# European Resource Adequacy Assessment (ERAA)

## Towards the Implementation of the "Clean Energy Package"

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# ENTSO-E and the European power grid

ENTSO-E Objective: setting up the internal energy market and ensuring its optimal functioning, and supporting the ambitious European energy and climate agenda.

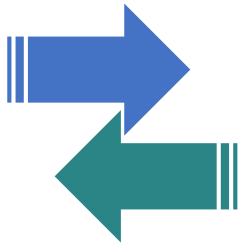
**43** TSOs, **36** countries

**3 673 TWh** generated

**3 631 TWh** consumed

**1 140 GW** of generation capacity

**500+** million citizens served



**+/- 435** TWh of electricity exchanged

**+/- 480 000** km of interconnections

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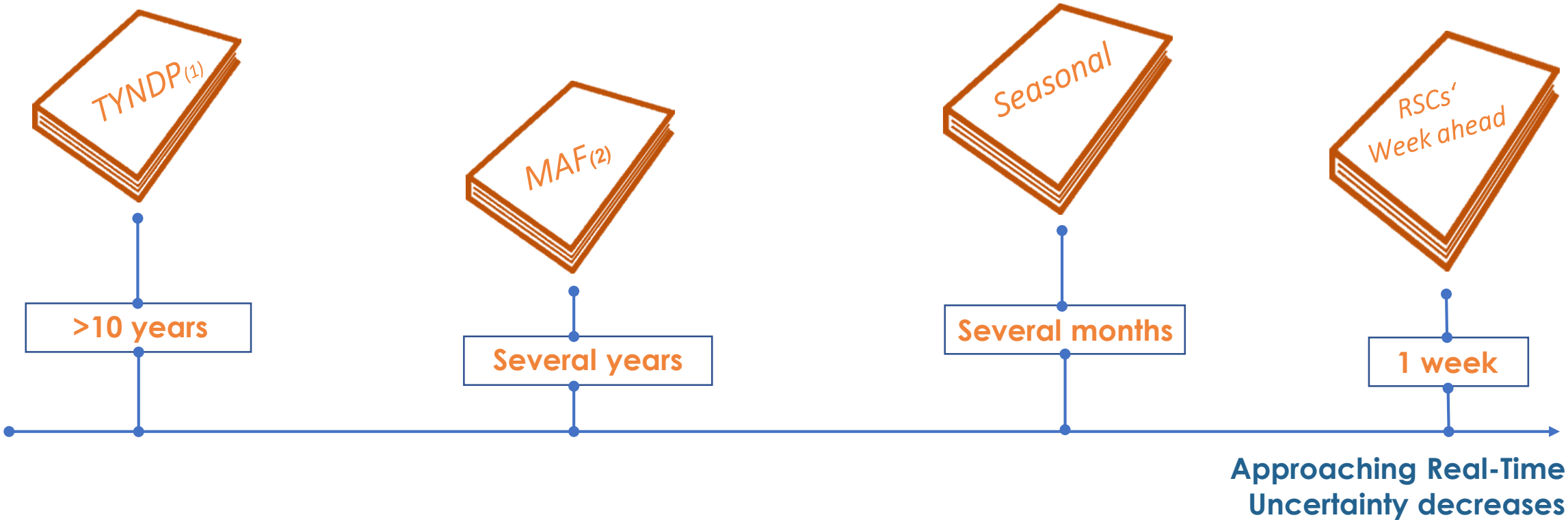
# Different risks addressed with different timeframes




Policy Decisions | Investment decisions | **Operational decisions**

(1) **T**en-**Y**ear **N**etwork **D**evelopment **P**lan
(2) **M**id-term **A**dequacy **F**orecast

