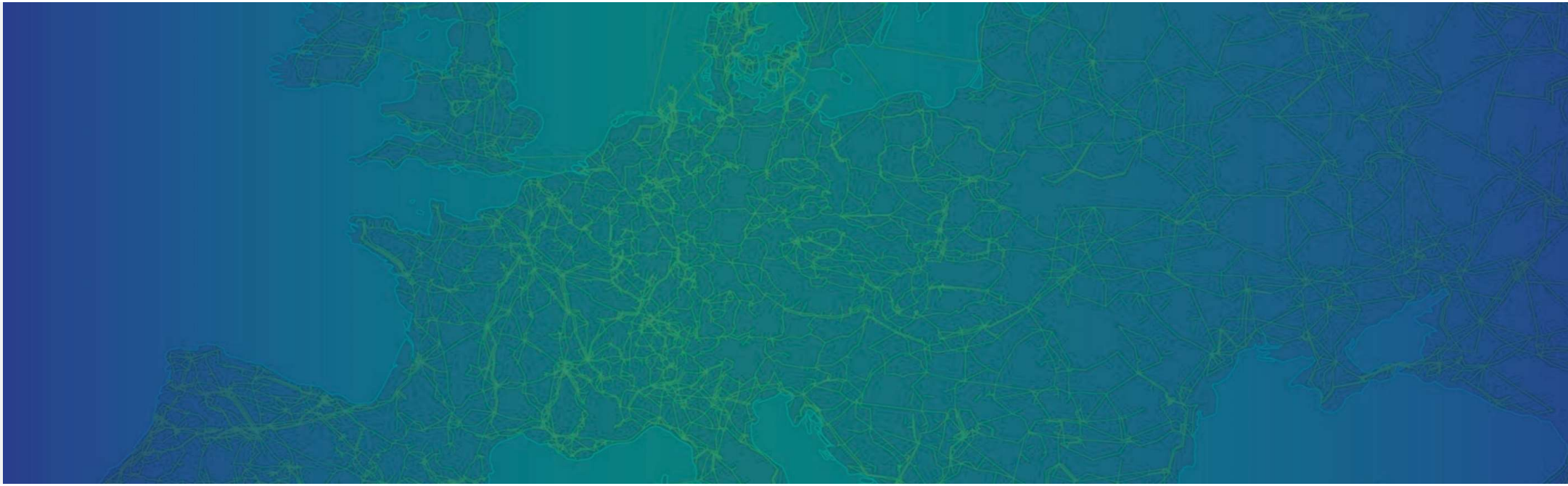
Physical Stakeholder Workshop

04 October 2024



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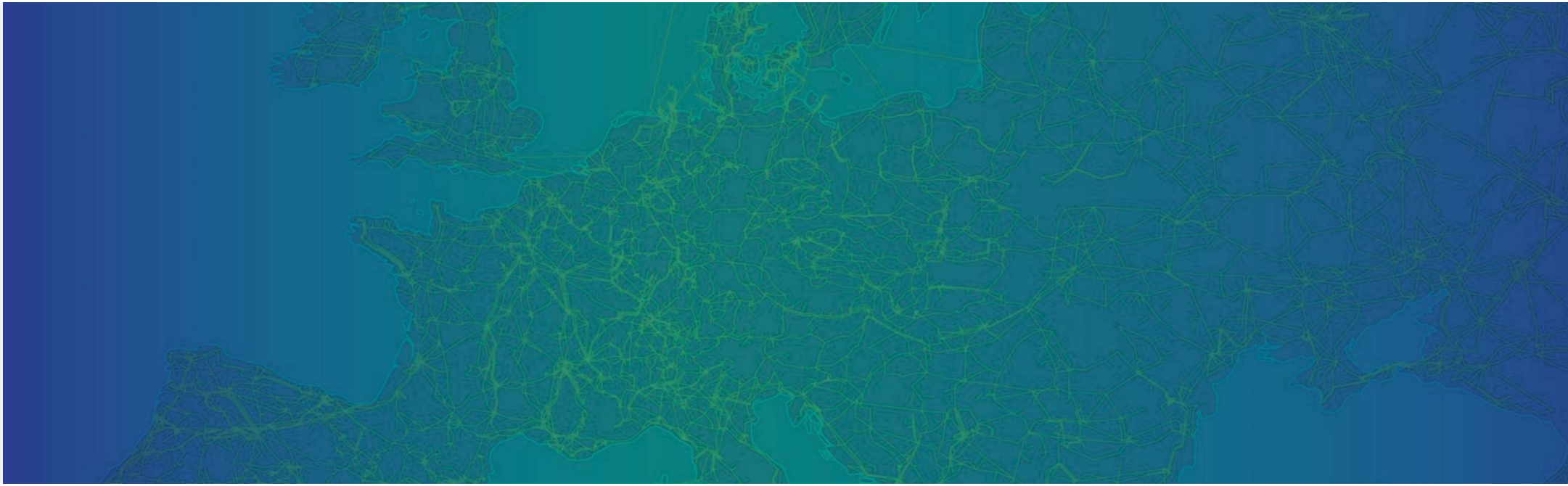
Agenda

Topic	Speaker(s)	Duration (presentation+Q&A)	Time
Intro • Tour de Table • Intro and objectives of the day • Timeline	Samy/Ioannis	15 min	09:30
Session 1 – Boundaries of the methodology and general approach	Mario	45 + 25 min	9:45 am
Session 2 – Flexibility needs covered	Mario/Hubert		10:55 am
Break		10 min	10:55 am
Session 3 – Input scenarios and sets of data	Ewa/Mario	40 + 20 min	11:05 am
Lunch		60 min	12:05 pm
Session 4 – Elements of methodology for system needs	Kristof	30 + 15 min	1:35 pm
Break		10 min	2:20 pm
Session 5 – Elements of methodology for congestion needs	Daniel	30 + 15 min	2:30 pm
Final Q+A	All	30 min	3:15 pm
Conclusion • Next steps - timeline	Samy	20 min	3:45 pm

Intro

Samy Geronymos



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Tour de Table

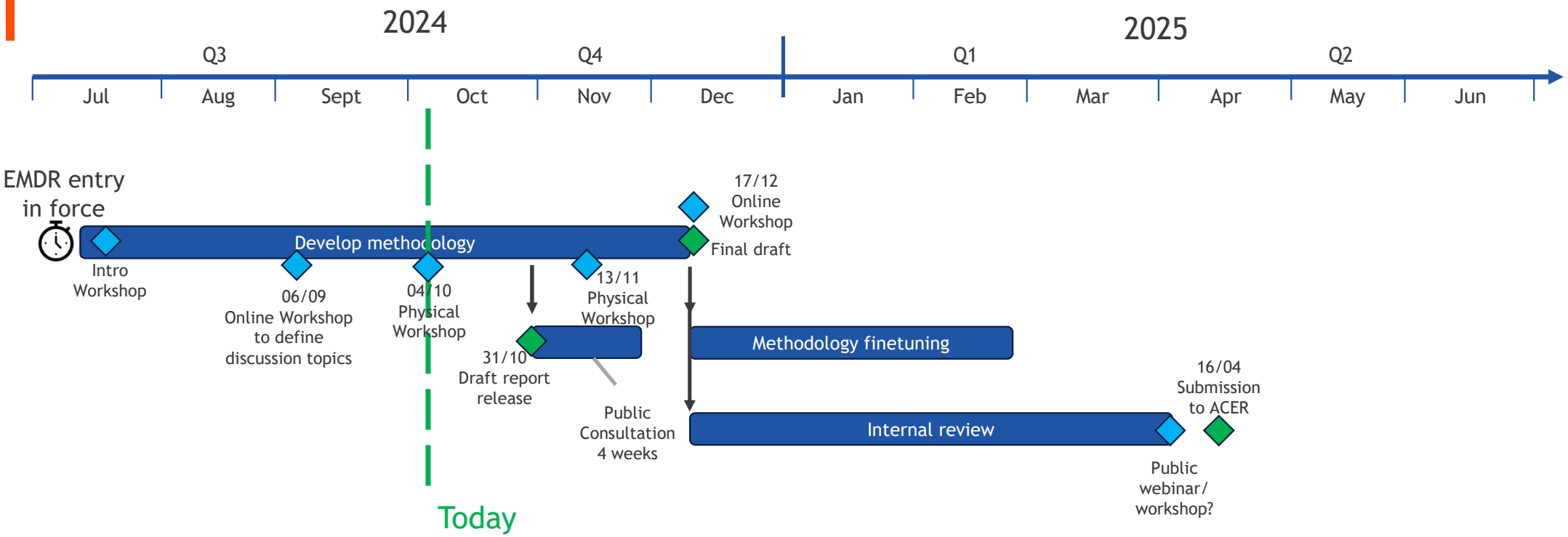
Name	Organisation
Mario Sisinni	Terna (TSO)
Ioannis Theologitis	ENTSO-E
Samy Geronymos	ENTSO-E
Anna Butenko	ENTSO-E
Shilpa Bindu	ENTSO-E
Jan Mervart	Ceps (TSO)
Stefan Sulakov	ESO (TSO)
Jules Guilbaud	RTE (TSO)
Monika Topel	Svenska Kraftnat (TSO)
Kristof De Vos	Elia (TSO)
Name	Organisation
Hubert Dupin	Enedis (DSO)
Arsim Bytyqi	EU DSO Entity
Valeria Battista	DSO Entity (DSO Entity)
Mehtap Alper	EU DSO Entity
Serena Cianotti	Enel (DSO)
Daniel Davi Arderius	E-Distribución (DSO)
Torsten Knop	E-ON (DSO)
Anneli Teelahk	EU DSO Entity
Santiago Gallego Amores	i-DE Redes Eléctricas Inteligentes (DSO)
Ewa Mataczyńska	PGE Dystrybucja (DSO)

Name	Organisation
Daniel IHASZ TOTH	ACER
Emmanouil SANTORINAIOS	ACER
Arthur LYNCH	ACER
David POZO CAMARA	Joint Research Center
Josipa LANDEKA	Joint Research Center
Thomas KAWAM	European Commission – DG energy
Mathilde LALLEMAND DUPUY	European Commission – DG energy
Christian Gruber	Eurelectric
HACHEZ Yvan	Eurelectric
Hans de Heer	smartEn
Michael Villa	smartEn
Martin Roach	EASE
Catarina Augusto	Solar Power Europe
Vidushi Dembi	WindEurope
Vasiliki Klonari	WindEurope
Isabel Alcalde	Hydrogen Europe
Irene Danti Lopez	EPRI
Vilislava Ivanova	E3G

Intro and Objectives of the day

- During the workshop ENTSO-E and EU DSO Entity will provide content on the topics prioritized as part of the 2nd Stakeholder webinar.
- The content aligns with the text of the methodology that the two association are drafting, **represents work in progress possibly subject to changes**, and focuses on the key principles driving the drafting activities.
- The stakeholders are invited to provide feedback to the content presented
- Prioritized topics not addressed in the first physical workshop will be addressed in the second one

Timeline

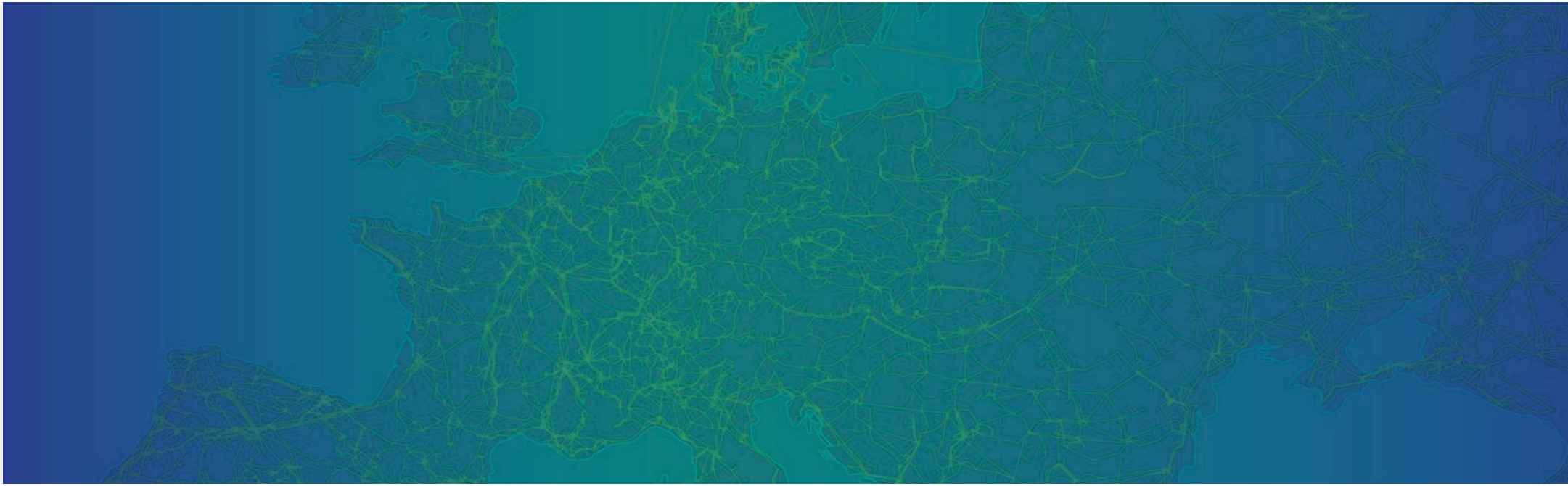


Report related

Stakeholder interaction

Session 1 – Boundaries of the methodology and general approach

Mario Sisinni & Hubert Dupin



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Definition of flexibility needs

From the EMDR…

EMDR Def.

