Generation adequacy assessment of the European Transmission System Operators

Benelux Association for Energy Economics

Brussels, 7 May 2013

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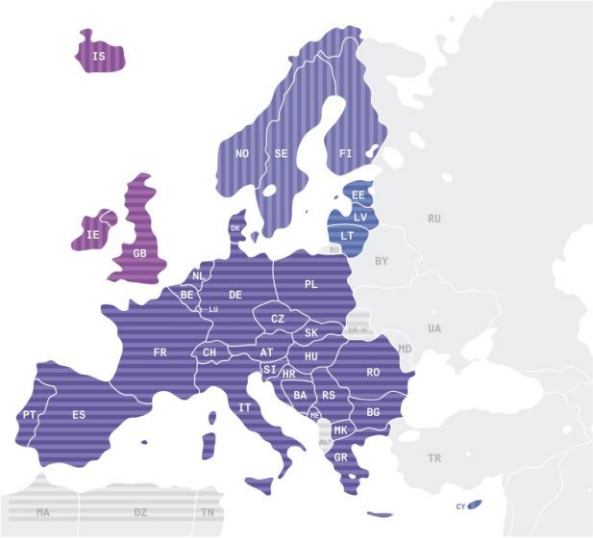
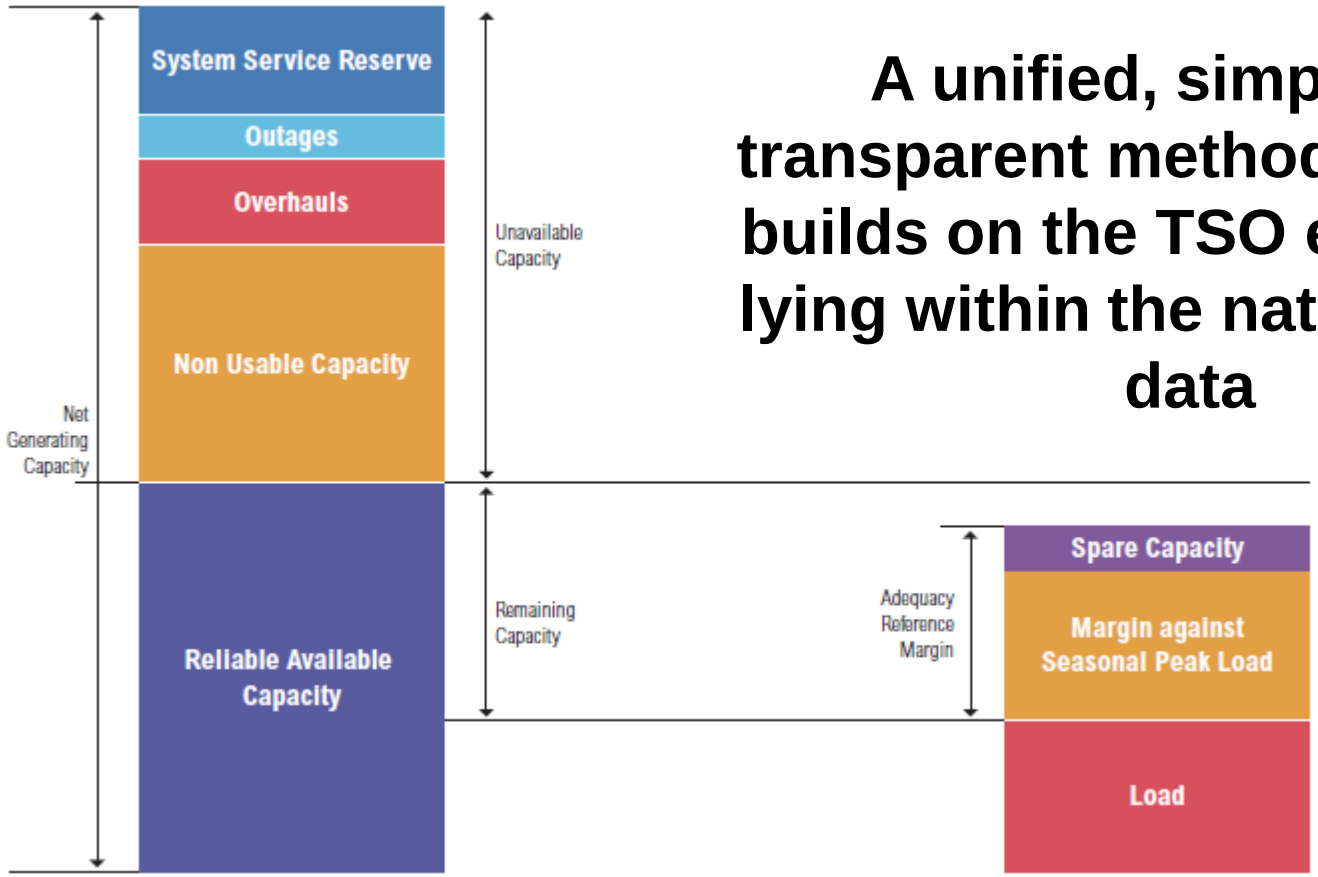
ENTSO-E tasks defined by Regulation (EC) 714/2009