# Focus on Adequacy: temporal and spatial granularity

Spatial Resolution

Pan-European

Regional/ National

Mid-Term Resource Adequacy

Seasonal Adequacy

Short-Term Adequacy

Mid-Term regional sensitivity

Seasonal regional sensitivity

Intra-week regional adequacy

Optional

Several years

Several months

month

week

day

Temporal Resolution

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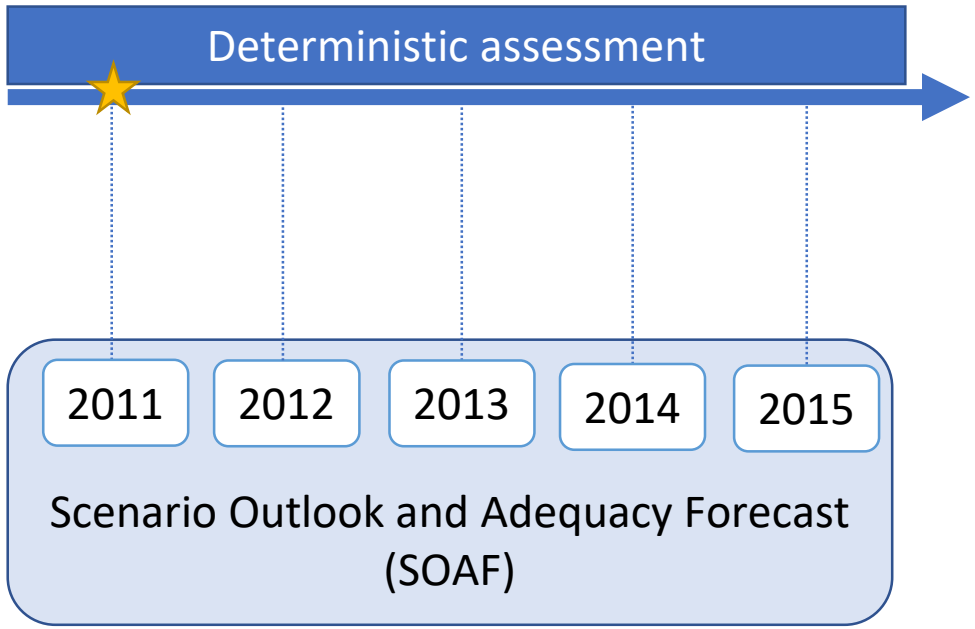
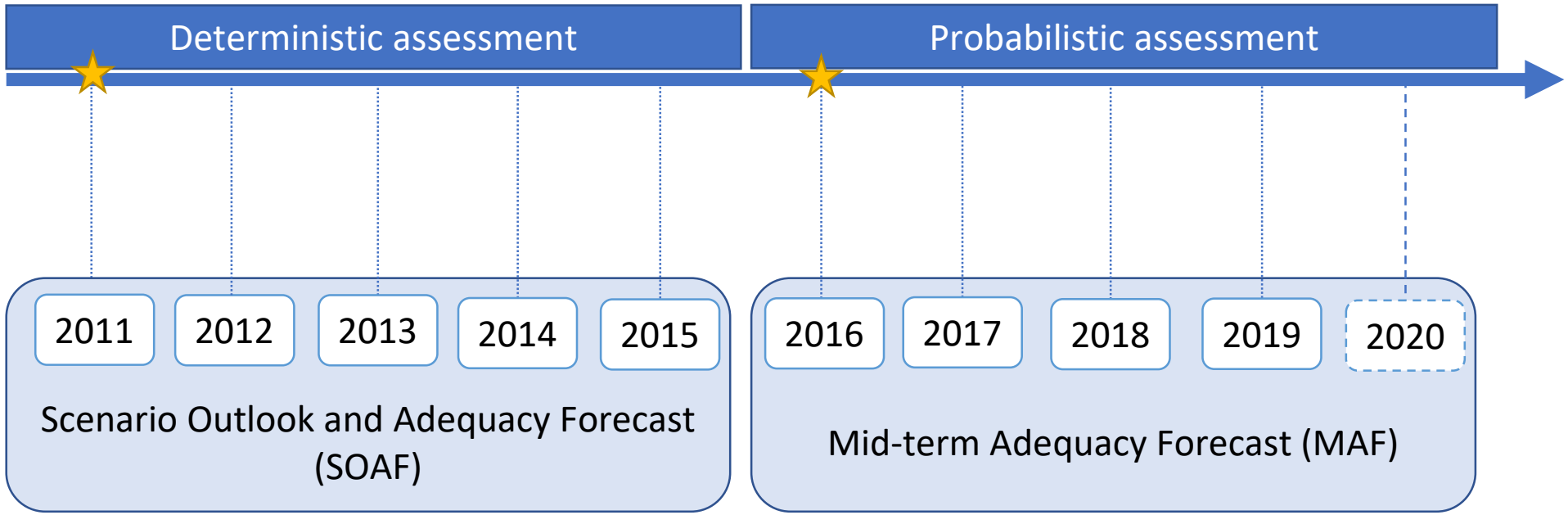
# The Mid-term Adequacy Forecast: Evolution through the years and current status