"**Flexibility**" means the ability of an electricity system to adjust to the variability of generation and consumption patterns and to grid availability, across relevant market timeframes

Art 19e

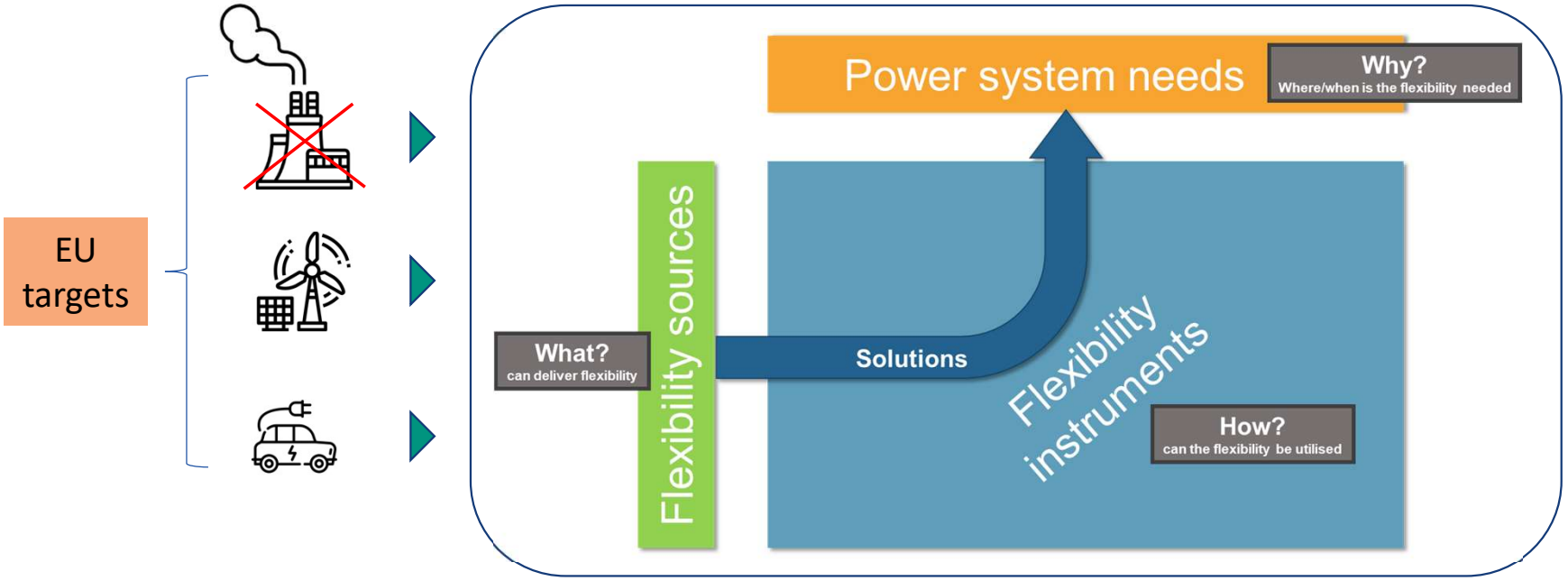
…The report referred to in paragraph 1 shall at least:
(a) evaluate the different types of **flexibility needs**, at least on a seasonal, daily and hourly basis, **to integrate electricity generated from renewable sources in the electricity system**, inter alia, different assumptions in respect to electricity market prices, generation and demand;

…develop a methodology for the analysis by transmission system operators and distribution system operators of the **flexibility needs**, taking into account at least:
(i) all available sources of flexibility in a cost-efficient manner in the different timeframes, including in other Member States;
(ii) planned investment in interconnection and flexibility at transmission and distribution level; and
(iii) **the need to decarbonize the electricity system** in order to meet the Union's 2030 targets for energy and climate, as defined in Article 2, point (11), of Regulation (EU) 2018/1999, and its 2050 climate neutrality objective laid down in Article 2 of Regulation (EU) 2021/1119, in compliance with the Paris Agreement adopted under the United Nations Framework Convention on Climate Change.

Definition of flexibility needs

What is a flexibility need? When does it occur?

In a fully carbon neutral system, based on electrified consumption and variable renewable energy sources, flexibility will be essential to complement the variability of both generation, demand and grid availability and to address the increase of system complexity

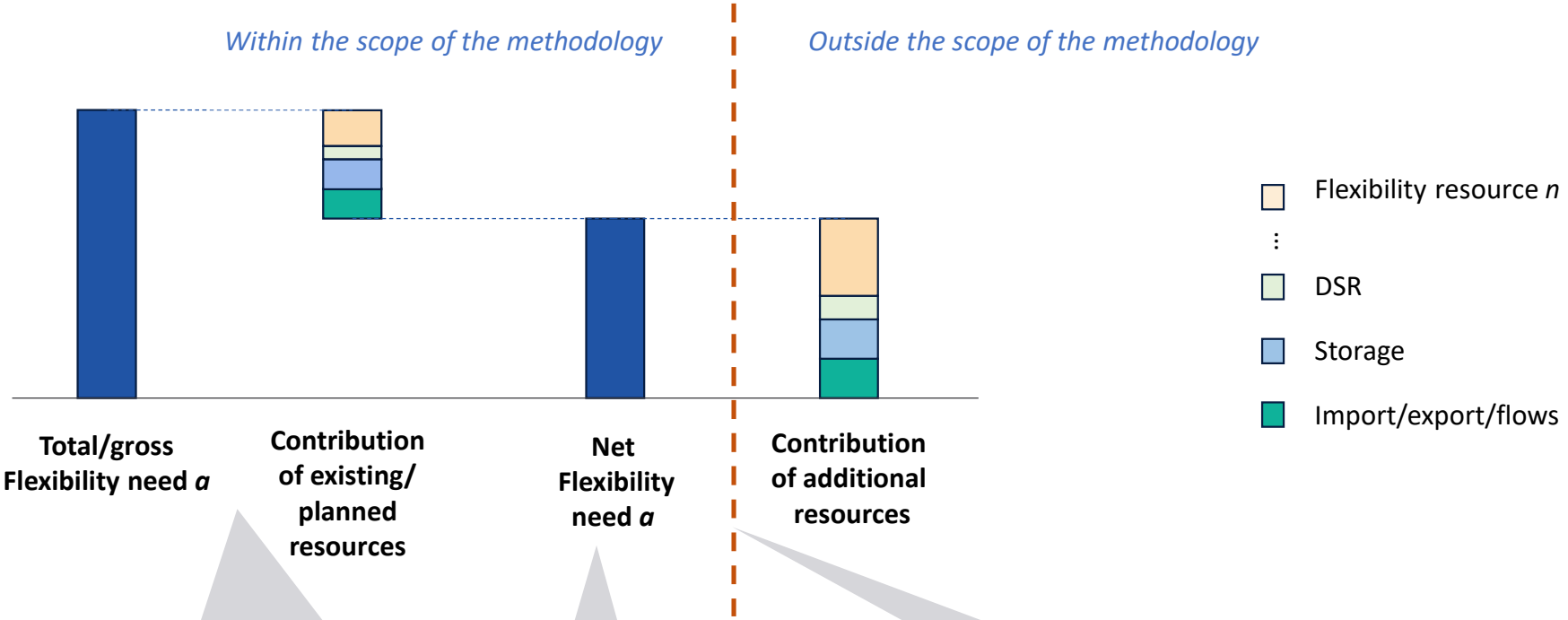


"Flexibility" means the ability of an electricity system to adjust to the variability of generation and consumption patterns and to grid availability, across relevant market timeframes

A flexibility need occurs when the power system is not able to cover this variability and availability

Definition of flexibility needs

Boundaries of the methodology



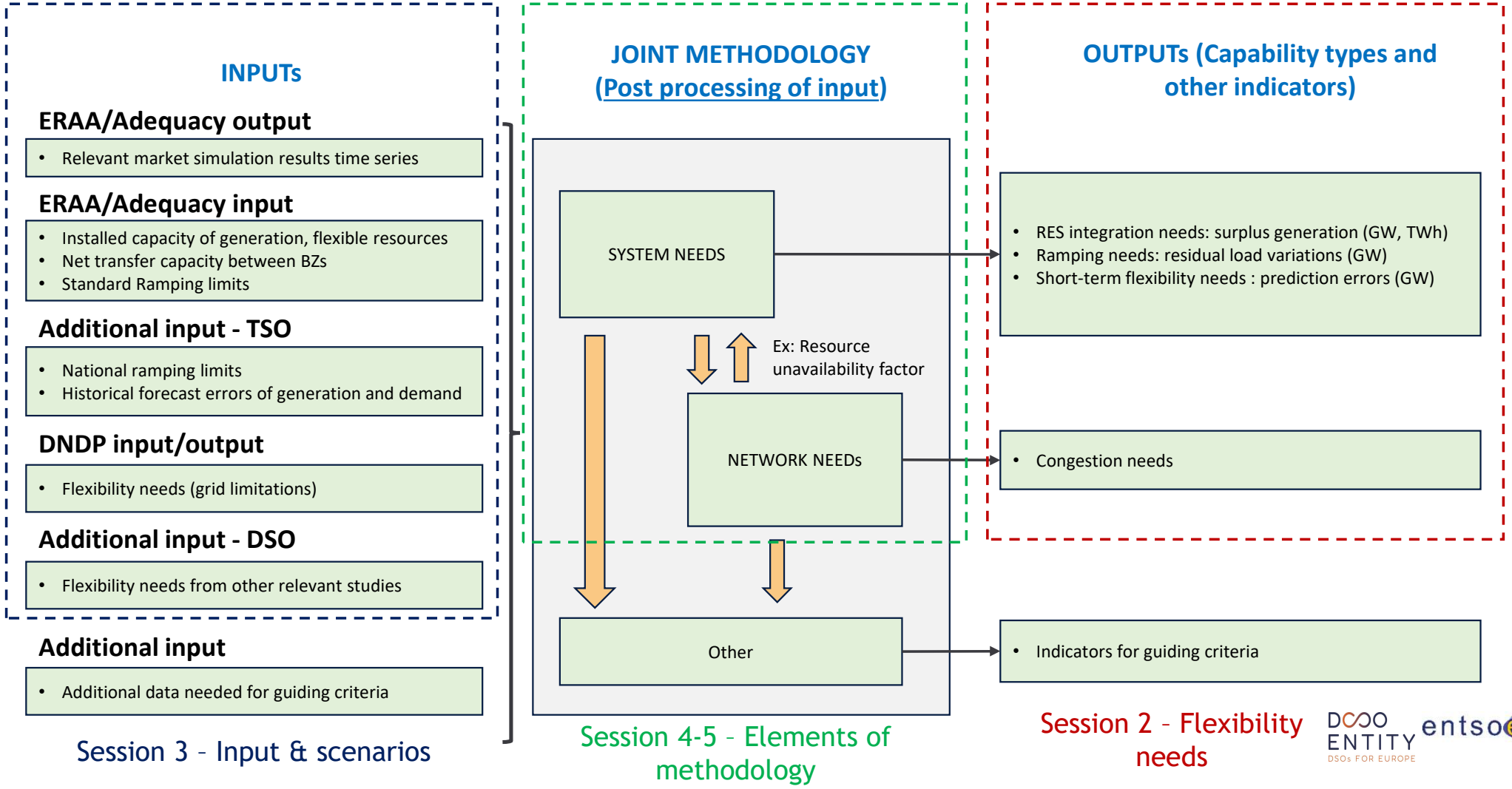
The methodology will consider appropriate **reference conditions** to account for:

- Planned investments in grid/flexibility
- Cost-efficient contribution of existing/planned flexibility resources
- Different assumptions in respect to electricity market prices, generation and demand

Flexibility needs are to be provided **through capability types**, i.e. actionable metrics (capacity, energy) **useful to policymakers** that keep technological neutrality

The methodology will also provide for **guiding criteria** to best interpret flexibility needs and orient policymakers to the identification of most suitable flex resources to cover them