- **A non-binding Ten Year Network Development Plan incl. a European generation adequacy outlook, every 2 years**
  - **"The European generation adequacy outlook … shall cover the overall adequacy of the electricity system to supply current and projected demands for electricity for the next five-year period as well as for the period between five and 15 years from the date of that outlook. The European generation adequacy outlook shall build on national generation adequacy outlooks ...**
- **Seasonal generation adequacy outlooks**
  - **As per the Draft Network Code on Operational Planning and Scheduling**
- **R&D Plans, common network operation tools, and of course drafting network codes.**

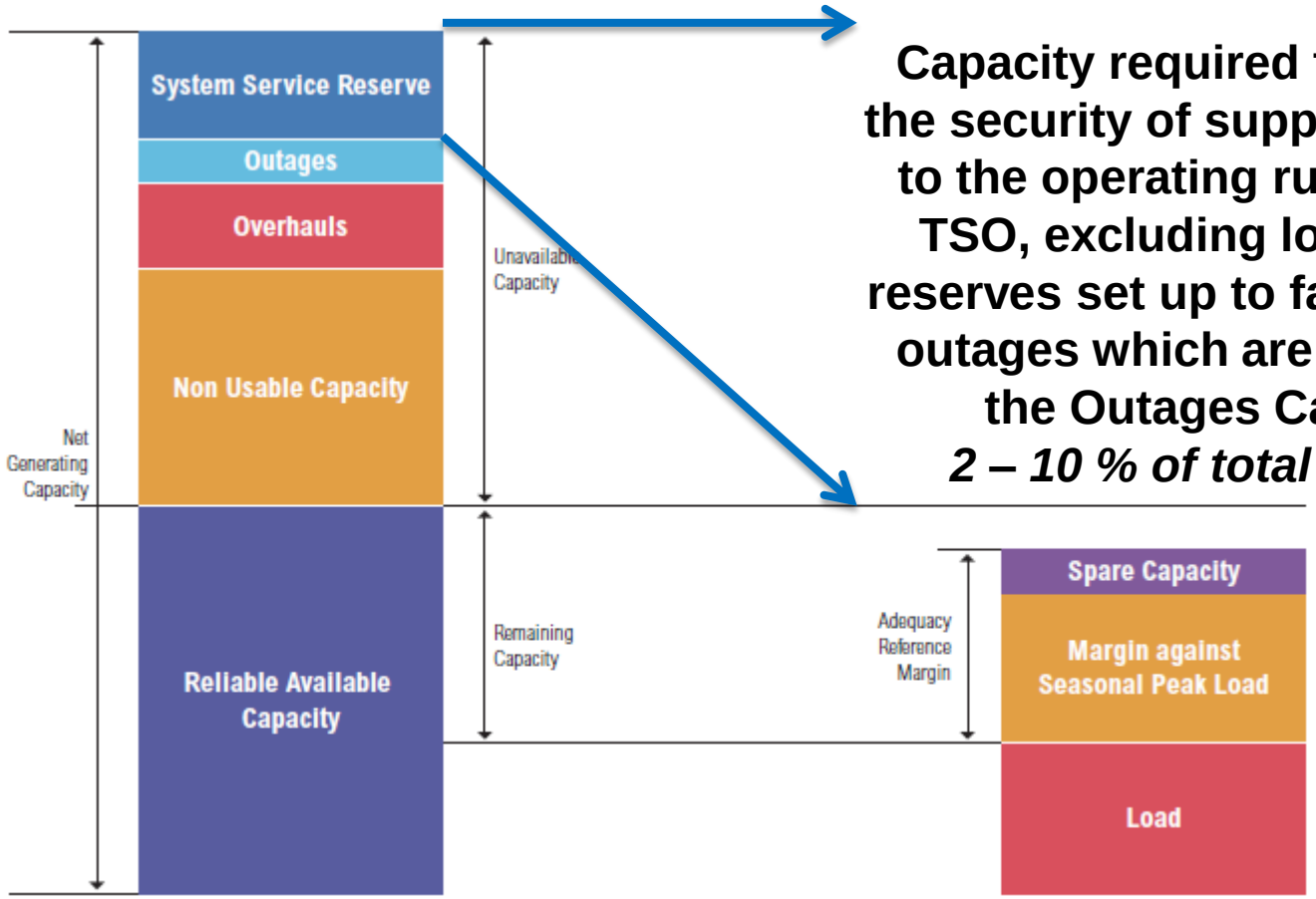


Adequacy methodology – decades of experience of the European TSOs



A unified, simple and transparent methodology that builds on the TSO experience lying within the national input data