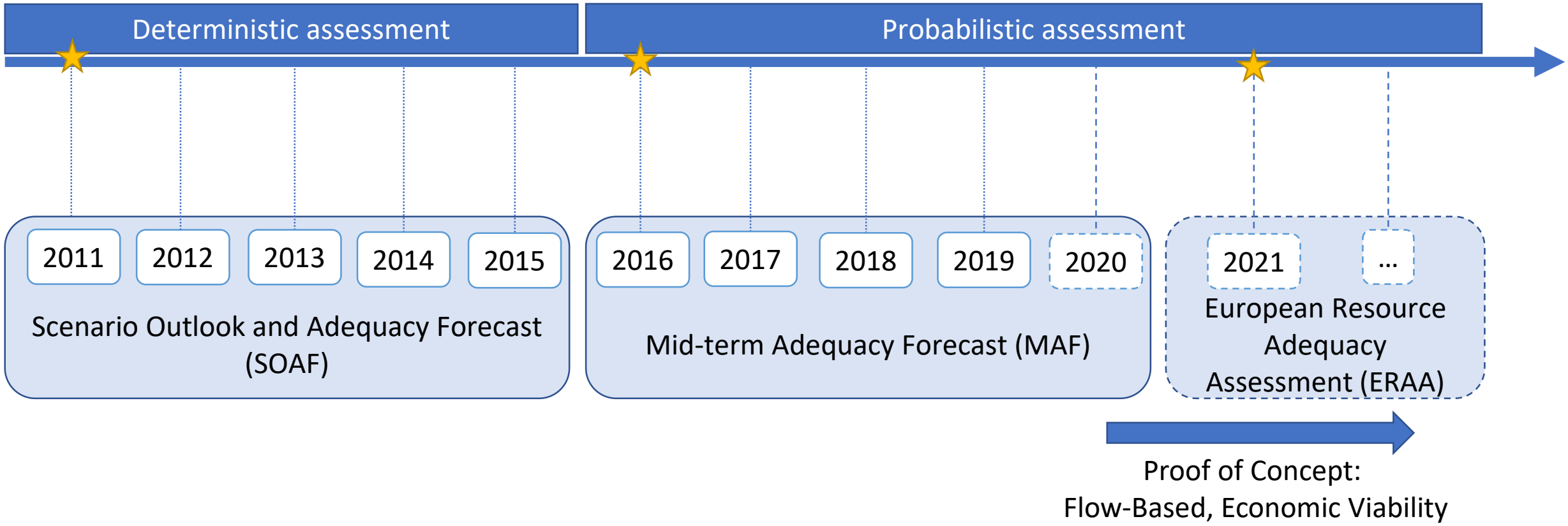
# From deterministic to probabilistic adequacy assessments



# From deterministic to probabilistic adequacy assessments



# From deterministic to probabilistic adequacy assessments



# State-of-Art probabilistic methodology

**Storage**

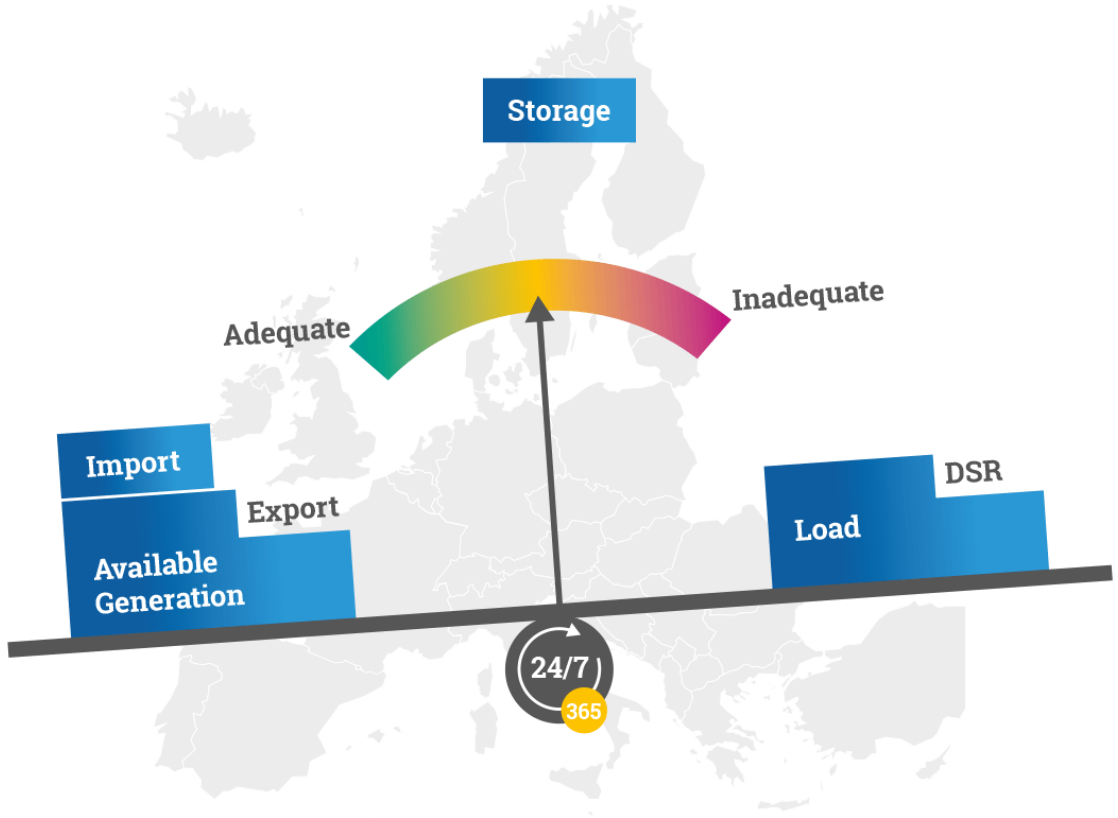
**Available Generation** | **Network Infrastructure** | **Demand**