General approach



Guiding principles to quantify system needs and support policy decision

- Define achievable, necessary and sufficient requirements for each Member State taking into account availability of information/tools and time constraints
  - Manage complexity in view of additional information it brings (avoid complex 'to be developed' methods)
  - Take into account existing constraints on availability of data/tools and effective implementation within the Regulation timeframe
  - Provide a base case assessment + additional options for Member States to conduct additional analysis, sensitivities, indicators whenever deemed possible/relevant
- Ensure consistency with ERAA/NRAA (in line with Article 19e of the EMDR)
  - Assessment mostly based on output data of ERAA/NRAA
  - Align with ERAA/NRAA scenarios and assumptions on sector coupling, non-fossil fuel resources, interconnections, ….
  - Base case assessment based on post-processing of ERAA/NRAA output, without involving additional simulations
  - Revisions of ERAA/NRAA input data, methodologies or outputs are out of scope of the FNA methodology
- Reference condition should reflect ERAA/NRAA evolutions and national needs
  - Assessment based on at least one reference scenario of ERAA/NRAA and associated market dispatch availability
  - Possibility for national TSO to run assessments based on additional reference conditions, including after adequacy step
- Ensure complementarity with ERAA/NRAA studies
  - Indicators such as RES surplus, Residual Load variations and prediction errors not accounted in ERAA/NRAA
- Enrich system needs results with insights on the TSO-DSO networks only when/where information is available and relevant
  - Limitations of generation output due to congestion (when/where available and not already accounted in ERAA/NRAA input data)
  - Availability of existing flexible assets on T/DS-level (when/where available and not already accounted in ERAA/NRAA input data)

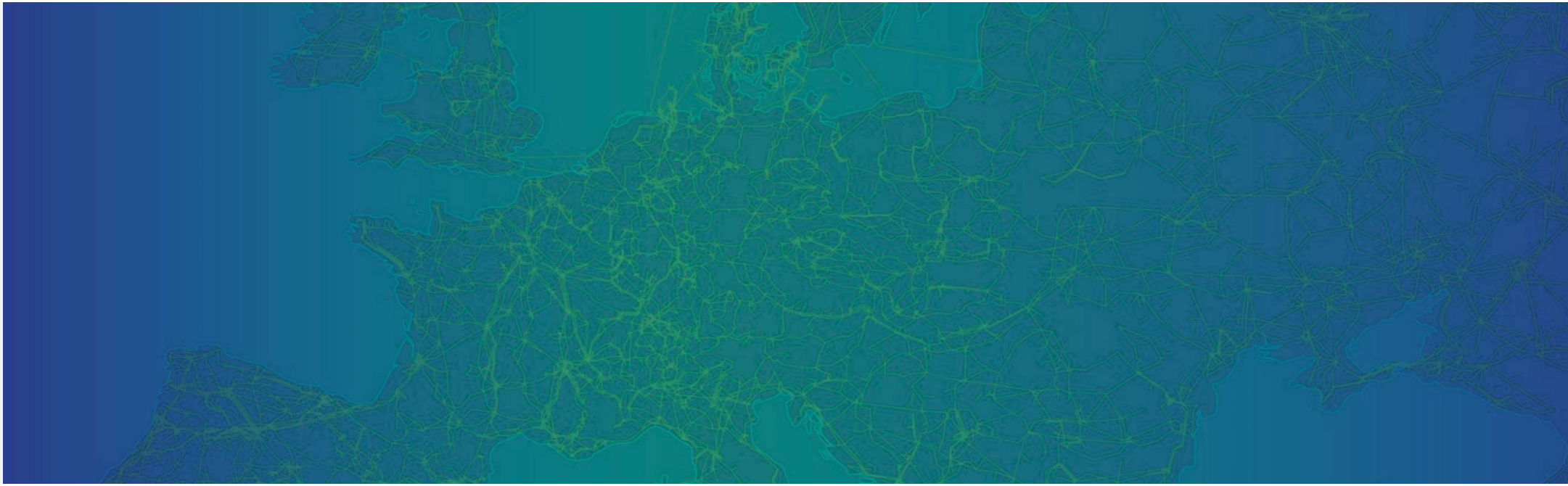
ERAA/NRAA: European/National Resource Adequacy Assessment

Guiding principles to quantify network needs and support policy decision

- Define achievable, necessary, and sufficient requirements in each Member State taking into account availability of information / tools and time constraints
  - Manage complexity in view of the additional information it brings (avoid complex 'to be developed' methods)
  - Take into account existing limits on availability of data / tools and effective implementation within the Regulation timeframe
  - Provide a base case assessment + additional options for Member States to conduct additional analysis, sensitivities, indicators whenever deemed possible / relevant
- Ensure consistency with national studies
  - Network needs assessment mostly based on output of Network Development Plans and needs for local services
  - Consistency requirements of NDP include consistency between themselves, with National Energy and Climate Plans …
- Ensure complementarity with existing studies
  - DNDP focus on local services, while other studies can provide further assessments
- Enable to enrich system needs results with insights on the DSO networks only when / where information is available and useful
  - Limitations of generation output due to congestion (when/where available and not already accounted in ERAA/NRAA input data)
  - Availability of existing flexible assets on T/DS-level (when/where available and not already accounted in ERAA/NRAA input data)

Session 2 – Flexibility needs covered

Mario Sisinni & Hubert Dupin



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Reminder of topic/aspect agreed at the webinar

Flexibility needs covered

General Description

- The methodology will evaluate the different types of flexibility needs to integrate electricity generated from renewable sources in the electricity system and due the electrification of consumptions
- Flexibility needs can be broadly split into system and network needs
  - System needs include for instance those associated to RES excess, management of Residual Load ramps and management of forecast errors of generation and demand
  - Network needs address those associated to congestions or voltage issues

Agreed aspects/questions to be to addressed and discussed at the workshops

- Most relevant flexibility needs to be covered as part of the assessment
- Complementarity with other type of needs (e.g. adequacy needs)
- Consistency with adequacy, ERAA and other studies of TSO/DSOs
- *Definition of need (covered in previous point)*

Reminder of topic/aspect agreed at the webinar

Expected outcomes - Capability types

General Description

- The results of the assessment will be needed by policymakers to define indicative national targets for Demand Side Response, Storage and other flexibility resources to be included in National Energy and Climate Plans
- Whenever possible the type and format of the outcomes of the assessment should serve this scope
- To this aim flexibility needs could be possibly expressed in terms of capability type, intended as indicator of a given need, expressed with relevant metrics (capacity, energy, duration…), while keeping technological neutrality

Possible relevant aspects/questions to be to addressed and discussed at the workshops

- Most suitable metrics for each need to be covered
- How to ensure simultaneously reliability of results and technological neutrality
- *Time characterization (daily, weekly…short, medium, long)*

Type of flexibility needs covered

System Needs

- Inertia
- Restoration

Out of scope following very TSO specific nature

- Short-term: prediction errors
- Ramping: residual load variations
- RES integration: surplus generation

Covering both TSO balancing and market portfolio balancing

- Adequacy & RES shortage

Already covered in ERAA/NRAA

Network needs

- Congestion management
- Voltage control*

*Included in DSOs studies

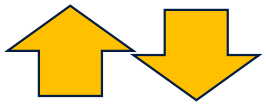
Choice of needs to be included in the assessment follows principles of compliance with the EMDR, relevance, complementarity with respect to other assessments and practical implementation

System needs – Overview

Seasonal → **Daily** → **Hourly** → **Real time**

System needs

RES integration needs : surplus generation	Ramping needs: residual load variations	Short-term flexibility needs : prediction errors
• Study downward flexibility needs based on behavior of the ERAA/NRAA surplus energy indicator in terms of energy, duration and intervals and periods and conditions at risk. • Refine flexibility needs into different timeframes (daily, weekly, monthly) based on optimizing a dummy flex variable on overgeneration volumes	• Quantify flexibility shortages associated to the management of up- and downward residual load ramps over a period of 60 minutes or lower based on the ramping constraints of dispatched units (ERAA / NRAA) • Based on comparison with residual load variations (ERAA / NRAA input, or output when accounting curtailment)	• Quantify flexibility shortages associated to the management of up- and downward residual load / generation prediction errors based on the margins of dispatched units (ERAA / NRAA) • Based on comparison with residual load prediction errors (ENTSO-E TP, national data,…)

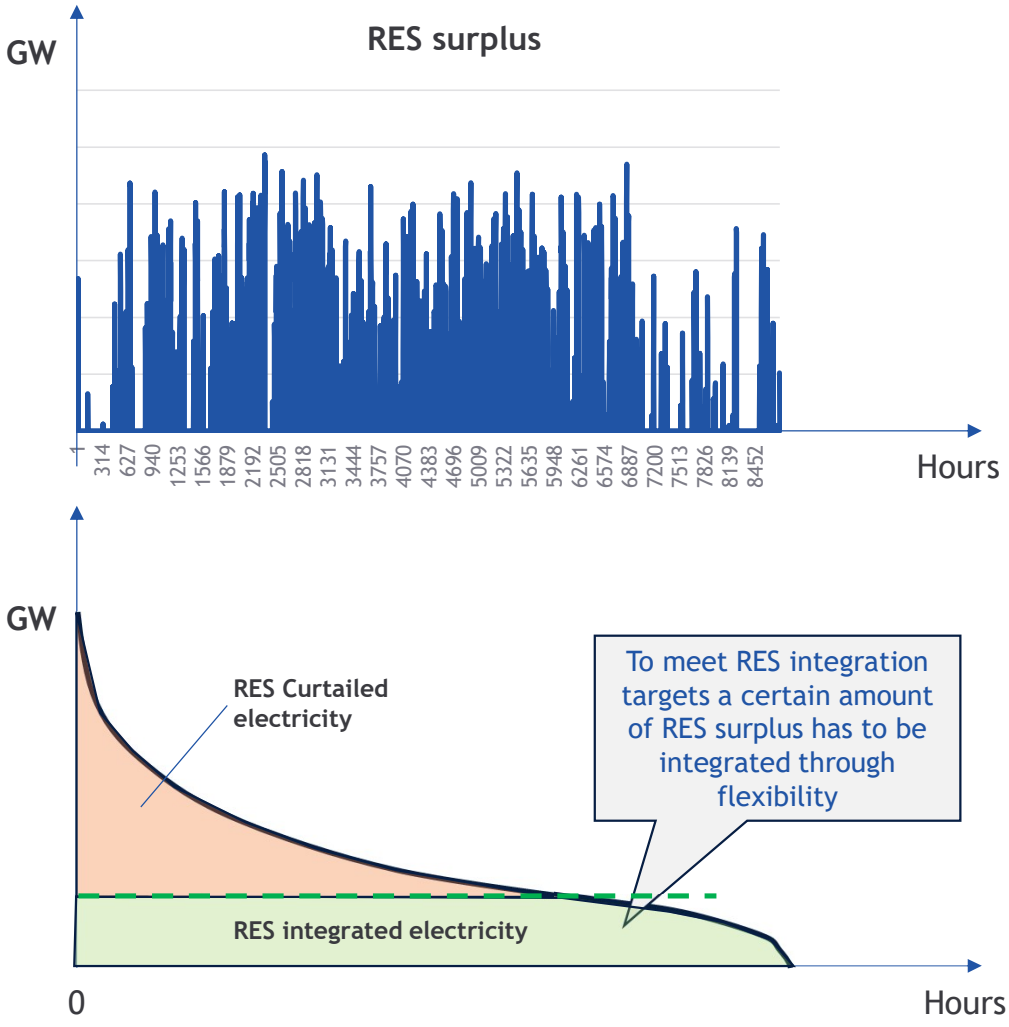


Pending relevance and availability of data

Network needs

- Injection constraints on T/DS-level (where not already accounted in ERAA/NRAA)
- Availability of existing flexible assets on T/DS-level (where not already accounted in ERAA/NRAA)

System needs – RES integration needs



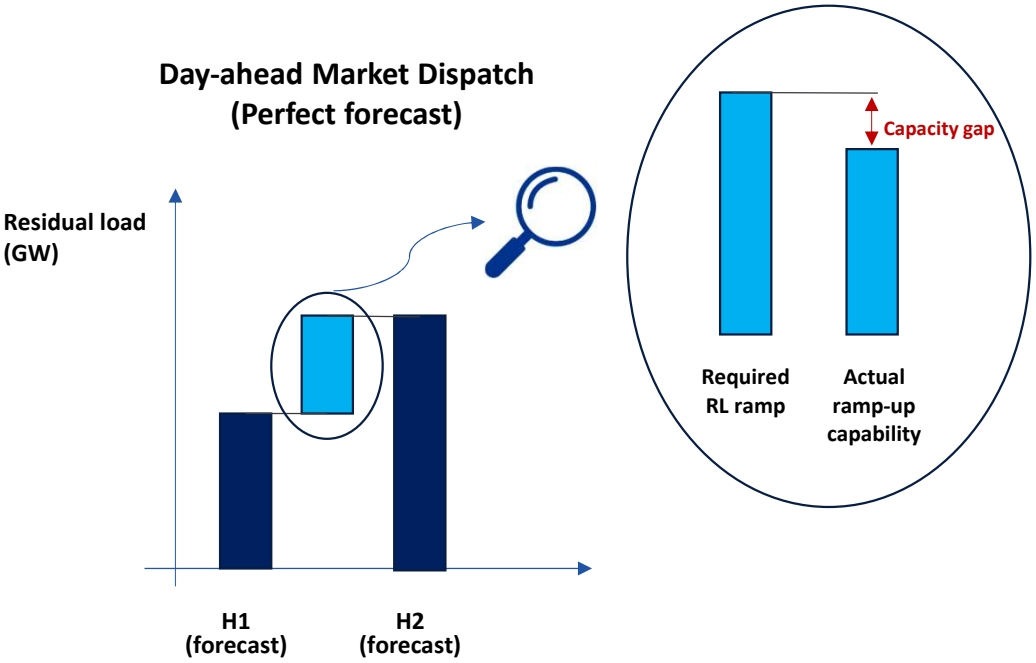
When it occurs? Why is important?

