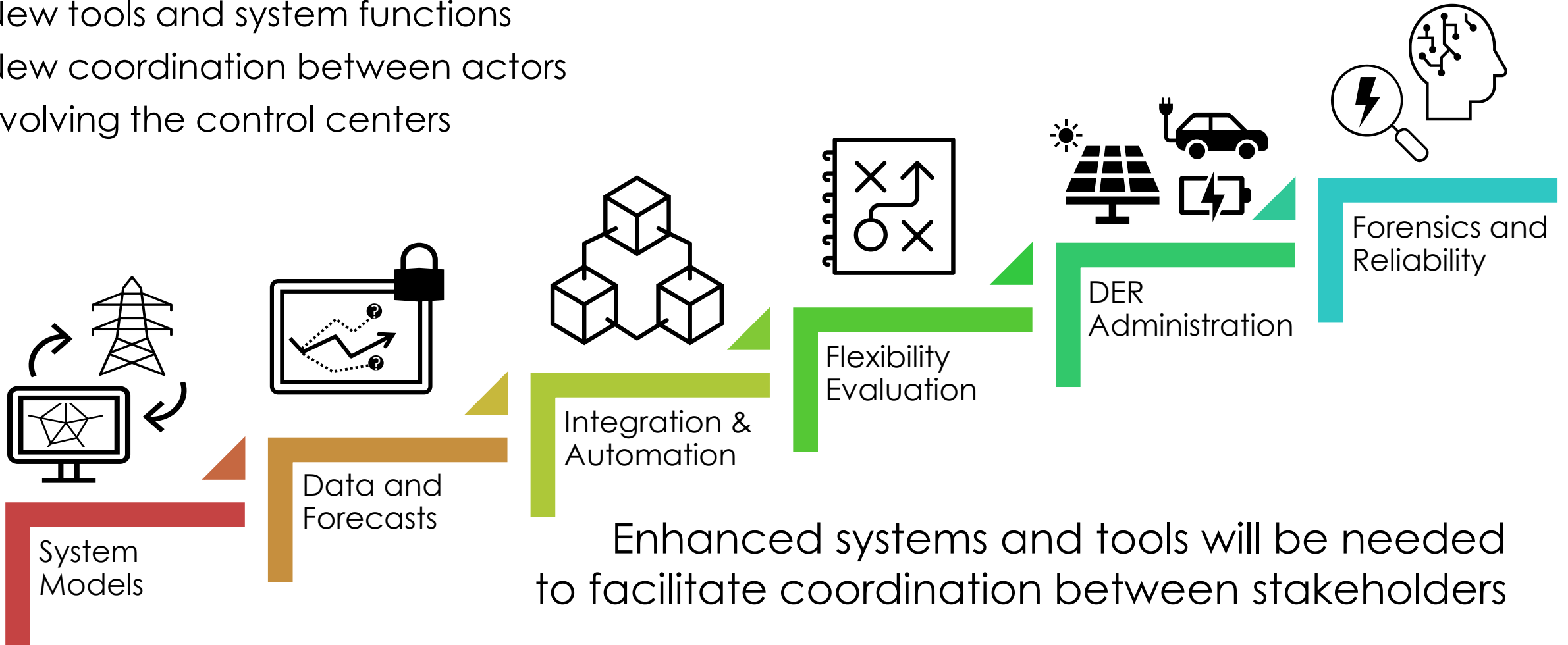
Where Did We Come From and Where Are We Going?