=

**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

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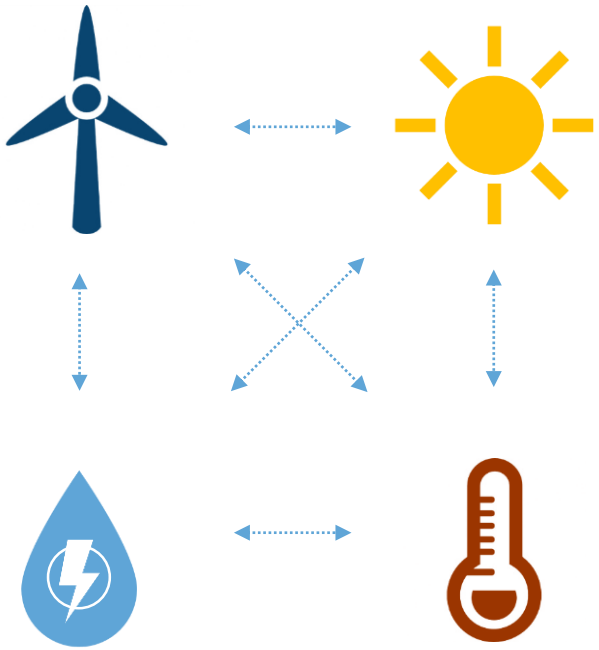
**Uncertainty in demand:**
- Temperature

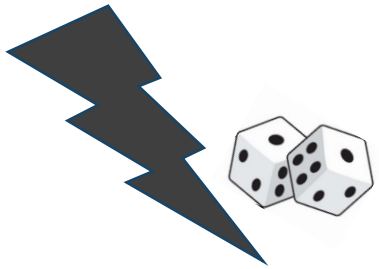
# Modelling Uncertainty: climate variables and random outages