- As a result of the increasing RES installed capacity, **RES surplus conditions will become structural**
- When RES surplus cannot be integrated in the system (technically and economically) it results in **curtailed electricity**
- Member States are requested to meet their individual **RES integration targets** defined in National Energy & Climate Plans or other national policies
- In this context **a flexibility need occur when the RES curtailed electricity does not allow the Member State to meet its RES integration targets**

Expected metrics/Capability type

- Max, min, mean percentile values of RES surplus (TWh, GW) across relevant timeframes (hourly, daily, weekly, monthly/seasonal)
- Probabilistic distribution of RES surplus (TWh, GW) across relevant timeframes (hourly, daily, weekly, monthly/seasonal)
- Other relevant representations (heat maps, correlation)
- Capacity of dummy & technology neutral flex resources (GW) to reduce daily, weekly and monthly needs while meeting RES integration targets

System needs – Residual Load variation



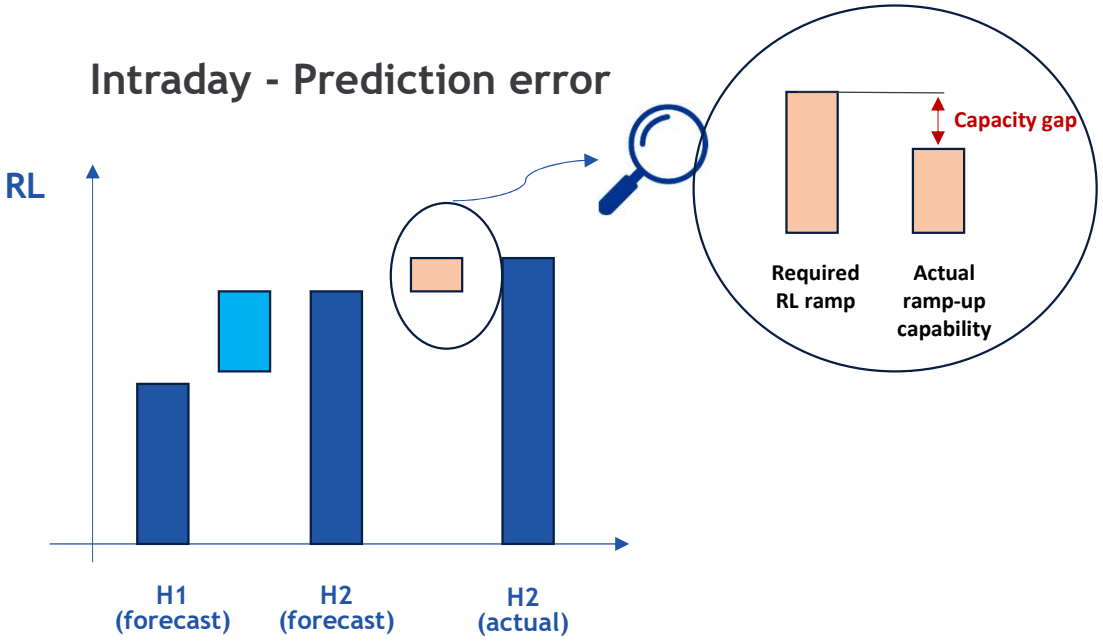
When it occurs? Why is important?

- Flexible units are normally needed and used to **manage forecasted variations of Residual Load**, broadly defined as the difference between demand, RES generation and Must Run generation
- **Actual ramping capability** of existing/planned flexible units **can be constrained** by their **technical limits** and **availability factors**
- In this context **a flexibility need occurs when actual ramping capability is not enough to meet the required RL ramp**

Expected metrics/Capability type

- Technology-neutral capacity gap (GW) to meet ramp-up/down requirements
- Max, min, mean, percentile and other characterization across different Climate Years

System needs – Prediction errors



When it occurs? Why is important?

- Flexible units are also needed to **manage unexpected variations of Residual Load** due to **errors in the prediction** of electricity generation and demand and due to outages
- **Actual ramping capability** of existing/planned flexible units **can be constrained** by their **technical limits** and **availability factors**
- In this context **a flexibility need occurs when actual ramping capability is not enough to meet the required RL ramp**

Expected metrics/Capability type

- Technology-neutral capacity gap (GW) to meet ramp-up/down requirements
- Max, min, mean, percentile and other characterization across different Climate Years

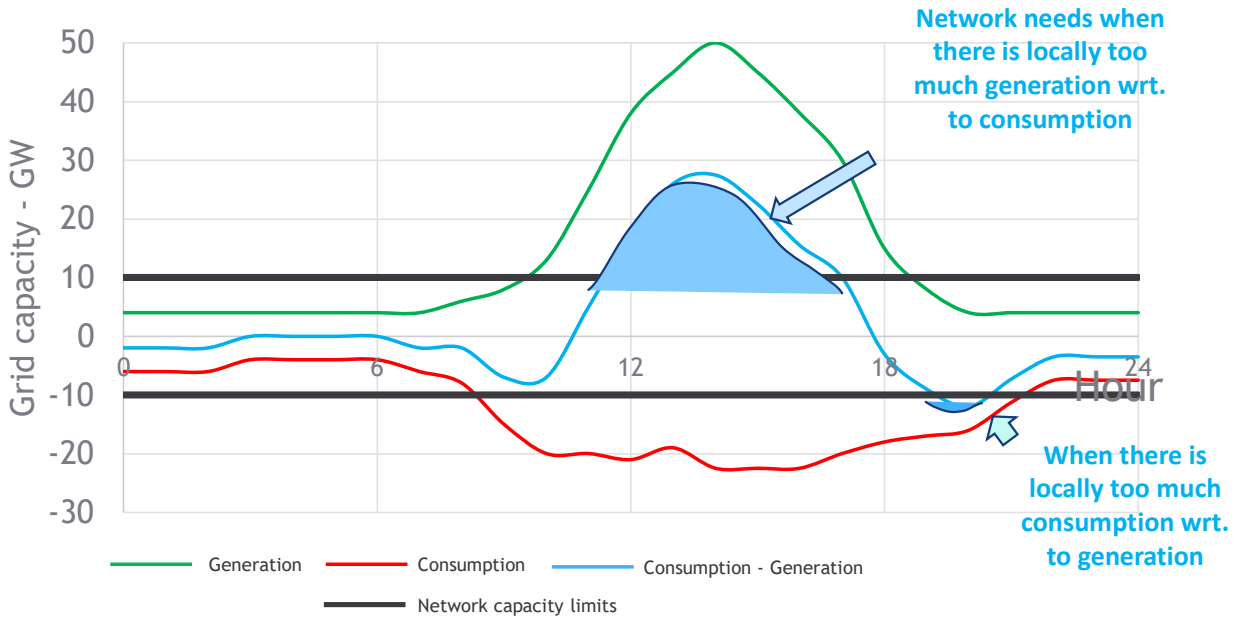
Network needs – Congestion & Operational Limits

Graph illustrates network needs
in a high PV area

when the grid is operated
in **normal "N" scheme**

/!\ Network needs **during outage have a completely different shape**

(unpredictable start time and duration, quantity depending on the load on "recovery" assets)



Network needs – Congestion & Operational Limits

When and where it occurs? Why is important?

- A '**congestion issue**' means a situation when the electric current flow through a physical asset exceeds operational limits
- SO **must maintain power flows within operational** limits, which induces flexibility needs to prevent or solve congestion
- Congestion can occur during sunny days (high PV areas), day or night during windy periods (wind farms areas), a combination of both in areas with lots of PV and wind farms.
- Congestion can also occur at any time for durations depending on the unavailable asset and the local and temporal network situation.
- Congestion reduces the amount of generation available to, or demand needed from, the system even if there would be no need from a system « copper plate » point of view.

Network needs – Congestion & Operational Limits

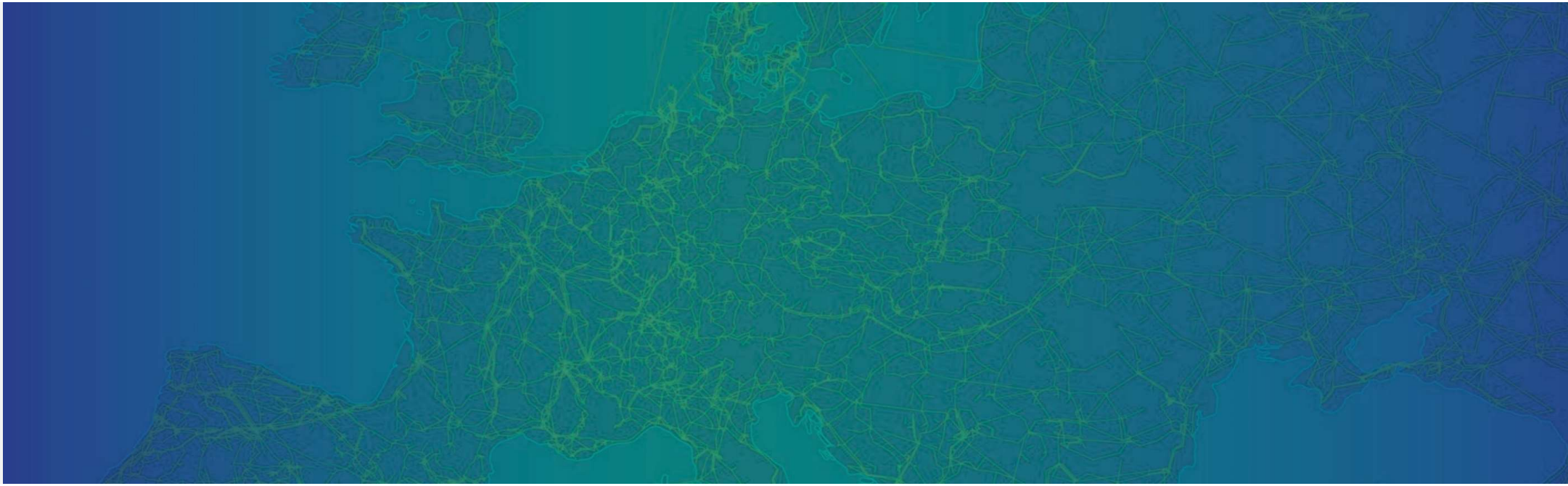
Expected metrics / Capability type

Upwards and downwards data:

- **Max GW of RES curtailment or demand outage expected in critical events over the planning time**
- **If possible : on the critical events, over the planning horizon : Expected TWh/year (split by season if possible) and/or TWh/day (typical days if possible)**
- **Hourly GW for specific days (if possible / available)**
- **/!\ The above metrics may be relevant for normal « N » scheme » ; metrics for N-1 (planned/unplanned outage) schemes would be different**

Session 3 – Input scenarios and sets of data

Mario Sisinni & Ewa Mataczynska



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Reminder of Topics agreed at the webinar

Input scenarios and sets of data

General Description

- The methodology for flexibility needs assessment will have to be fed by set of data/analysis provided by TSOs and DSOs at national level
- The set of input data shall include only those data which are needed to produce the report on the estimated flexibility needs and comply with the requirements of the Regulation
- Data might refer to specific energy scenarios (for instance to ensure alignment with policy targets), intended as future projections of supply and demand needed to run the assessment within the context of the ongoing energy transition

Possible relevant aspects/questions to be to addressed and discussed at the workshops

- Alignment with policy targets (e.g. on RES integration, electrification) and information included in policy scenarios
- Consistency with adequacy, ERAA and other studies of TSO/DSOs
- Use of the scenario data collected for other studies/additional data needed
- Use of national vs pan-EU scenarios and data
- Inclusion of data from different sectors (i.e. Sector Coupling)
- Climate data and conditions to be considered for the assessment (e.g. number of Climate Years, sources of climate data,…)
- How to account for existing flex resources
- How to consider grid developments
- Stakeholder engagement processes during implementation to assess input data
- System integration to maximize flexibility

ERAA/NRAA methodology vs FNA

A grid is adequate when sufficient generation and import capacity allow demand to be met, guaranteeing security of supply