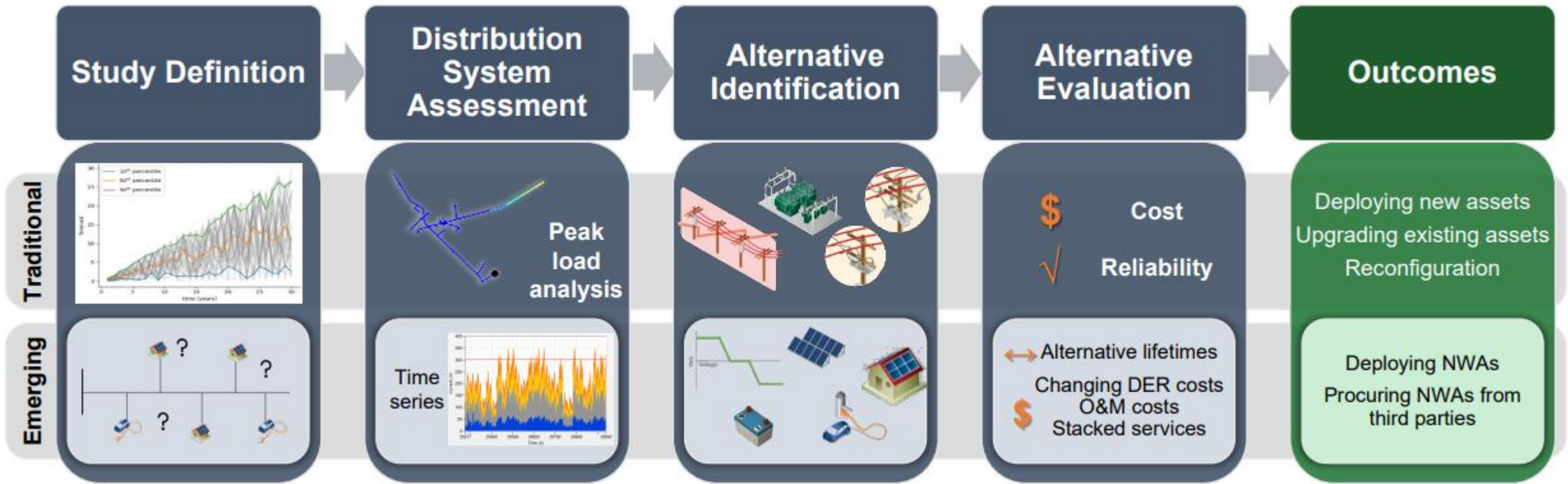
Implementation Challenges for DSOs

- » Additional systems to enable participation
- » New tools and system functions
- » New coordination between actors
- » Evolving the control centers