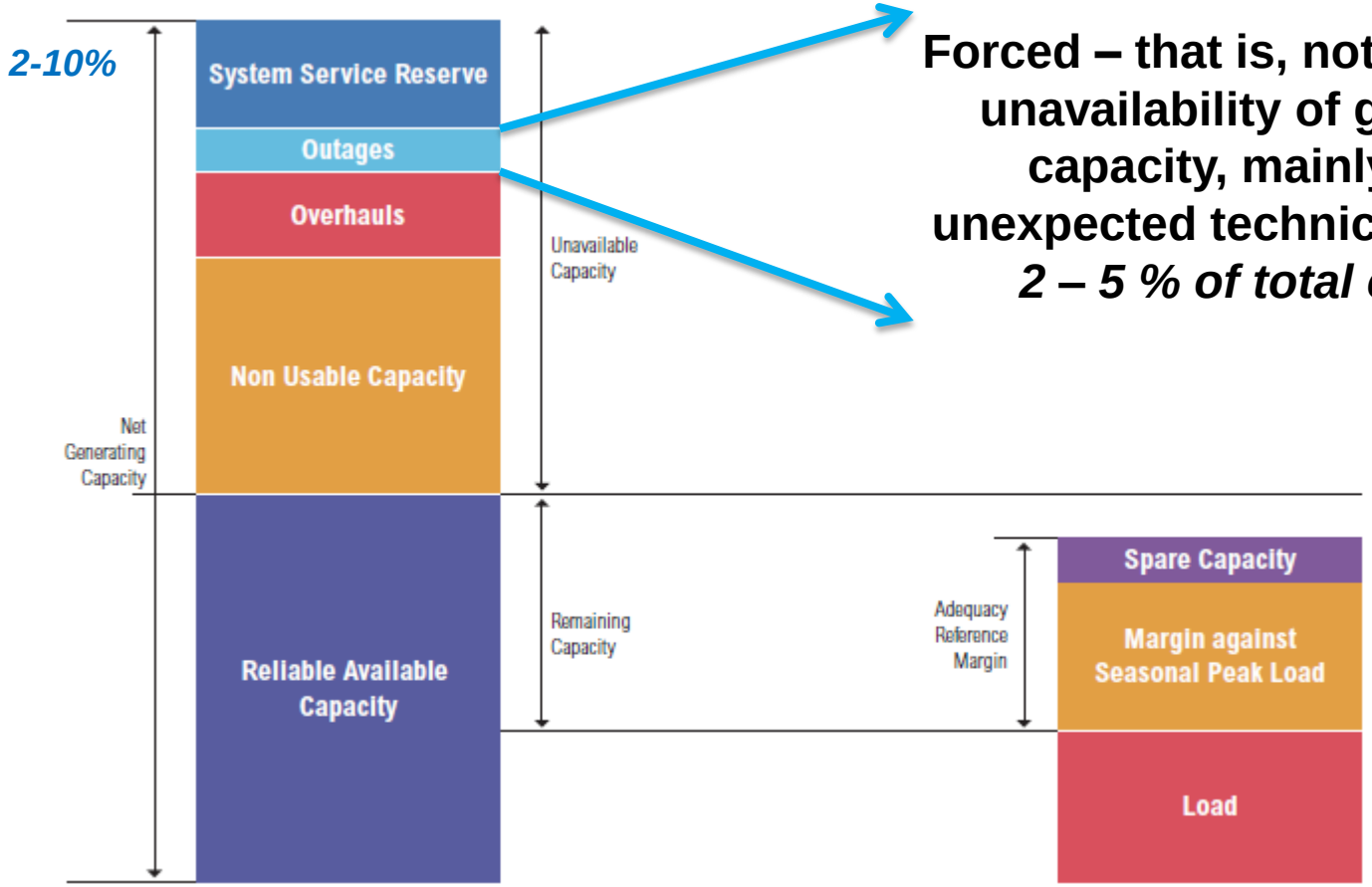
Adequacy methodology – decades of experience of the European TSOs



Capacity required to maintain the security of supply according to the operating rules of each TSO, excluding longer-term reserves set up to face potential outages which are counted in the Outages Category