Storage

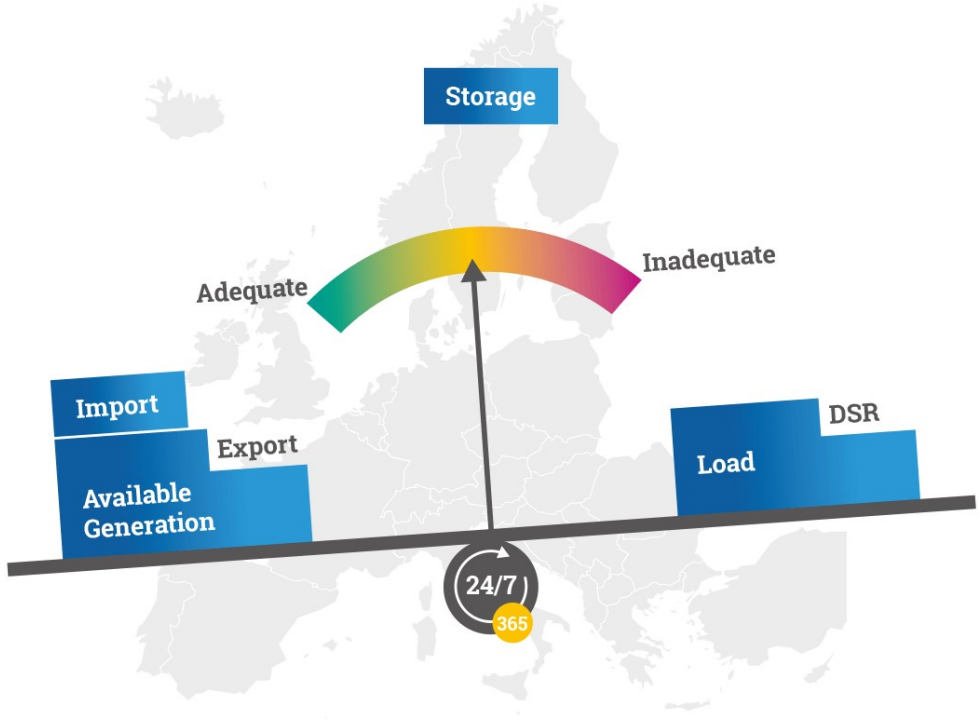
Available Generation | **Network Infrastructure** | **Demand**

=

Deterministic Forecast
- ENTSOs' Scenarios
- Planned Outages

+

Uncertainty in supply:
- Wind generation
- Solar generation
- Hydro generation
- Forced outages



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Deterministic Forecast
ENTSOs' Scenarios

+

Uncertainty in demand:
- Temperature/climate

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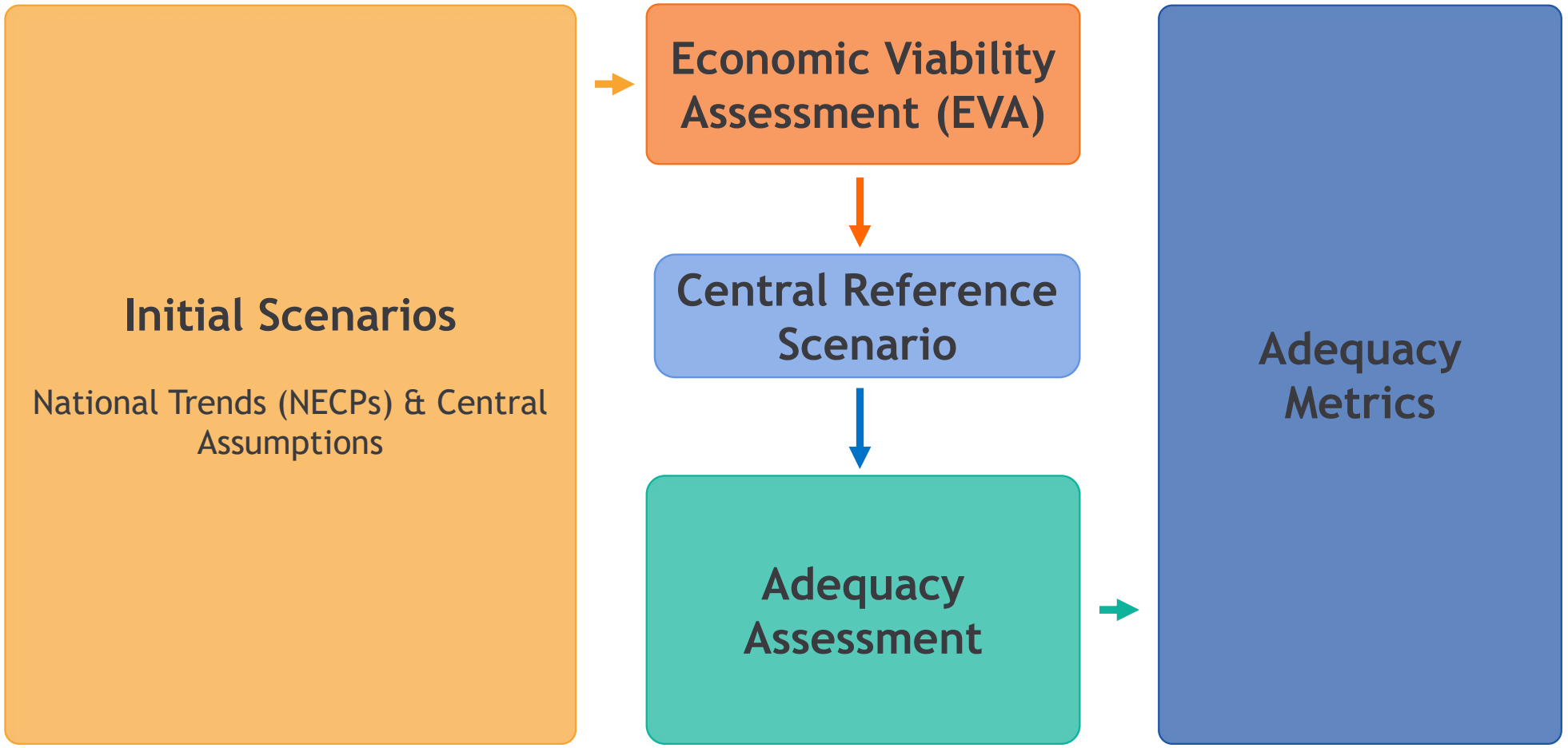
The ERAA – A multi-step process



The Framework of the ERAA

PEMMDB

Net Generation Capacities

Market Coupling

Net Transfer Capacities
Flow-Based

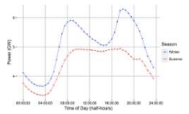
PECD

Capacity Factors

Hydro Database

Temperature profiles

DEMAND



Native demand forecasts

National Trends (NECPs) & Central Assumptions

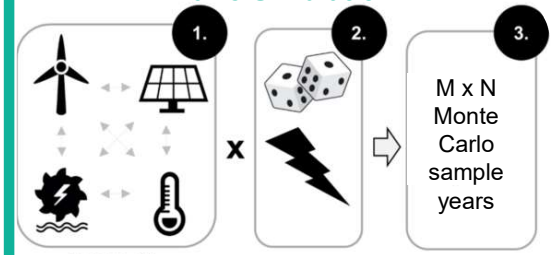
Economic Viability Assessment (EVA)

- Stochastic overall costs minimization
- Iterative revenue-based approach

Central Reference Scenario

- Include EVA entry/exit of market capacity

Economic Dispatch* Model: Monte Carlo Simulation



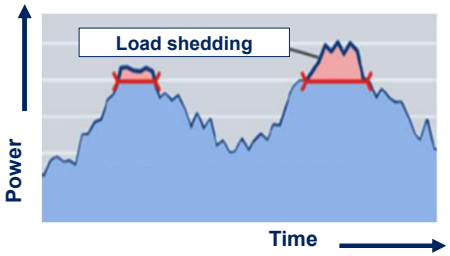
N years of independent climate data

M random draws for unplanned outages

adequacy Metrics

$$EENS = \frac{1}{M \times N} \sum_j ENS_j$$

$$LOLE = \frac{1}{M \times N} \sum_j LLD_j$$



LOLE = Loss Of Load Expectation [h/yr]:

average number of hours in which the demand exceeds the generation and import capacity in a market area.

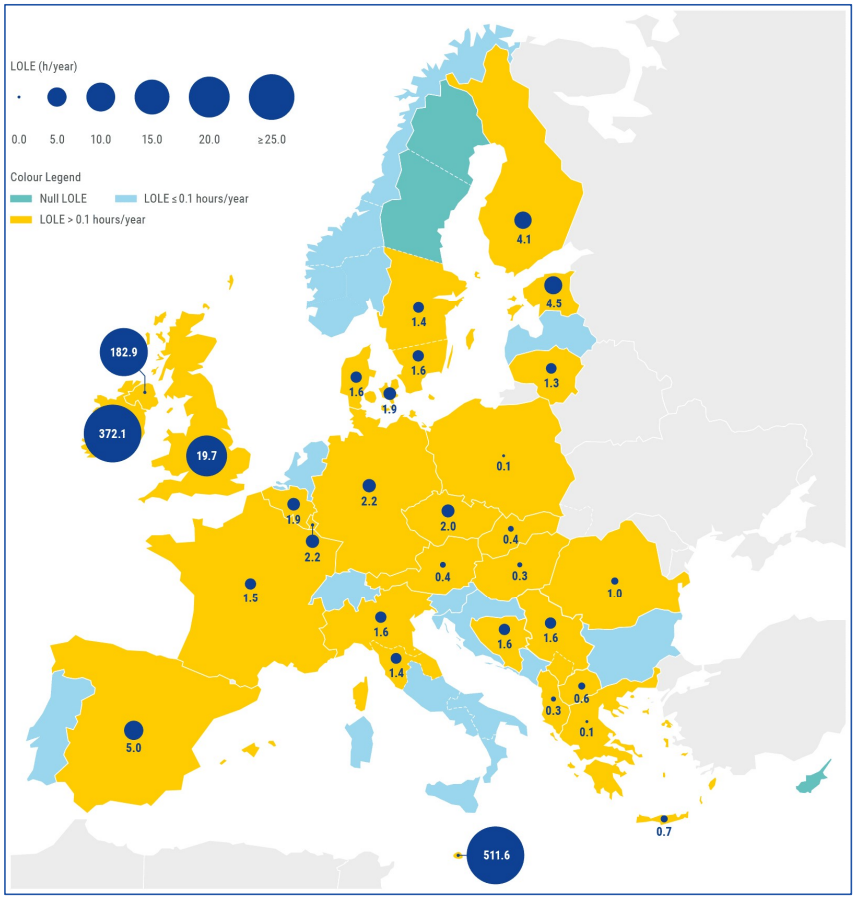
EENS = Expected Energy Not Served [GWh/yr]:

average energy not supplied when the demand exceeds the generation and import capacity in a market area.

* The ERAA Economic Dispatch model dispatches resources in the system to meet demand for every hour of the simulation and every study zone, while minimizing costs and respecting a set of constraints (Interconnector capacity for example)

ERAA adequacy results published – 2023 edition

Adequacy



ERAA/NRAA as an input to FNA (1 of 2)

The use of ERAA/NRAA market dispatch output as a starting point for the Flexibility Needs Assessment allows a reliable quantification of needs while complying with the requirements of the EMDR

"…estimated flexibility needs for a period of at least the next 5 to 10 years"

ERAA/NRAA already cover the + 10 years horizon

"…achieve security and reliability of supply"

Adequacy is part of the security and reliability of supply. FNA complements ERAA/NRAA

"The report shall be consistent with the European resource adequacy assessment and national resource adequacy assessments"

Consistency is ensured via ERAA/NRAA output

"…taking into account the integration of variable renewable energy sources and the different sectors…,… interconnected nature of the electricity market"

"potential availability of cross-border flexibility/ take into account sources of flexibility that are expected to be available in other Member States"

"consider planned investment in interconnection and flexibility at transmission and distribution level; and

the need to decarbonise the electricity system in order to meet the Union's 2030 targets for energy and climate"

ERAA/NRAA are already based on policy scenarios accounting for:

- Sector coupling (e.g. hydrogen, P2G)
- Planned interconnections
- Modelling of all EU and relevant non-EU countries and associated RES, demand, generation and flexibility

ERAA/NRAA as an input to FNA (2 of 2)

The use of ERAA/NRAA market dispatch output as a starting point for the Flexibility Needs Assessment allows a reliable quantification of needs while complying with the requirements of the EMDR

"…consider the potential of non-fossil flexibility resources such as demand response and energy storage, including aggregation and interconnection, to fulfil the flexibility needs"

"…consider all available sources of flexibility in a cost-efficient manner in the different timeframes, including in other Member States;"

"…Consider different assumptions in respect to electricity market prices, generation and demand"

The key input to the FNA is represented by ERAA/NRAA economic dispatch simulations, that already provide as a result the cost-efficient and optima use of existing available sources of flexibility, including those in other Member States

By considering a wide variety of climate conditions, ERAA/NRAA economic dispatch simulations also intrinsically consider different conditions in respect to resulting electricity market prices, generation and demand, while ensuring compliance with policy targets

Distribution Network Development Plans

Background – legal basis for DNDP in Network Code Demand Response

- Framework Guidelines NCDR (95) The new rules shall establish principles for the DSO's NDP described in Article 32 of the Electricity Directive

2019/944 Article 32

3. The development of a distribution system shall be based on a transparent NDP that the DSOs **shall publish at least every two years** and shall submit to the regulatory authority. The NDP shall provide transparency on the **medium and long-term flexibility services needed**, and shall set out the **planned investments for the next five-to-ten years**, with particular emphasis on **the main distribution infrastructure** which is required in order to connect new generation capacity and new loads, including recharging points for electric vehicles. The NDP shall also include the use of demand response, energy efficiency, energy storage facilities or other resources that the DSO is to use as an alternative to system expansion.

4. The DSO **shall consult** all relevant system users and the relevant TSOs on the NDP. The DSO shall **publish the results** of the consultation process along with the NDP, and submit the results of the consultation and the NDP to the regulatory authority. The regulatory authority may request amendments to the plan.