***M*** **climate years of interdependent climate data**



**x**

***N*** **random draws for unplanned outages**



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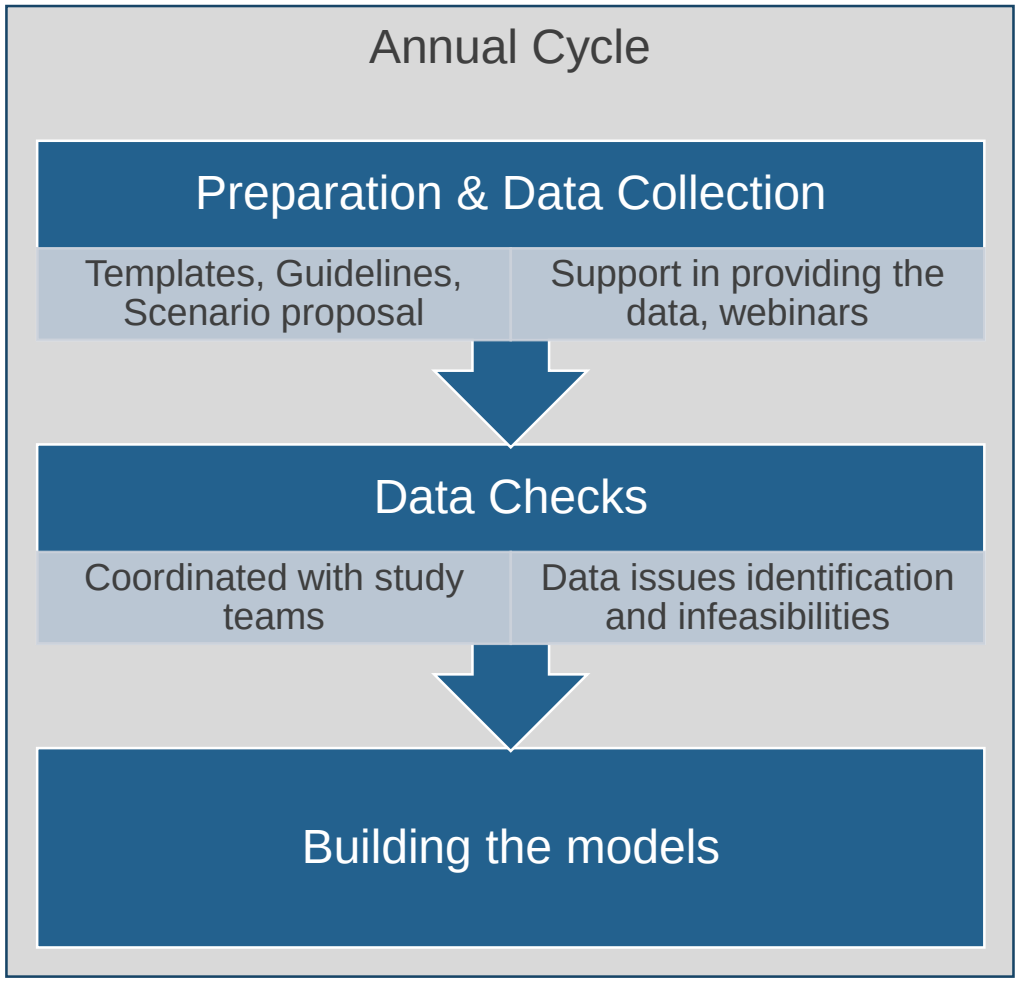
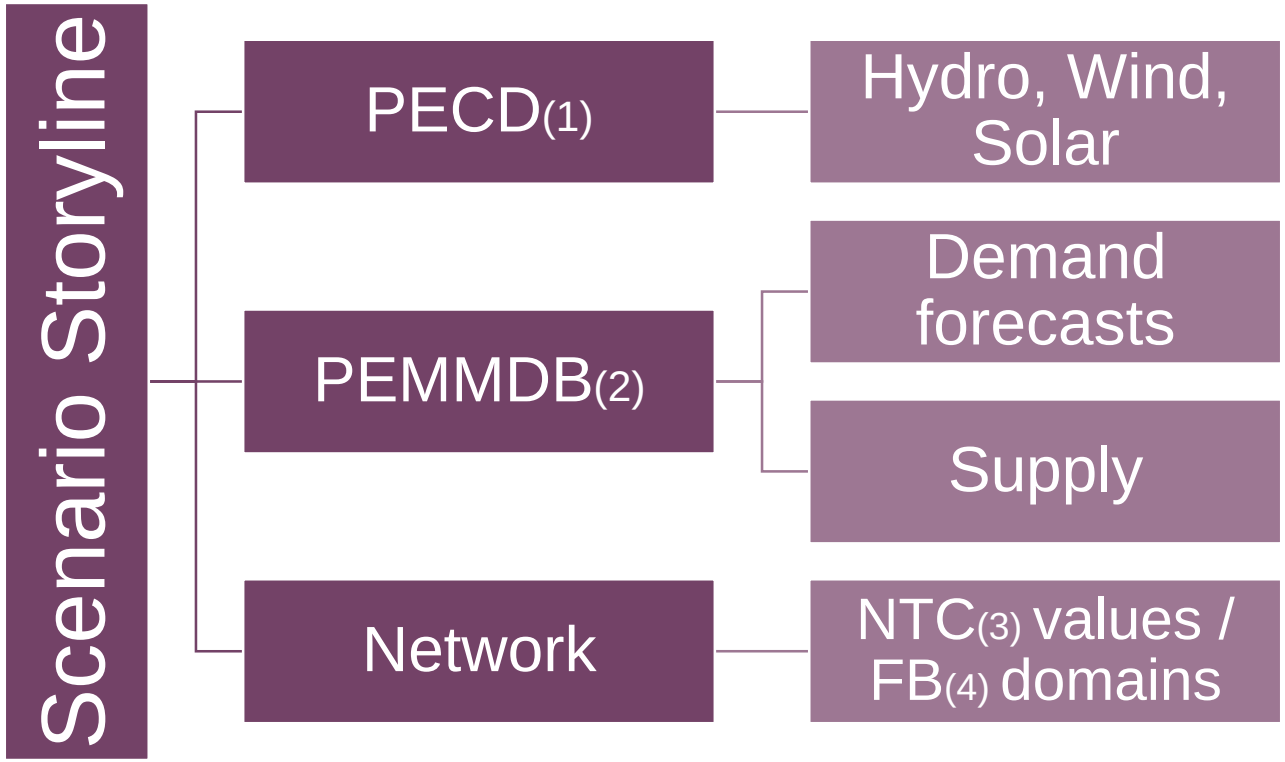
**Monte Carlo sample years**

***M x N*** **years**

# Data & Models at ENTSO-E: data collection




(1) **P**an-**E**uropean **C**limate **D**atabase
(2) **P**an-**E**uropean **M**arket **M**odelling **D**ata**B**ase
(3) **N**et **T**ransfer **C**apacities
(4) **F**low-**B**ased

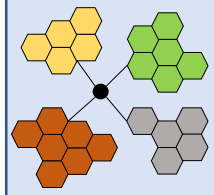
# Assumptions and limitations

| | |
|---|---|
| Perfectly competitive market | • Economic dispatch model for each hour of the target years;<br>• Generation offers are considered equal to the generating costs of each unit without strategic bidding/offering. |
| Elasticity of demand | • Inelastic demand to price;<br>• Demand Side Response with activation price and duration. |
| Focus on Day-Ahead & Intraday markets | • Resources designed to cope with real-time scarcity events are not part of the available capacity;<br>• Out-of-the-market measures, e.g., strategic reserves, are not in scope. |
| Perfect foresight | • Forecast errors from day-ahead to real-time are not considered - Perfect foresight for RES generation, hydro generation and demand. |

# Mid-term Adequacy Forecast: lessons-learned and improvements

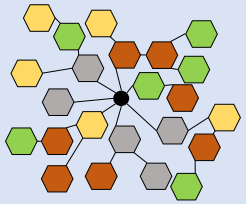
## 1. Data are key!