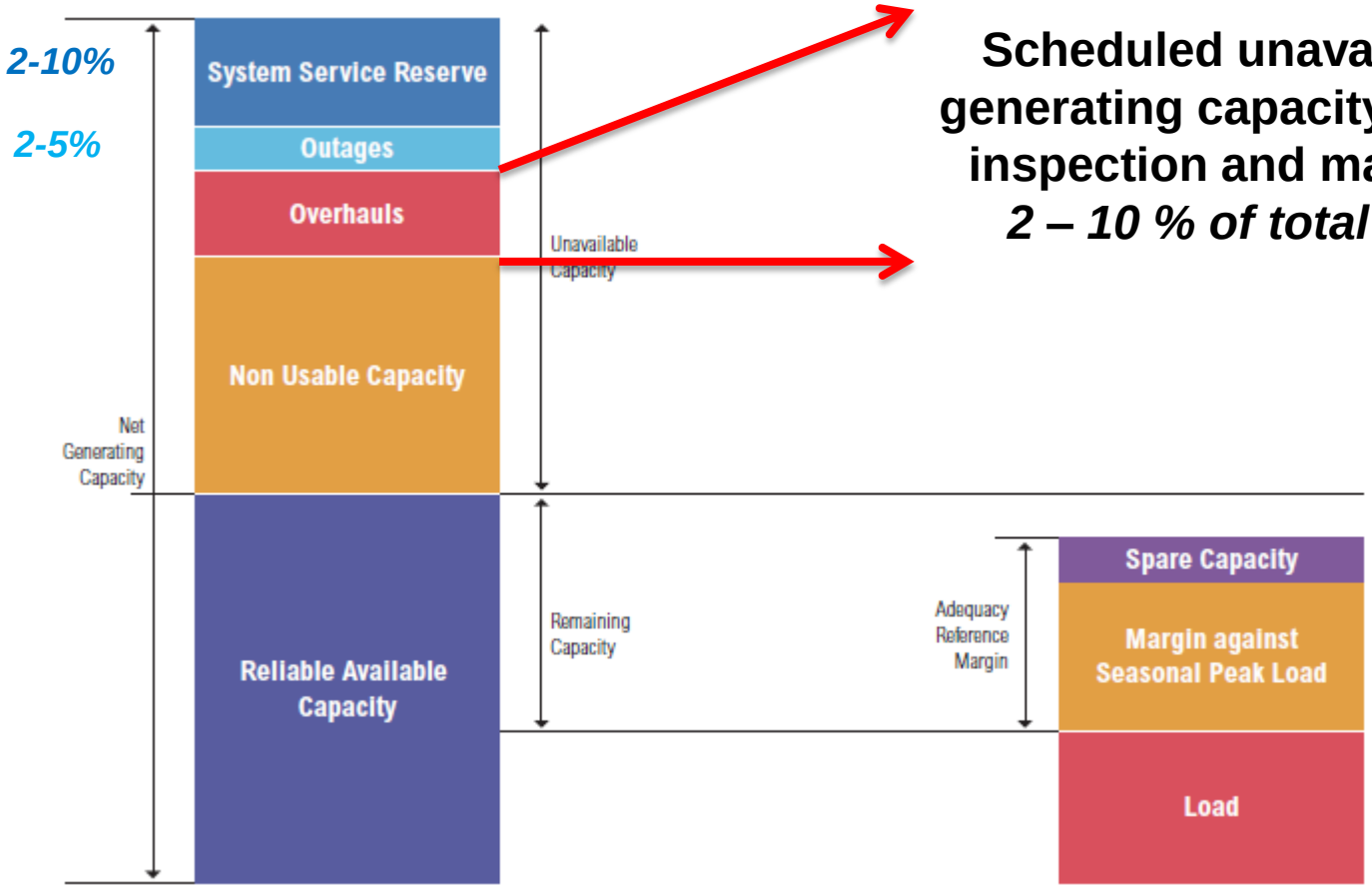
2 – 10 % of total capacity

Adequacy methodology – decades of experience of the European TSOs



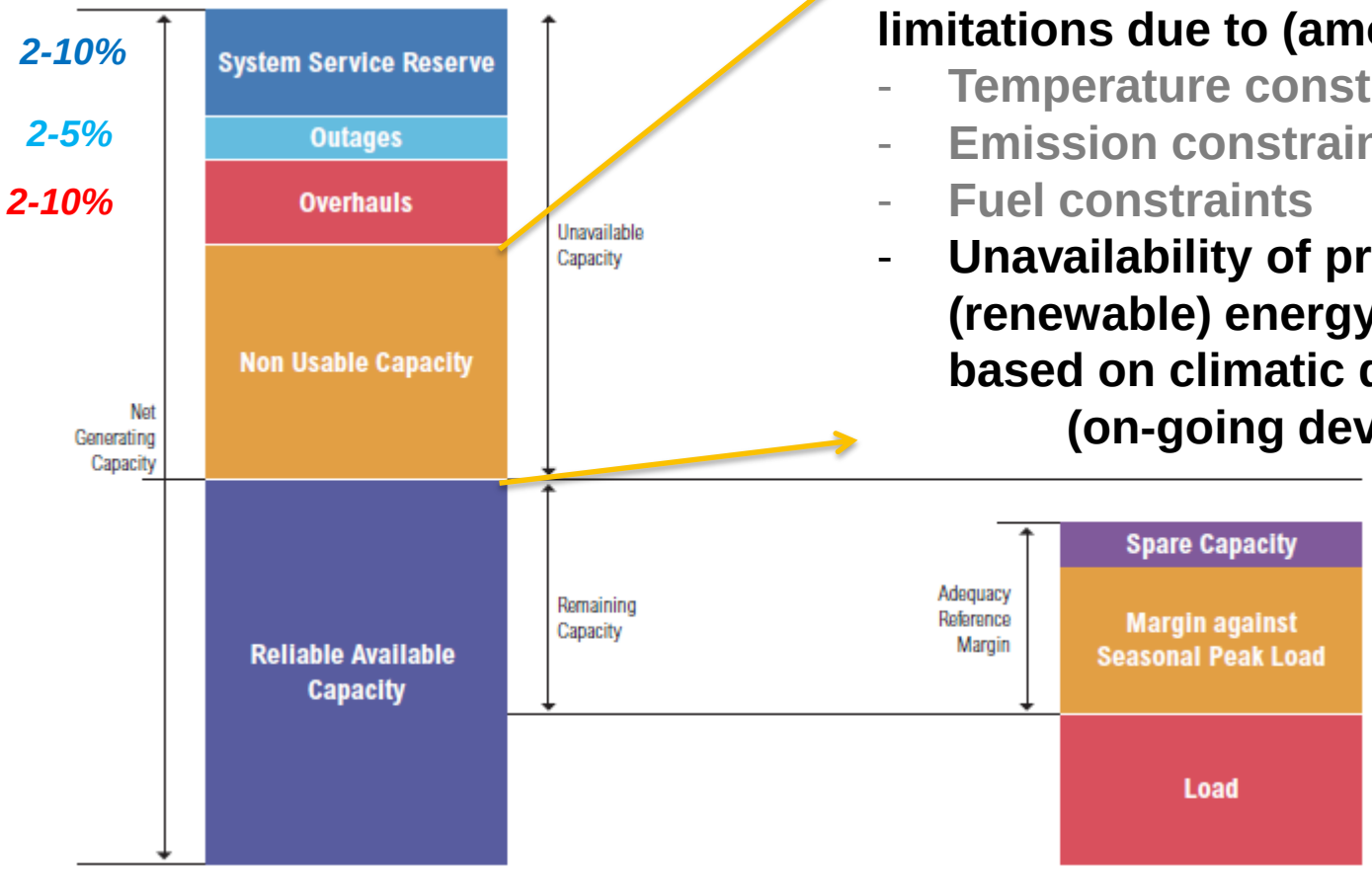
Forced – that is, not scheduled - unavailability of generating capacity, mainly due to unexpected technical problems
2 – 5 % of total capacity