Background – content of the DNDP

- **General principles on the planning criteria**, allowing for taking into account particular characteristics at national and DSO level. On national level, the DSOs shall apply planning criteria that are **consistent between them** and with the planning methodology of the **national TSOs for the TYNDP** where relevant.
- **Scenario data and/or assumptions** shall be sufficiently consistent among all DSOs on national level, taking into account the scenarios used by the national TSO in its planning.
  - Reflect the most plausible futures of the electricity distribution system **for the next five to ten years**, including anticipatory needs defined in accordance with relevant national processes;
  - Be coordinated between the concerned distribution and transmission system operators;
  - Encompass, at least, **current and forecasted electricity demand, generation and storage capacities and consider national energy and climate plans**, local energy strategies and other relevant development factors
- Information on **planned and ongoing investments and on local flexibility services**

General principles on the DNDP

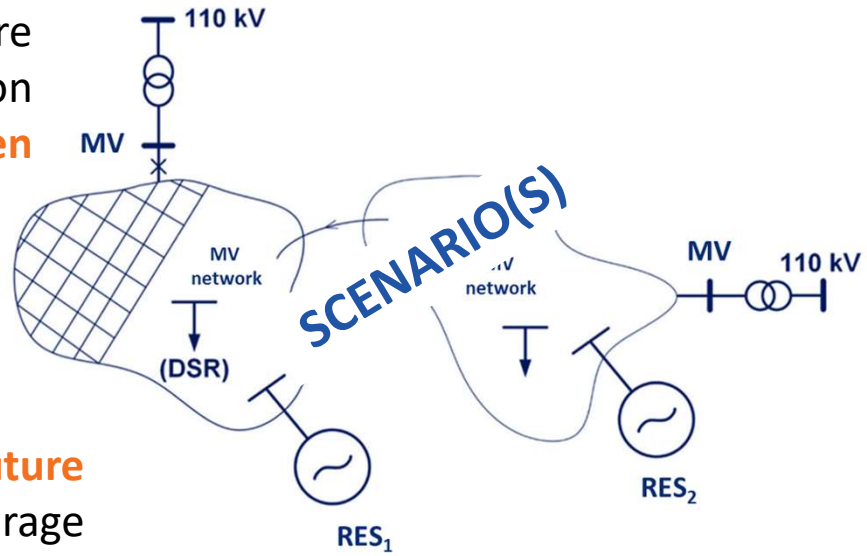
The methodology for planning and identifying needs for local services is described in each DNDP and complies with the following criteria

- abide national regulation and comply with national requirements for operators
- allow for taking into account particular characteristics at national and DSO level (voltage levels, regions)
- identify and establish DSOs observability areas
- be coordinated with the planning methodology and the scenario building process of the national TSOs
- consider development scenario(s)
- consider congestion local services
- consider generation or demand limitations
- consider flexible connection agreements (non-firm connection agreement),
- consider other relevant criteria

Requirements on development scenario(s)

Allow to identify the **future needs** of distribution **network development and local services**

Describe the **most probable prospective(s)** of the future electricity distribution system, in the **five-to-ten** years window



Be coordinated between concerned DSOs and TSOs and national bodies

Encompass existing and future demand, generation, storage capacities, consider national energy and climate plans, local energy strategies and relevant development factors

Scenario(s) **assumptions** be described comprehensively for stakeholders

DNDP as an input to FNA for DSO network needs 1/2

The use of DNDP output as a starting point for the Flexibility Needs Assessment allows a reliable quantification of needs while complying with the requirements of the EMDR

Article 19e

"…estimated flexibility needs for a period of at least the next 5 to 10 years"

"…consider the potential of non-fossil flexibility resources such as demand response and energy storage, including aggregation and interconnection, to fulfil the flexibility needs"

"…consider all available sources of flexibility in a cost-efficient manner in the different timeframes, including in other Member States;"

"potential availability of cross-border flexibility/ take into account sources of flexibility that are expected to be available in other Member States"

DNDP shares a vision of needs for local services on a technology neutral basis

- "provide transparency on the medium and long-term flexibility services needed"
- "include the use of demand response, energy efficiency, energy storage facilities or other resources that the DSO is to use as an alternative to system expansion"
- "take into account demand response and other relevant resources and assess future needs for local SO services, in particular as an alternative for grid reinforcement"

What DNDP contains

- Information to market participants as to future local services needs in the medium and long-term have been taken
- Needs in DNDP may be aggregated, especially at lower voltage levels where the cinematics of the network can depend on a single actual connection application, or the behavior of a single system user

/!\ Actual local services needs being procured may differ from DNDP → in market info

/!\ Network needs may extend beyond local services, in particular considering flexibility relative to connection agreements

/!\ cross border issues are of little relevance for DSO local services

DNDP as an input to FNA for DSO network needs 2/2

The use of DNDP output as a starting point for the Flexibility Needs Assessment allows a reliable quantification of needs while complying with the requirements of the EMDR

Article 19e

"consider planned investment in interconnection and flexibility at transmission and distribution level;

"…achieve security and reliability of supply"

"…taking into account the integration of variable renewable energy sources and the different sectors…,… interconnected nature of the electricity market"

DNDP "set out the planned investments for the next 5 to 10 years, required to connect new generation capacity and new loads, including recharging points for electric vehicles"

"…Consider different assumptions in respect to electricity market prices, generation and demand"

"be consistent with the European resource adequacy assessment and national resource adequacy assessments"

the need to decarbonise the electricity system in order to meet the Union's 2030 targets for energy and climate"

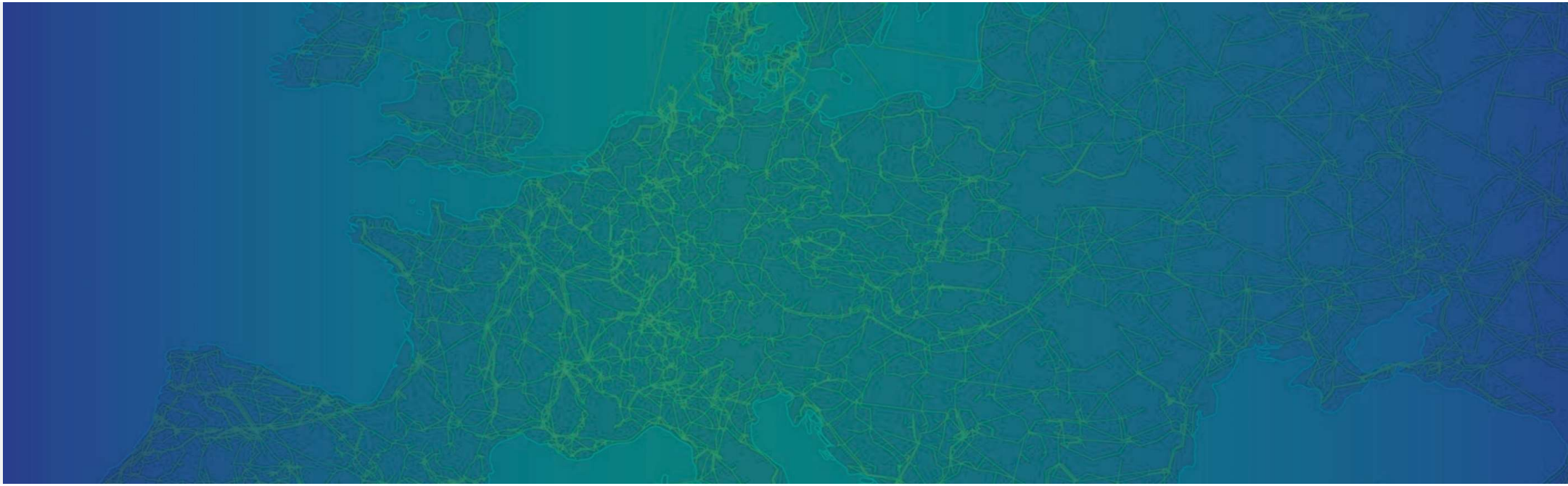
DNDP assumptions and scenarios are consistent with other national existing scenarios, and in particular NECP, and scenario used by TSO in its planning

Scenario data and/or assumptions shall be sufficiently consistent among all DSOs on national level, taking into account the scenarios used by the national TSO in its planning.

/!\ consistent does not mean and cannot be identical

Session 4 – Elements of methodology for system needs

Kristof de Vos



DSOs FOR EUROPE

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Reminder of guiding principles and system needs indicators

Guiding principles

FEASIBILITY
Minimum requirements build on existing tools and post-processing accessible (i.e. ERAA/NRAA) allowing for additional specifications where nationally relevant

CONSISTENCY
Use of scenarios, assumptions and methodologies of existing studies to the extend possible (i.e. ERAA/NRAA)

COMPLEMENTARITY
Complement shortage indicators studied in existing methodologies and studies (i.e. ERAA/NRAA)

APPLICABILITY
Technology-neutral metrics (e.g. MW and MWh of surplus energy) enabling the assessment of policy targets and need for measures

POLICY RELEVANCE
Focus on system needs (variations of generation and demand) and network needs (grid availability) in line with EMDR definition

System needs indicators

RES integration needs : surplus generation
- Study downward flexibility needs based on behavior of the ERAA/NRAA surplus energy indicator in terms of energy, duration and intervals and periods and conditions at risk.
- Refine flexibility needs into different timeframes (daily, weekly, monthly) based on optimizing a dummy flex variable on overgeneration volumes

Ramping needs: residual load variations
- Quantify flexibility shortages associated to the management of up- and downward residual load ramps over a period of 60 minutes or lower based on the ramping constraints of dispatched units (ERAA / NRAA)
- Based on comparison with residual load variations (ERAA / NRAA)

Short-term flexibility needs : prediction errors
- Quantify flexibility shortages associated to the management of up- and downward residual load / generation prediction errors based on the margins of dispatched units (ERAA / NRAA)
- Based on comparison with residual load prediction errors (ENTSO-E TP or national data)

Network needs

NETWOK NEEDS

RES Injection constraints due to local congestions

General approach

Out of scope of the FNA

ERAA/NRAA

Economic dispatch simulation

Ensure CONSISTENCY by re-using inputs for ERAA / NRAA :

- Residual load (hourly)
- Residual load variations (hourly)
- Load & Renewable generation (hourly)
- Installed capacities of assets

Ensure CONSISTENCY by re-using results of ERAA / NRAA

- Surplus energy per hour
- Economic dispatch

(per unit / technology, per hour)

Identification or revision of targets for installed non-fossil flexibility resources, to be eventually supported by dedicate mechanisms

In scope of the FNA

System needs assessment

Network needs Assessment

RES integration

Ramping

Short-term flex

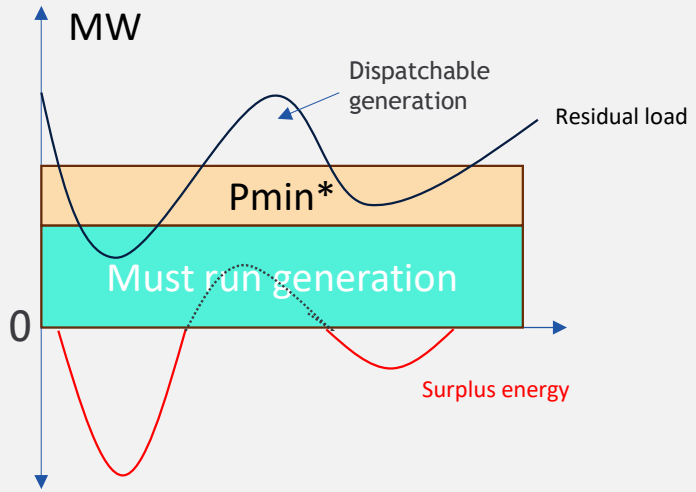
Where applicable

Assessment against existing RES integration targets

1. RES integration needs

The RES integration needs is calculated to cover surplus renewable energy that needs to be curtailed, typically during low demand and high renewable generation conditions. It follows system constraints and cannot be stored, shifted or exported by available storage, demand response or transmission capacity

Illustration of surplus energy



*minimum generation levels of dispatched units

Retrieve the surplus generation from ERAA / NRAA per hour, per simulation (e.g. climate year) for a certain target year(s)

Network needs

RES Injection constraints due to local congestions

Only when relevant/available

Statistical analysis of the surplus generation :

- Key indicators (average, maximum, percentiles)
- Probability distribution (e.g. box plots)
- Periods at risk (e.g. heat map)
- Conditions at risk (e.g. correlation)

When and under which conditions does a member state faces the risk of surplus/curtailment ?

Operational challenge?