**PEMMDB 2.0**



**Clustering:**
Generating units clustered by technology

**PEMMDB 3.0/3.1**



**Individual power plant data:**

- economic parameters
- technical details
- scenario building fundamental assumptions

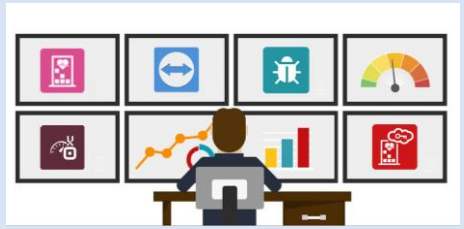
## 2. Quantifying adequacy

Investigating missing capacity: a metric for better-communicating adequacy levels and risks.

## 3. Sensitivities

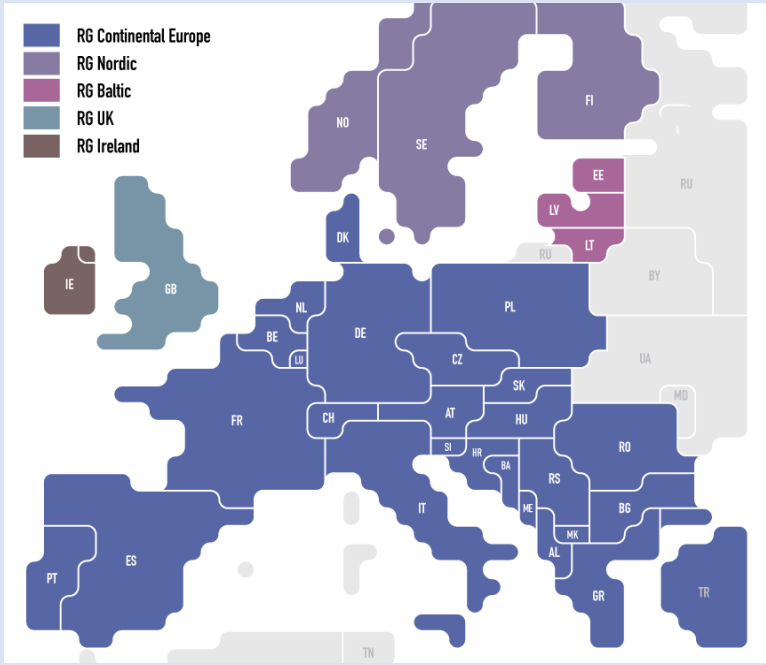
Ad-hoc sensitivities to complement the base-case results, e.g.:
*Stress-test scenario for accelerated carbon policies