Adequacy methodology – decades of experience of the European TSOs



Scheduled unavailability of generating capacity for regular inspection and maintenance
2 – 10 % of total capacity

This transparent methodology is simple to apply at different time and MW scales but builds on stochastic analyses



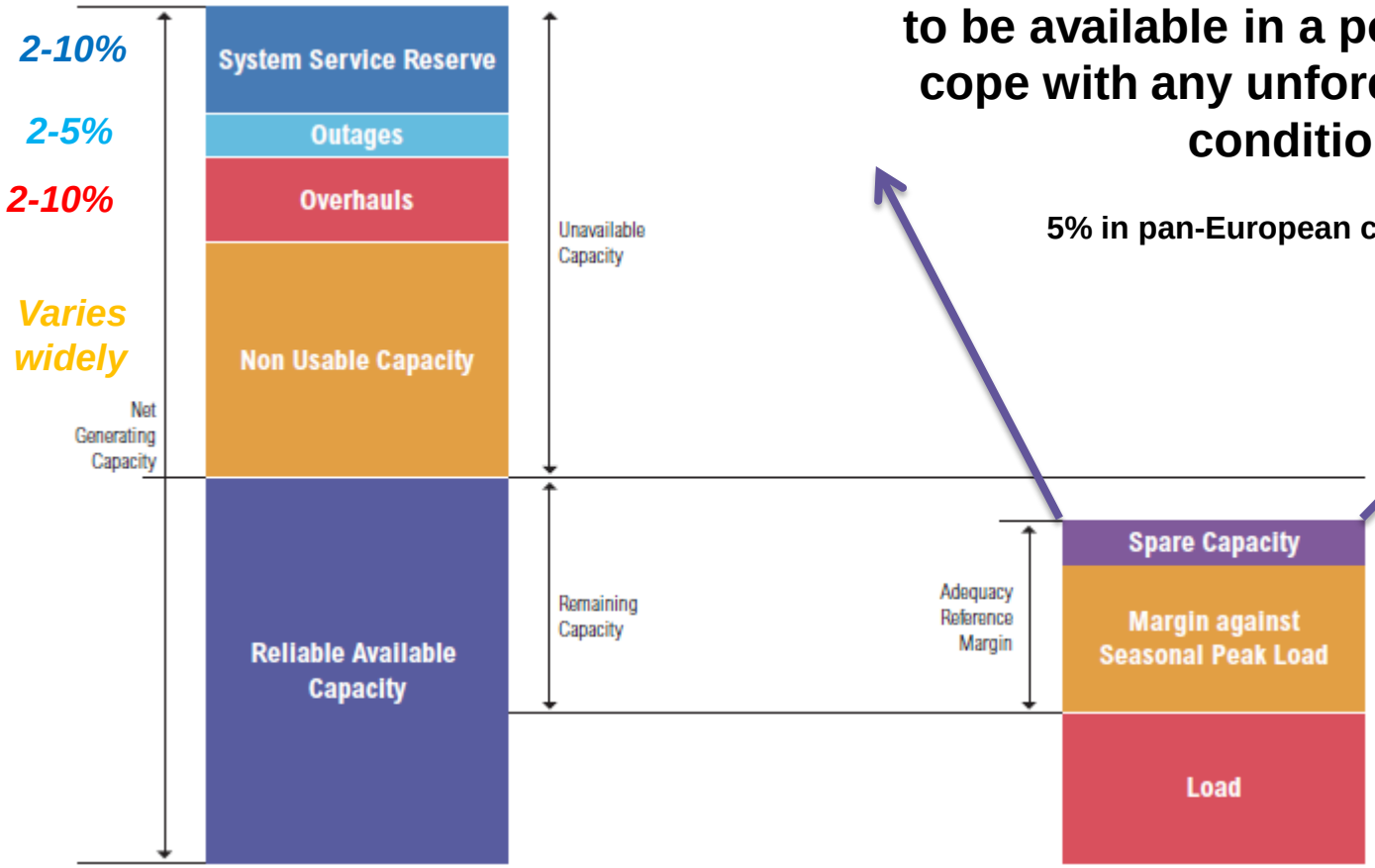
Non-usable capacity includes limitations due to (among others):