Assessment of total surplus energy in terms of seasonal, daily and hourly basis and in view of national RES integration targets

Determination of RES integration needs in terms of an optimization of a 'dummy' flex variable (GW) (representing non-fossil fuel technology) on seasonal, daily and hourly basis

National Targets

nts

2. Ramping needs

The Ramping needs is calculated to cover the lost energy (demand shedding or renewable curtailment) following the ramping constraints of controllable units to follow hourly residual load variations

- This analysis complements the simplification of some technical constraints in ERAA / NRAA with lower relevance for adequacy (e.g. simplification of minimum power or start-up / shut-down constraints to manage computation power)
- Member states already accounting such technical constraints in their NRAA can study the behaviour of surplus generation and shortage indicators during non-scarcity related periods

Retrieve the residual load from ERAA / NRAA per hour, per simulation (e.g. climate year) for a certain target year

Retrieve the economic dispatch from ERAA / NRAA per unit / technology, per hour, per simulation (e.g. climate year) for a certain target year

Network needs

Only when relevant/available

Determine the residual load variation per 60 minutes per hour

Identify aggregated up- and downward ramping capabilities per hour, per simulation based on technical constraints per dispatched unit / technology, per hour

Accounting cross-border flexibility (remaining capacity)

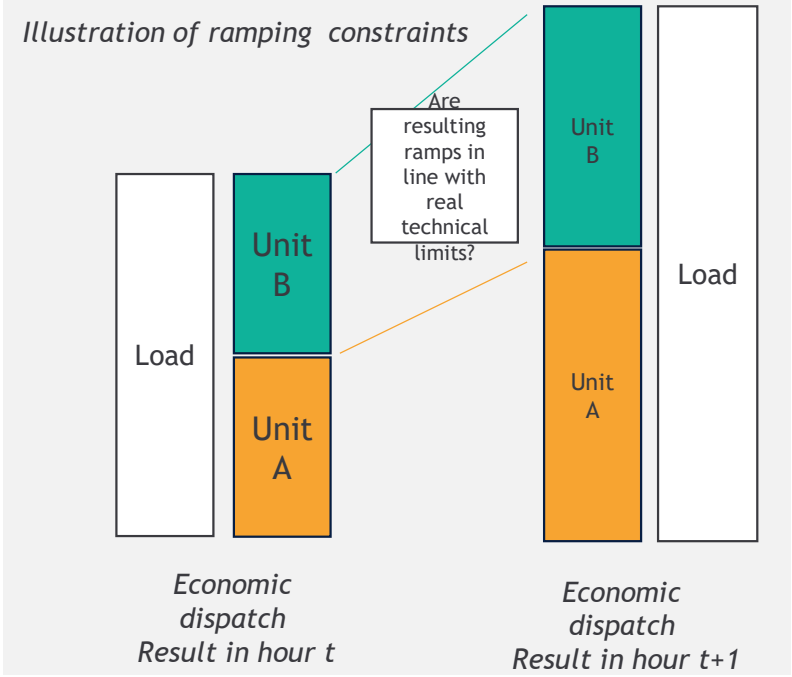
Technical characteristics of technologies

Identifying **additional ramping needs** by means of the difference between the residual load variation and available ramping means (GW)

Statistical analysis of the ramping needs

Capacity gap (GW)

Illustration of ramping constraints



3. Short-term flexibility needs

The short-term flexibility needs is calculated to cover the lost energy (shedding/curtailment) following the technical constraints of controllable units to cover unexpected variations of the demand, renewable generation or forced outage of assets

- To give a complete view on flexibility needs during the intra-day and balancing time frame, the method covers flexibility required by the market (to balance portfolios) as well as transmission system operators (to balance residual imbalances)
- This analysis complements the assumptions of 'hourly resolution' and 'perfect forecasts' in the ERAA assessments

Retrieve the residual load prediction errors from national databases

Retrieve the economic dispatch from ERAA / NRAA per unit / technology, per hour, per simulation (e.g. climate year) for a certain target year

Network needs

Only when relevant/available

Determine the probability distribution and the flexibility needs to cover e.g. 99.9% of all forecast errors (where possible associated with system conditions)

Identify aggregated up- and downward margins between 5 minutes and 5 hours, per simulation based on technical constraints per dispatched unit / technology

Accounting cross-border flexibility (remaining capacity)

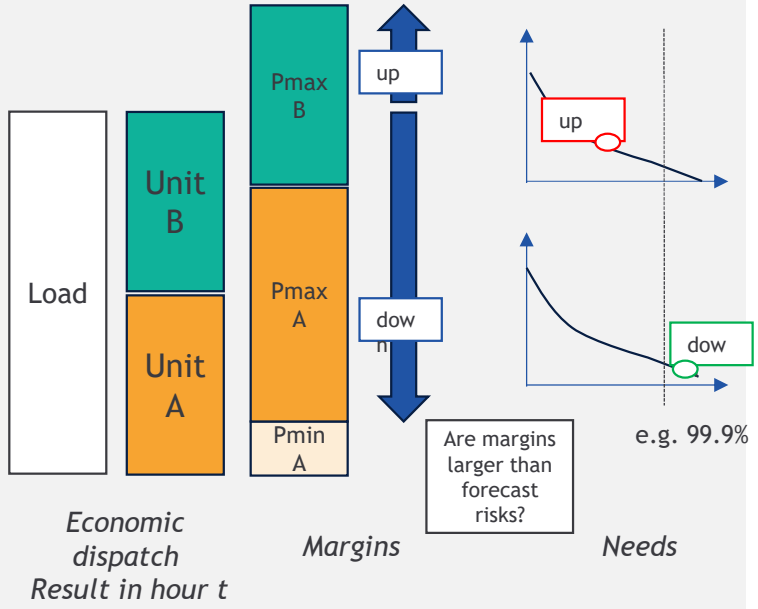
Technical characteristics of technologies

Identifying **additional short-term net flexibility needs** by means of the difference between the and flexibility needs and the means (margins)

Statistical analysis of the short-term flexibility needs

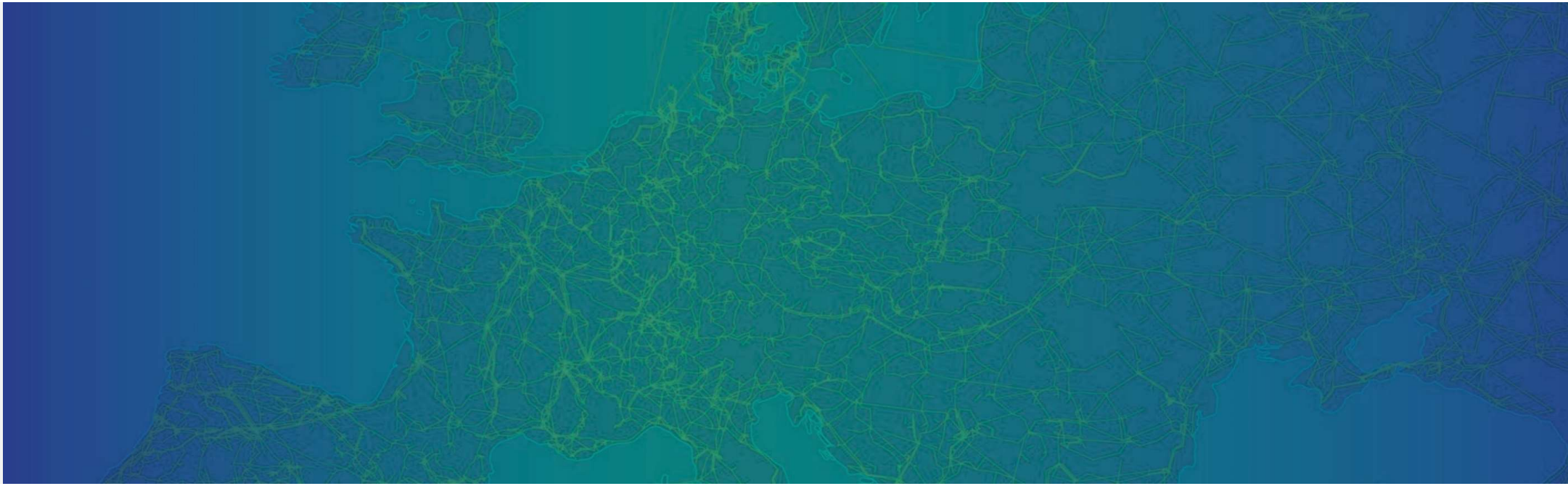
Capacity gap (GW)

Illustration of short-term flexibility



Session 5 – Elements of methodology for network needs

Daniel Davi Arderius



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Network need - Process overview

Network needs (prevent or solve congestion) : BOTTOM-UP approach

STEP 1: DSO provide data and analysis to National Entity

- **Each DSO provide flexibility needs** from **DNDP** + flexibility needs from additional assessments if relevant
  → input for the flexibility assessment from each DSO to national entity

STEP 2: National Entity synthetises data from STEP 1

- **Overall National needs** to prevent or solve congestion

STEP 3: DSO and TSO fine tune forecast of system needs if / where / when needed and relevant

- **If or where network needs** might have a **relevant impact** on system needs, **fine tune data**
- DSO provides data with better time or locational granularity to TSO and **TSO takes into account for system needs**

STEP 4: -> Guiding criteria -> policy recommendations

STEP 1 – Flexibility needs to solve or prevent congestion from each SO

1

For the next five to ten years, each SO is responsible to provide data:

- **Annual activated flexibility volumes to solve or prevent congestion**
- **Ranges of daily and hourly flexibility to solve or prevent congestion**
- **/!\ data will be aggregated, as local data is highly dependent of local dynamics of system users connection application, change of individual injection/consumption patterns, …**

2

As default DSO (respectively TSO) shall use annual volumes of local services identified in DNDP used to prevent or solve grid limitations. When these volumes do not encompass all future flexibility needs in their grid, additional assessments shall be performed by the corresponding DSO (resp. TSO). These assessments shall consider:

- **Each DSO (resp. TSO) shall perform a forecast based on its available data and NECP scenarios**
- **Each DSO (resp. TSO) shall consider the grid reinforcements described in DNDP and TYNDP**

3

Volumes of grid limitations and corresponding flexibility needs from DSO shall be provided to the National Entity based on the template and units defined in this methodology.

STEP 1 and 2 : Data from each DSO for the methodology

- /!\ Work in progress (to be confirmed if possible to compute / provide)

❑ **Data on flexibility needs for DSO (based on injection and data for consumption scenario over the planning horizon) - data upwards and downwards**

- **Potential metrics (to be confirmed if / where and to which extent possible to compute/provide)**
  - **Max GW of RES curtailment or demand outage expected in critical events over the planning time**
  - **If possible : on the critical events, over the planning horizon : Expected TWh/year (split by season if possible) and/or TWh/day (typical days / typical network conditions if possible)**
  - **Hourly GW for specific days (if possible / available)**
  - **Qualitative data where quantitative data is not available**
- **/!\ The above metrics may be relevant for normal « N » scheme » ; metrics for N-1 (planned/unplanned outage) schemes would be different**

- **/!\ Data only for DSO network needs – does not concern resources activated for TSO (network or system needs) purposes**
- **Where relevant, data from some DSO can be extrapolated based on the data provided by other DSO.**

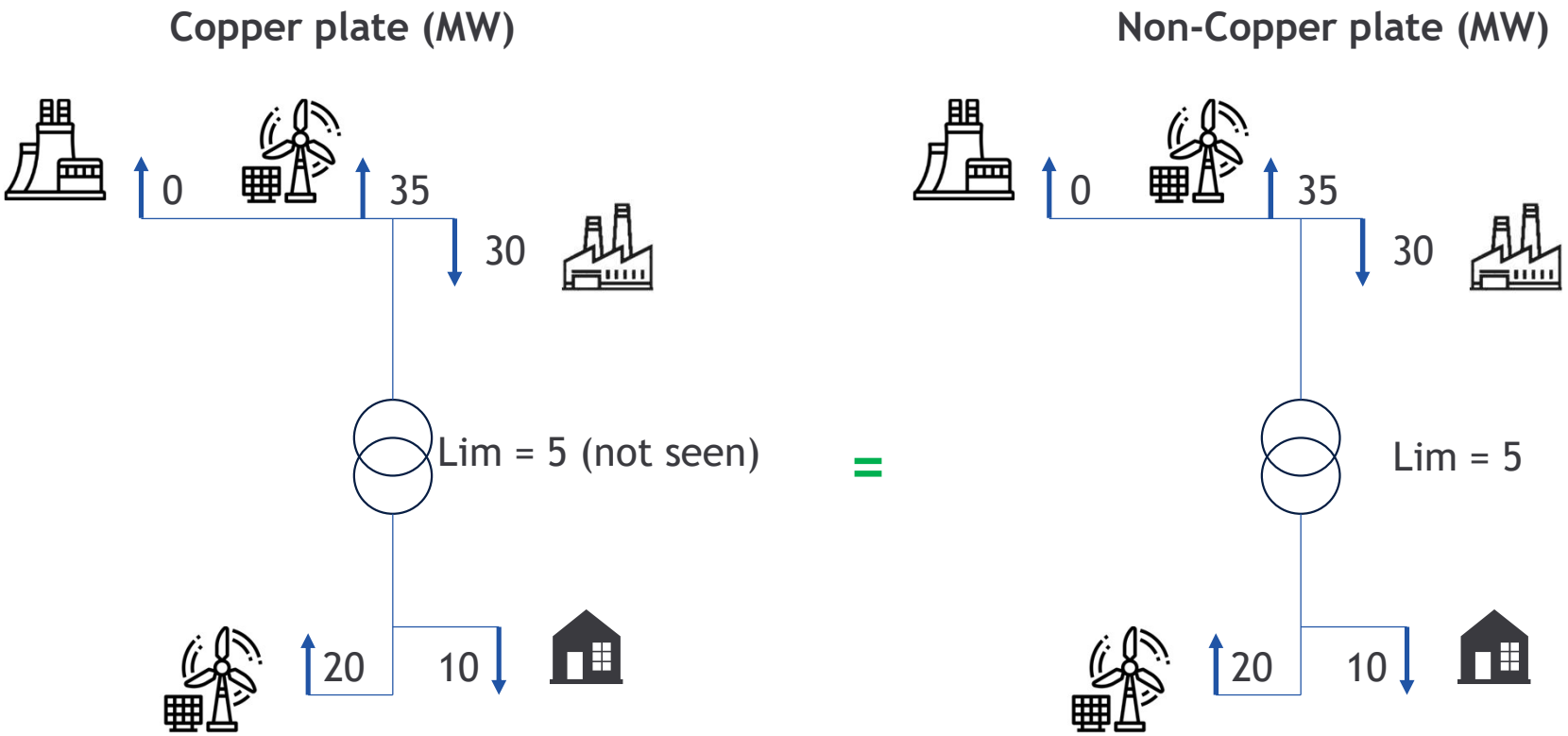
- **Still to be addressed : guiding criteria**
  - Max possible downwards flex when there is excess generation. For example, for assessing max possible downwards flex, we should consider all other flex means than curtailing generation