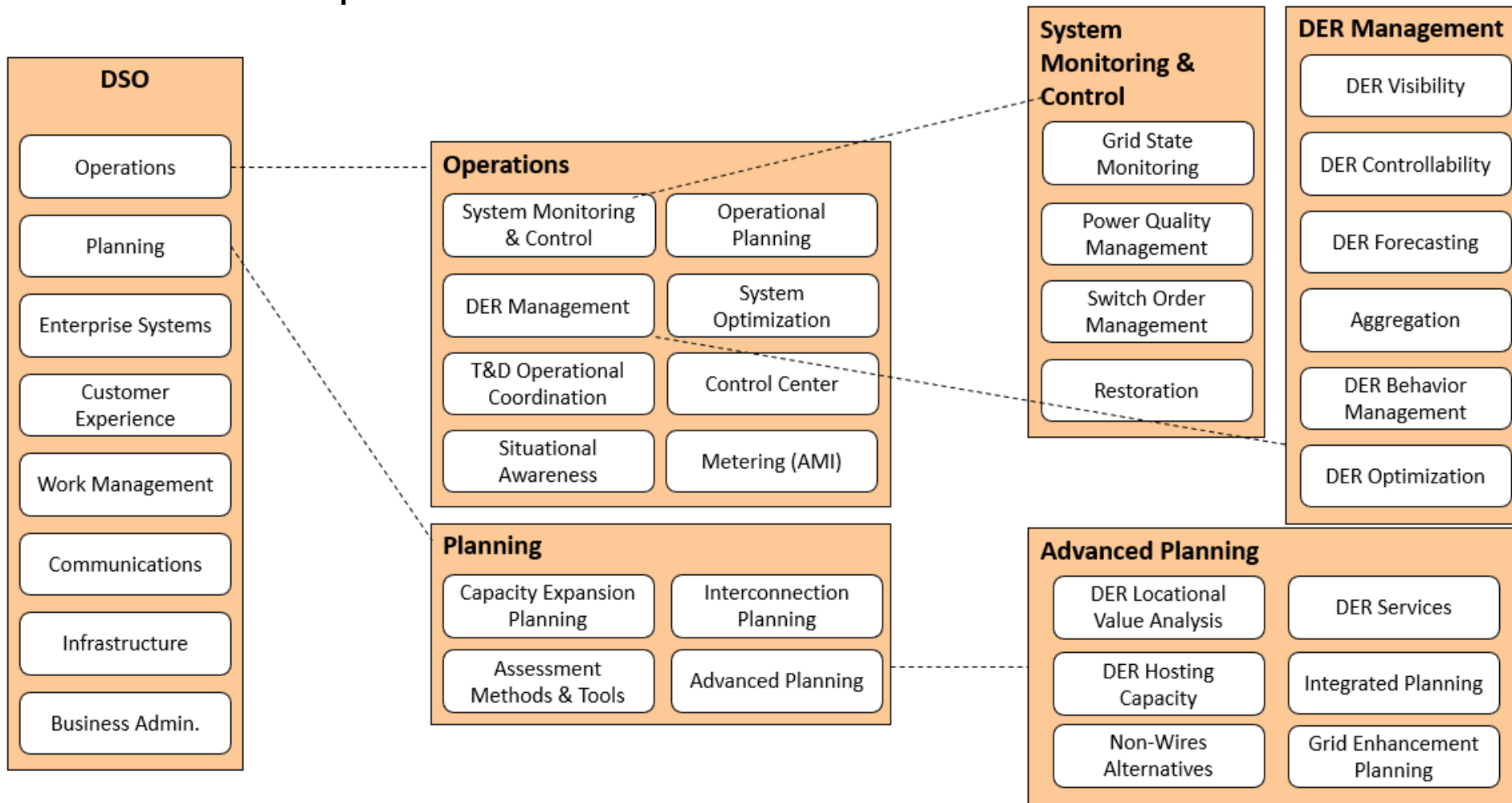
Evolving Distribution Planning Process





Refining a Vision for Greater Flexibility Services

Map Actions to Capabilities



FERC ORDER 2222

A High Level Overview

What is a DER? What is a DER Aggregator?

DER: any resource located on the distribution system, any subsystem thereof or behind a customer meter

DERA: Entity that aggregates one or more DER for purposes of participation in RTO and ISO markets

What are the Key Implementation Challenges?



How Does 2222 Enable DER to Participate in ISO/RTO Markets?

Key Eligibility Requirements

- All DER technologies can **heterogeneously** aggregate to meet RTO/ISO requirements, if aggregation is at least **100 kW** in size
- Existing and/or new **participation models**
- Aggregation as **geographically broad as technically feasible**
- Data, bidding, metering, and telemetry for **DERAs** **balanced** with existing requirements, but reduce burden on **DERs**
- Limit compensation for the **same service** in other programs

What is the Timeline?

ISO tariff modifications due 7/19/21, most have extensions
Implementation date part of each RTO/ISO proposal

ORDER 2222 enables DER participation in ISO/RTO Markets

Who does this impact?

Customers
DER
Aggregators
Distribution Utilities
RTOs/ISOs
Regulators

How Will Market Participation Be Coordinated?

• **Main market interface:** **RTO/ISO** ↔ **AGGREGATOR**

• Key Elements of Coordination

- Distribution utility **preclears** DER to join an aggregator
- Distribution utility may **override** DERA schedule to ensure distribution system safety and reliability
- **Data sharing** practices between all parties
- **Retail rate authorities** involved in coordination
- Allow regional **flexibility**, no explicit **coordination framework**

Relevant EPRI Research Areas



Distribution Operations and Planning

Key Findings from Workstream 2

WS2
Distribution
Ops &
Planning

Interconnection



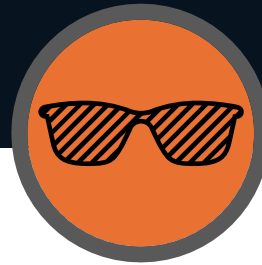
- Current study practices may not capture aggregate impact from bulk system services
- Firm capacity standards buy utilities some time to prepare for operational override needs

Registration



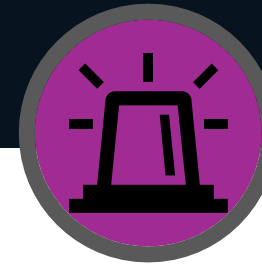
- Coordination with ISO/RTO and State/Local regulators needed to establish dual participation rules
- Enhanced data repositories or DER systems of record will enable quick access and sharing

Visibility



- Monitoring and visibility of BTM DER is limited or non-existent
- Advanced forecasting and state estimation may be sufficient to provide needed situational awareness

Control



- Rules based approach to DER management will persist until tools allow just-in-time analytics
- Communication pathways with devices and/or aggregators are needed to enable override command

Metering



- Metering configurations and rate structures vary between states and regions
- Requirements must balance visibility, cost of entry, and ability to audit performance



See you in Geneva for CIRED 2025

16 - 19 June 2025, Palexpo, Geneva

cired2025.org