- Temperature constraints
- Emission constraints
- Fuel constraints
- **Unavailability of primary (renewable) energy – assessed based on climatic data (on-going development)**

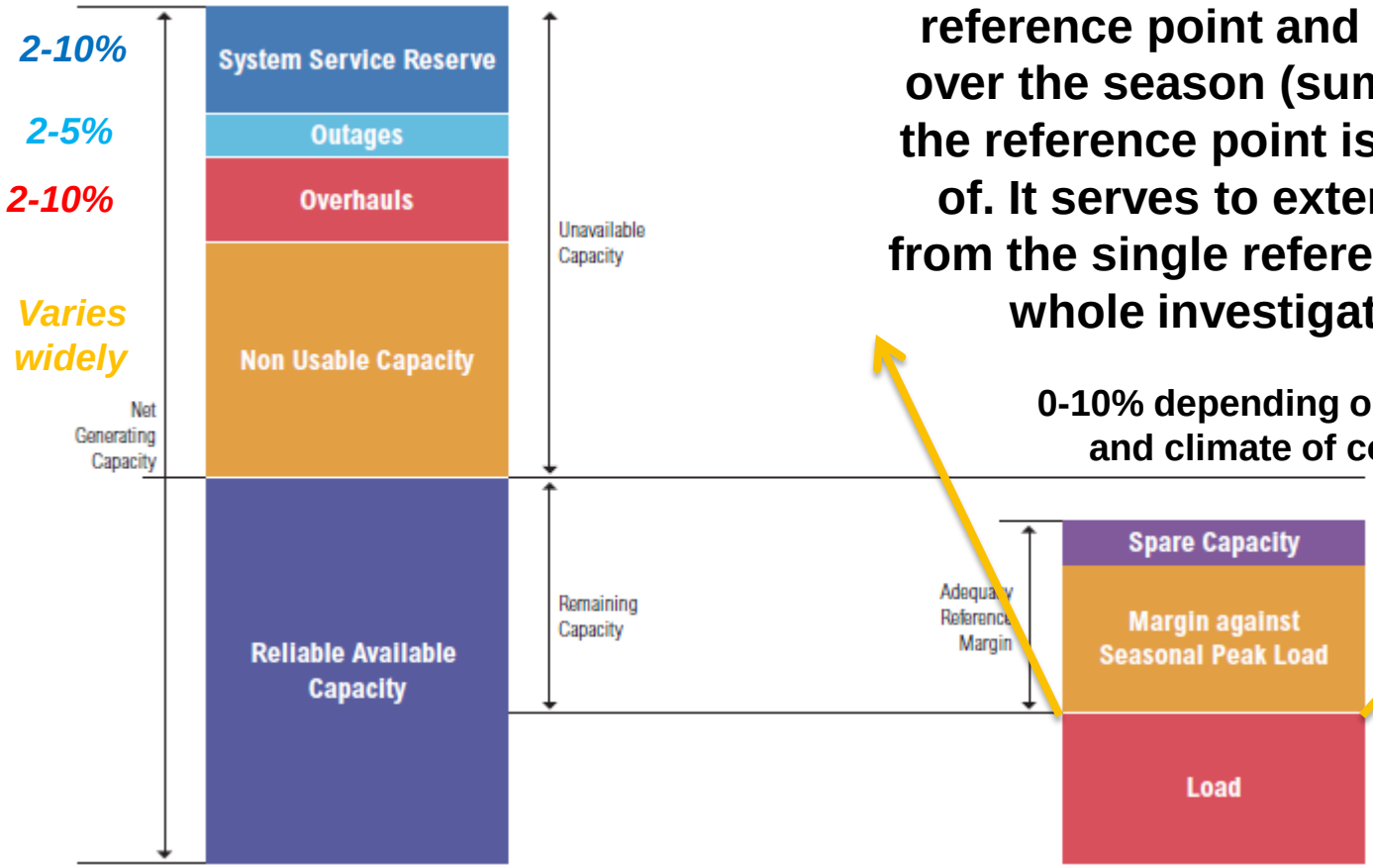
This transparent methodology is simple to apply at different time and MW scales but builds on stochastic analyses

The additional capacity which needs to be available in a power system to cope with any unforeseen extreme conditions

5% in pan-European calculation



This transparent methodology is simple to apply at different time and MW scales but builds on stochastic analyses