## 4. Monitoring role of MAF



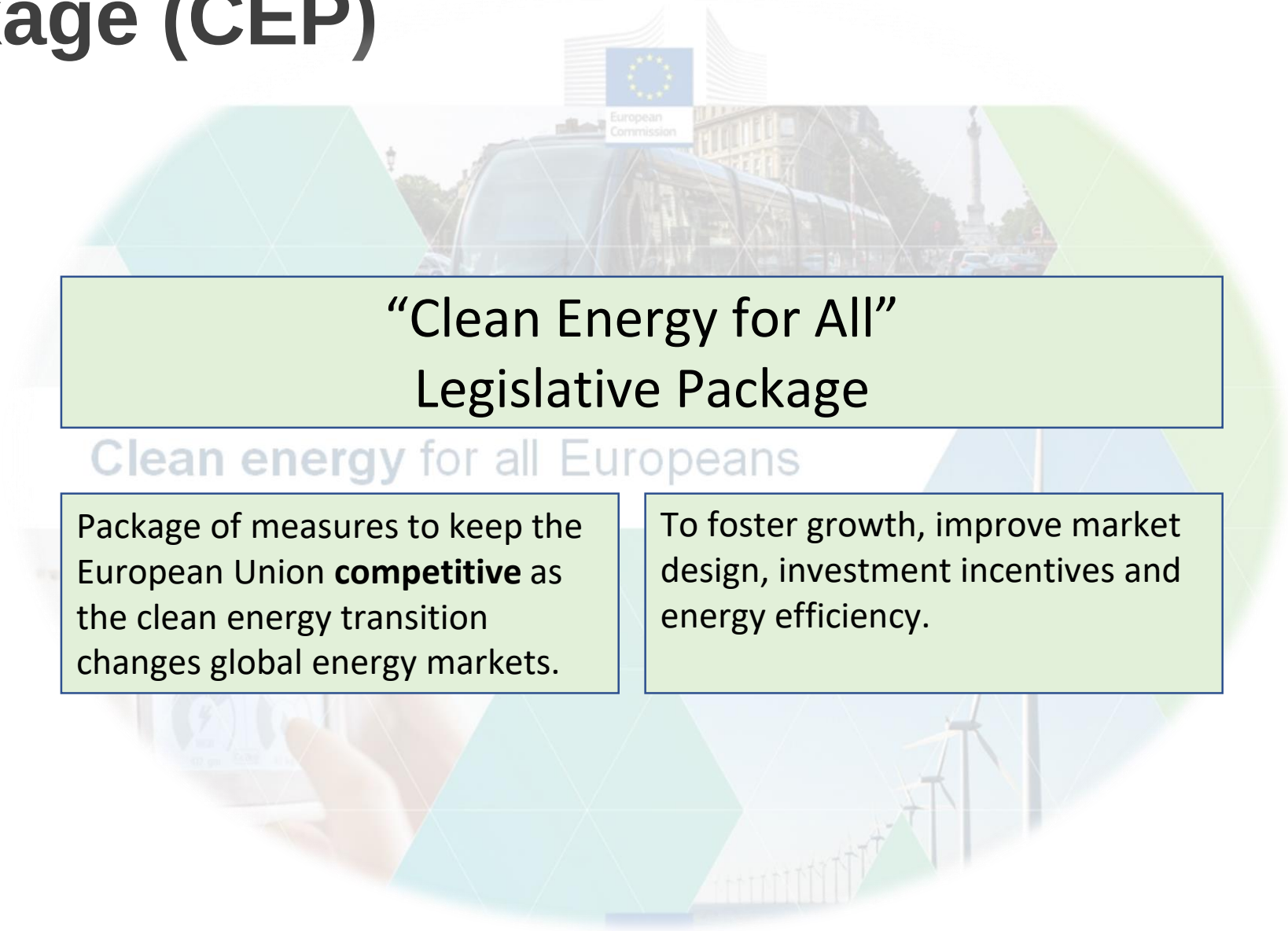
## 5. MAF alone is not enough

Set the framework for detailed regional/national studies to investigate in depth specific solutions (sensitivities on DSR, RES, storage, capacity, flexibility, interconnectors, etc.);



# Clean Energy Package:
# The new adequacy methodology and the challenges of implementation

# The “Clean Energy for all Europeans” legislative package (CEP)




“Clean Energy for All”
Legislative Package

Package of measures to keep the European Union **competitive** as the clean energy transition changes global energy markets.

To foster growth, improve market design, investment incentives and energy efficiency.

# CEP deliverable methodologies from ENTSO-E

**What does this mean for ENTSO-E and adequacy in Europe?**

**Three main methodology packages (delivered by ENTSO-E):**

1. Methodology for the European Resource Adequacy Assessment (ERAA)

2. Methodology for:
   - Cost of New Entry (CONE)
   - Reliability Standards
   - Value of Lost Load (VoLL)

3. Methodology for calculating the maximum entry capacity for cross-border participation to Capacity Mechanisms

# ERAA: Impact of CEP implementation and new challenges

## What are the main differences with current methodologies?

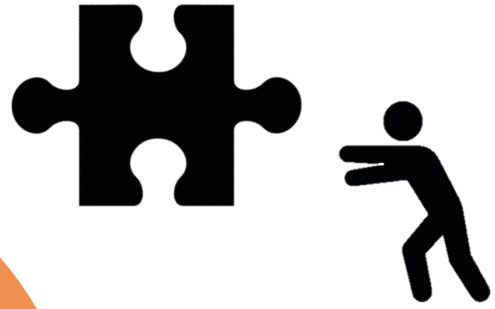
### Current Approach (MAF 2019)

- Probabilistic market modelling
- 7 years ahead - 2 simulated years
- Bottom-up approach and expectations of commissioning / decommissioning
- No explicit CM considerations
- NTC approach, flow-based only tested
- No sectoral integration

### Target Approach

- ❑ Probabilistic market modelling
- ❑ 10 years ahead - annual granularity
- ❑ Economic viability of generation assets, integrated in the model
- ❑ Integrated consideration of CM
- ❑ Compliance with FBMC when available
- ❑ Sectorial integration (P2X consideration)

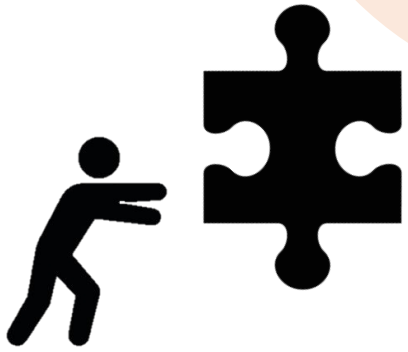
# ERAA: A basis for enhancements of market design, market integration & security of supply