STEP 3 – Fine tuning
if /where / when needed and where data is available or relevant

- TSO and DSO can **fine tune the estimation of system or network needs** by exchanging data that feeds associated quantification approaches, depending **on the relevance to fine-tune and to yield more accurate data**
  - **when comparing orders of magnitude** of DSO network needs, TSO network needs, system needs and the impact of uncertainty and assumptions on DSO / TSO / system needs
  - **when considering the relevance of providing granular / local data with assumptions and uncertainty with respect to aggregated data with more certainty,** or the capability to provide such additional data
- This additional information allows to revise the system needs upwards or downwards in function of:
  - Additional RES integration / ramping / short-term needs following moments with local congestions while **avoiding double counting** during simultaneous local congestions and surplus RES energy in the system
  - Additional or reduced RES integration / ramping / short-term needs following moments with reduced or additional availability of local flexibility resources
  - Scheduled generation and consumption by affected area to increase the accuracy of the assessment
- TSO and DSOs shall agree on
  - Identification of the DSO grid areas affected by congestions, where fine-tuning would be useful
  - approaches for annualization of results if additional data is provided for specific conditions (e.g. representative days of the year, renewable generation and load conditions
  - on coverage approaches in case factors are representative for only a sub-set of DSOs at national level,

STEP 3 – Fine tuning: situation where it is not necessary

When the whole system is in RES excess condition, system need assessment already address RES curtailment due to local congestions

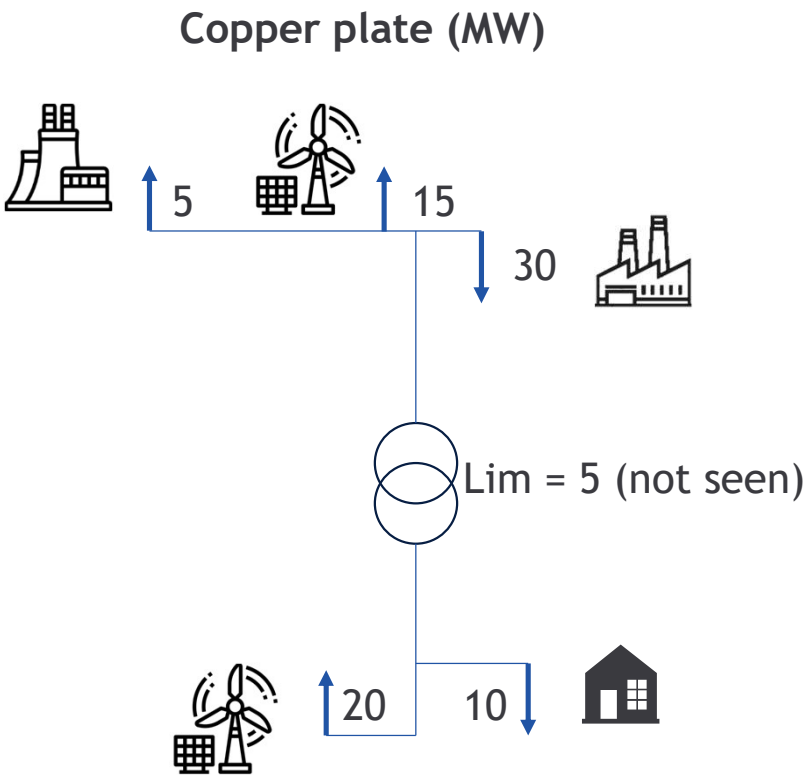


Total RES curtailed = 15

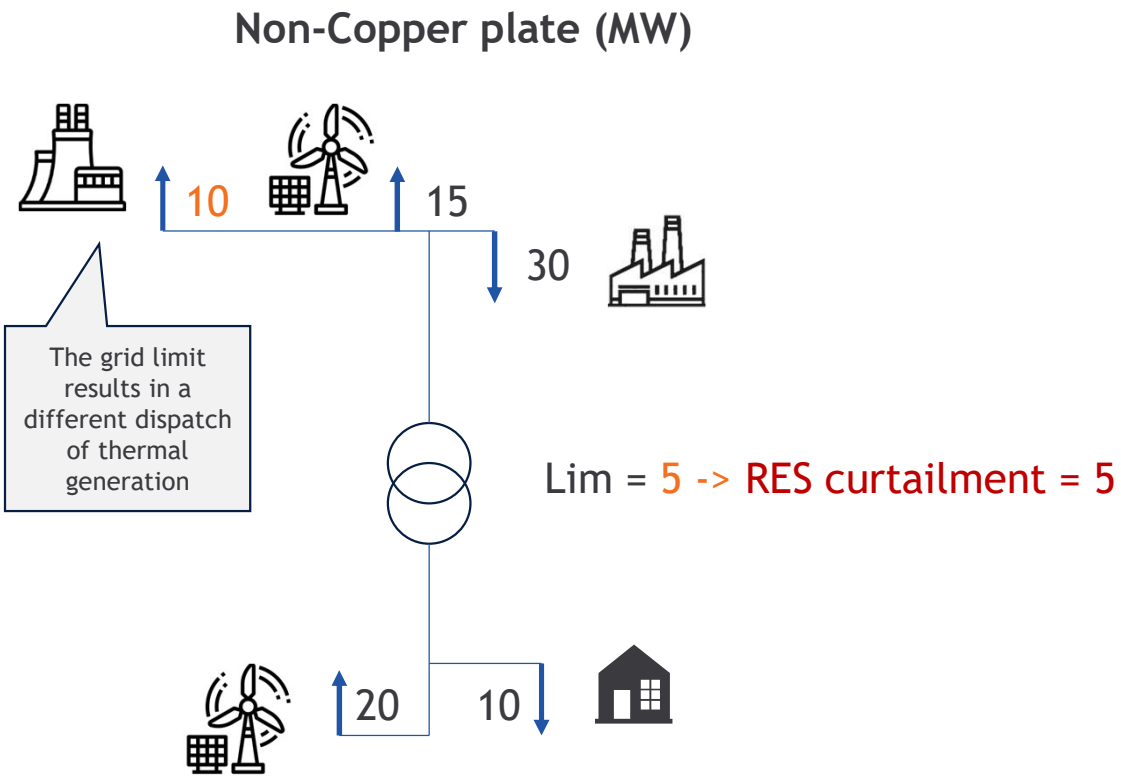
Total RES curtailed = 15

STEP 3 – Fine tuning : situation where it is useful

When the whole system is not in RES excess condition, system need assessment does not assess RES curtailment due to local congestions, thus underestimating overall RES curtailment

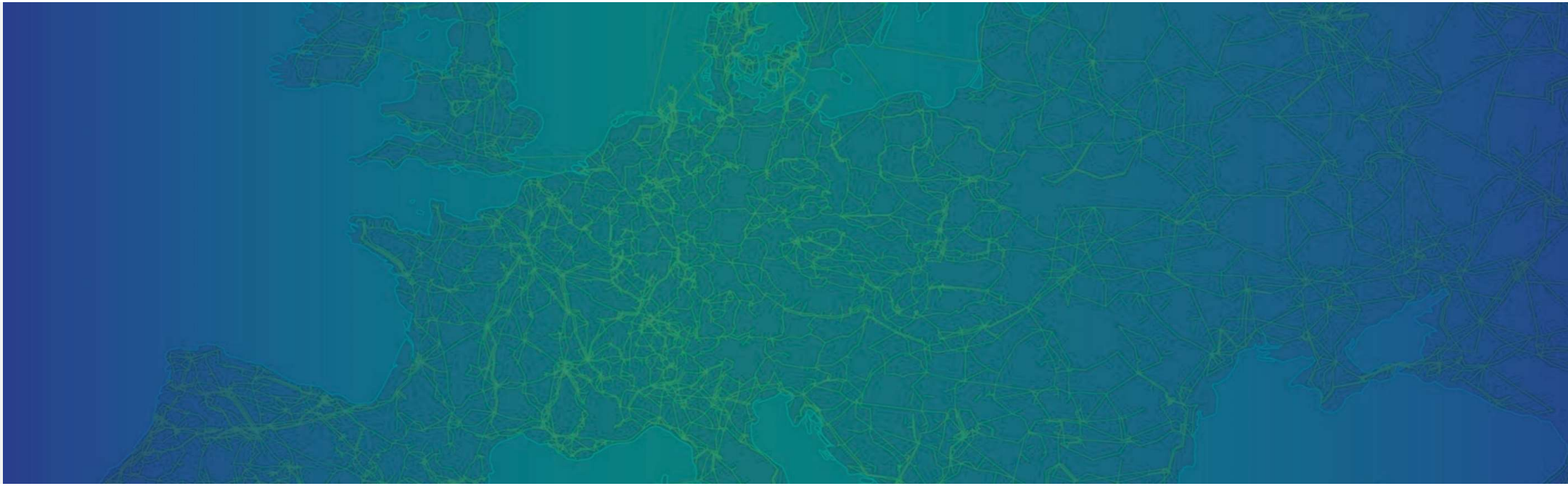


Total RES curtailed = 0



Total RES curtailed = 5

Next steps



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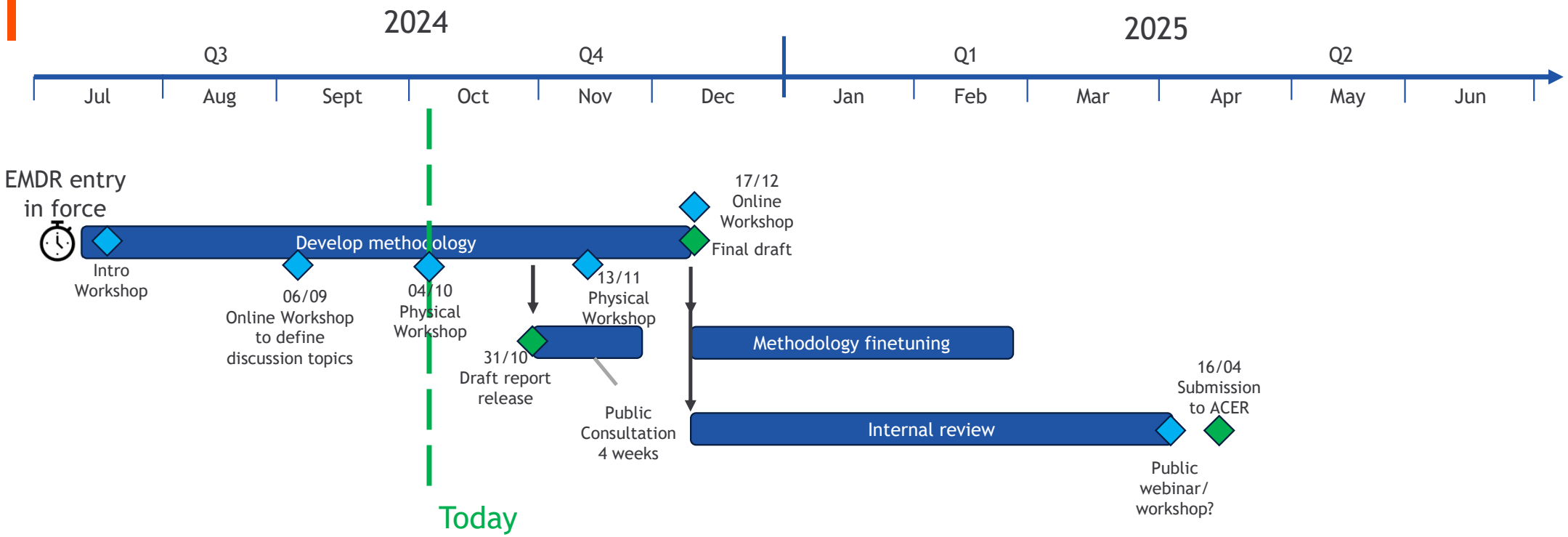
Next steps



- Consultation window opening at end of October

Report related

Stakeholder interaction

Feedback for next workshop

Stakeholders are invited to bring forward their views on the current methodology