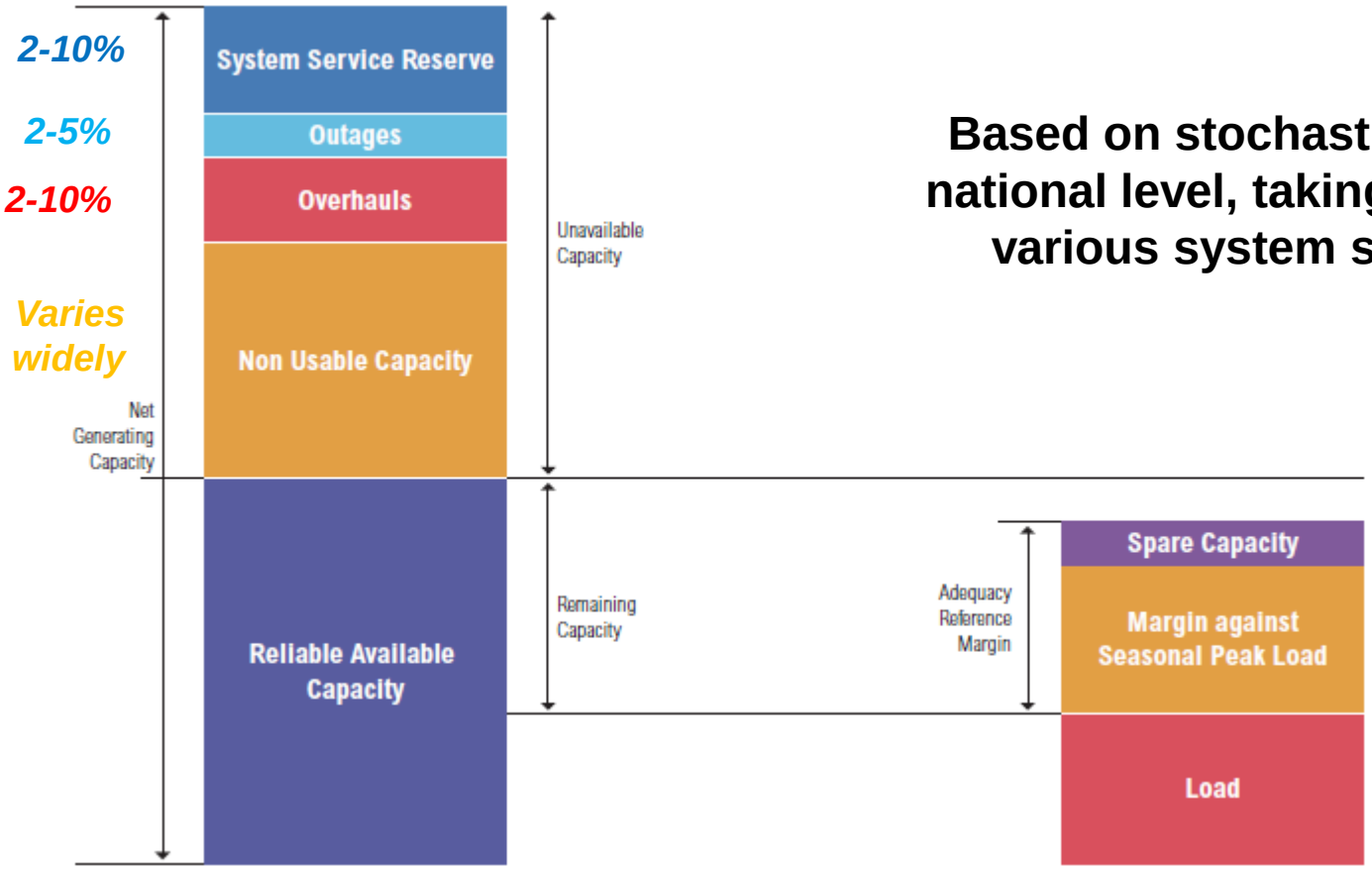


The difference between Load at the reference point and the Peak Load over the season (summer or winter) the reference point is representative of. It serves to extend the results from the single reference point to the whole investigated period.