**One adequacy methodology** for European, regional and national assessments

**Common adequacy indicators** as a basis for regionally coordinated national security of supply standards

**Pan-European and national assessments complementing each other in a consistent approach**

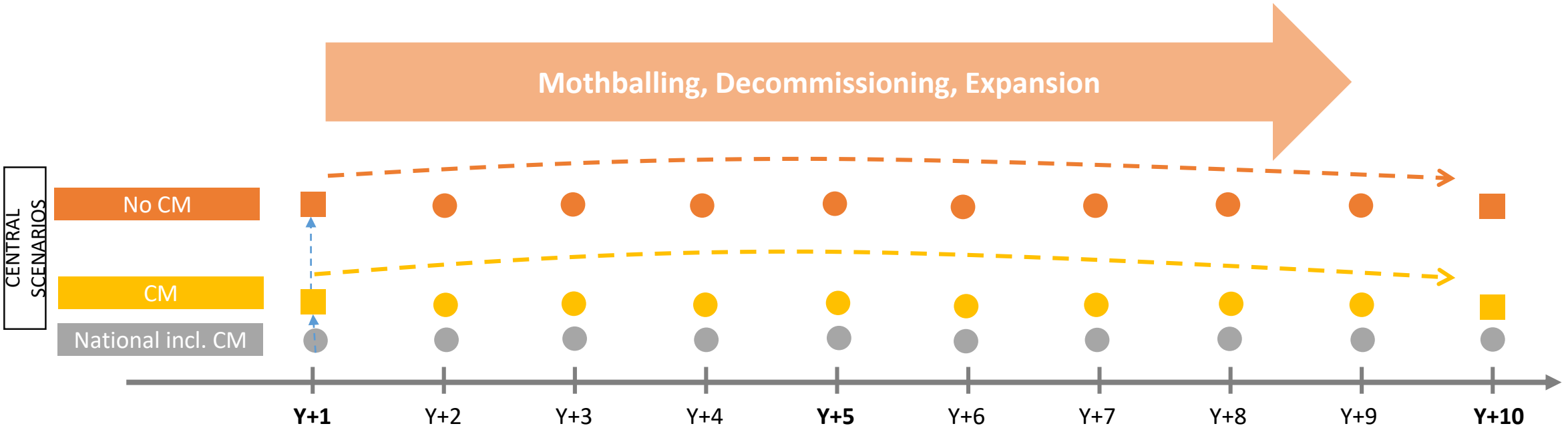


# Focus on ERAA: appropriate scenarios for a reliable assessment

The European Resource Adequacy Assessment will include:

- An **economic assessment** of the likelihood of retirement, mothballing, new-build of generation assets;
- Definition of policy units – can't be mothballed or retired;
- Transparent source of costs – specifics to be defined;
- Number of climate years – compromise between accuracy and computational complexity, consideration of climate change impact.

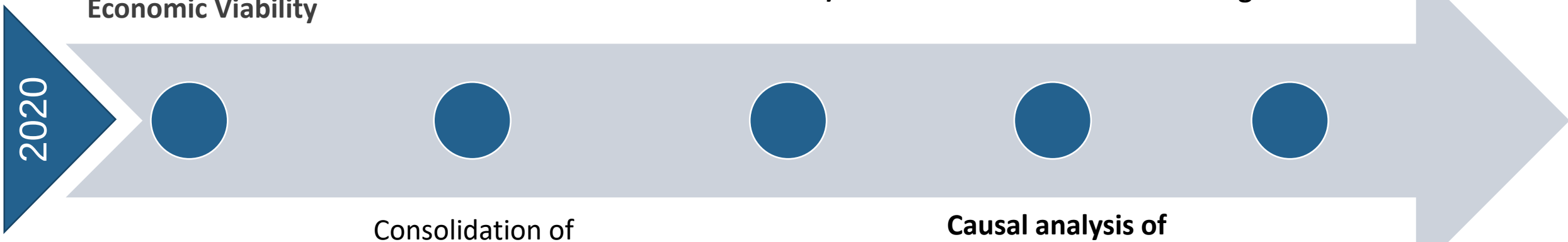

# Focus on ERAA: central scenarios and increased complexity




- Non-policy resources which are non-viable are retired/mothballed.
- Viable new resources are expanded.

# European Resource Adequacy Assessment: **Implementation roadmap**

# ERAA: Stepwise implementation roadmap




Internal proof of concept:
**Flow-Based,**
**Economic Viability**

Consolidation of Flow-Based framework suited for **5-10 years.**

Proof of concept application of **Economic viability** .

Consolidation of **Economic viability** & scenarios **with/without CM**

**Causal analysis of scarcity situations**

- **Yearly granularity**
- **Sectorial integration tests**

*More detailed implementation roadmap to be published soon at ENTSO-E Website*

# Thank you!

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