0-10% depending on season and climate of country

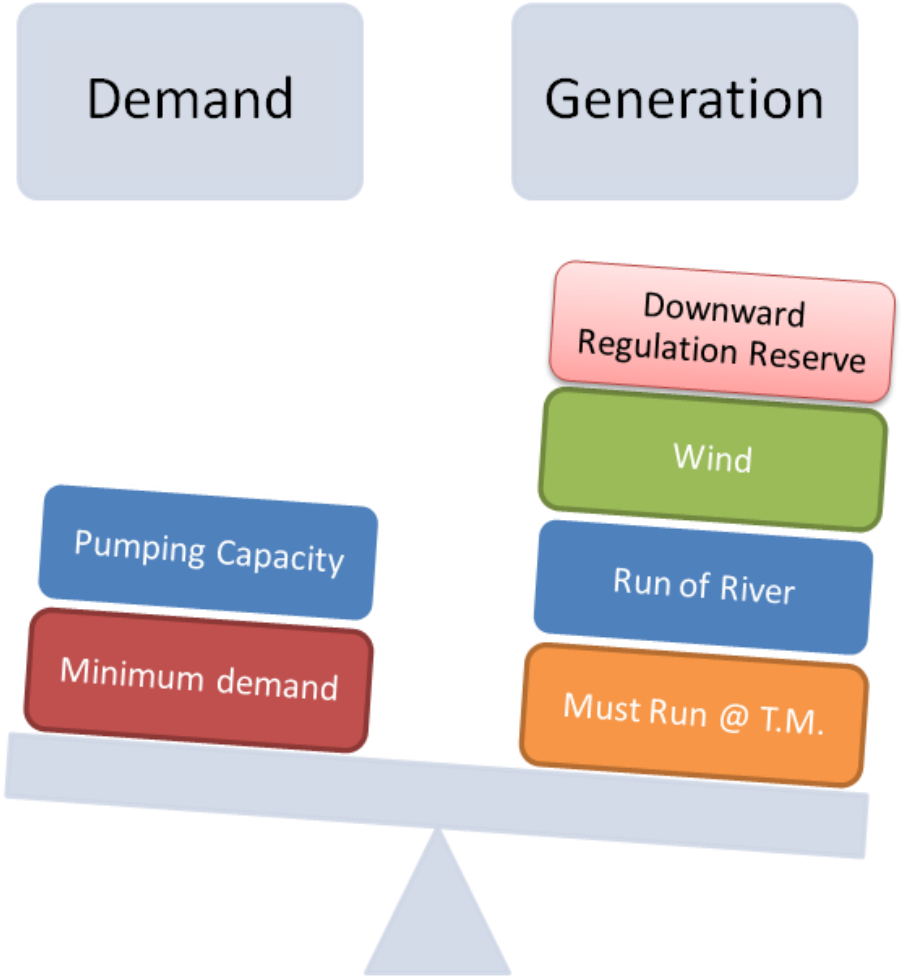
5%

This transparent methodology is simple to apply at different time and MW scales but builds on stochastic analyses



Based on stochastic analysis at national level, taking into account various system specificities

Newest addition to system adequacy analyses with special relevance for RES integration: Downward regulation analysis



We need to export the excess of generation, but…

Are there enough export capacities?

Are neighbouring countries able to import this power?

Further on-going development: use of synchronous climatic scenarios for RES availability data

System Challenges: how to assess them?

- With increasing variable RES there is a growing concern that shortages in flexibility, in its broadest term, are increasing risks to system security.
- ENTSO-E and its TSOs members are best placed to provide the necessary expertise to determine risk on generation adequacy, as well as its associated impacts on security of supply.
- This creates challenges, in the first instance, to developing the necessary tools and metrics to assess the issues.
- ENTSO-E and TSO are dependent to some extent to the transparency of data regarding demand side management and generator in particular.
- Question is whether generation adequacy on its own (comparing load vs. available generation over a period of time, highlighting the most critical hours) is the only measure of short and long term system security.

Challenges Ahead – RES Drivers

RES weather related variability

- Significant new challenge for system operation (power imbalances, lower levels of firm generation capacity, loss of services from displaced generation).
- **Answer increased controllability and flexibility of all power elements.**

Forecasting errors (e.g. wind)

- Synchronous generators displaced
- **Need for a much larger 'reserve' to deal with forecast errors**

Renewable non-synchronously connected

- Renewable generating units mainly non-synchronously connected
- Inertia on the system will be reduced
- Increased frequency sensitivity of the power system
- **Need frequency regulating capabilities with fast acting frequency controls**

System Challenges: how to assess them?

- ENTSO-E and its member TSOs are actively developing the tools and techniques to address these issues over time, and are open to discussion.
- **ENTSO-E welcomes a dialogue between stakeholders (EC, Member States, ACER, market participants) and ENTSO-E to agree on a high-level definition on the expected scope and content of the adequacy reports, enabling us to further enhance the methodology accordingly.**

Our suggestion

The needs of the system should drive decisions on whether, in what region and to what extent capacity mechanisms are needed
ENTSO-E has the legal mandate and decades-long experience in following system adequacy down to weekly granularity and at timescales from several months up to 15-years
The TSOs are appropriately neutral to provide these statistics and forecasts to policy makers and the market, and their core responsibility of keeping the lights on is very close to this.
ENTSO-E can develop its adequacy methodologies further to be fit for purpose as basis for MSs' capacity mechanism and other decisions.

ENTSO-E Adequacy Scenarios

2020 Time Horizon	
Scenario A: “conservative”	• to demonstrate whether additional investments are necessary to maintain appropriate adequacy levels • only confirmed investments taken into account
Scenario B: “best estimate”	• TSO best estimate for future developments • generation capacity evolution described in Scenario A **PLUS** future power plants whose commissioning can be considered as reasonably credible • includes an assessment of the likeliness of the projects, based on reasonable regional economic considerations • provided that market signals give adequate incentives • the most likely shutdown of power plants expected is considered, based on official notifications and additional criteria such as technical lifetimes • market conditions not (yet) fully and uniformly reflected
Scenario EU2020	Derived top-down from EU policy goals to reflect necessary development to meet these targets

ENTSO-E Adequacy Scenarios

In the future reports it is planned to provide a deeper analysis of market trends, including information aiming at assessing the viability of current amount of fossil fuel plants or the outcomes of the on-going discussions on capacity mechanisms.

ENTSO-E long-term visions

On track for
Energy Roadmap 2050

Low degree of integration of the internal electricitiy market

High degree of integration of the internal electricitiy market

Vision 3: "Green Transition"

- Favourable economic and financial conditions
- Reinforced national energy politics
- Parallel national R&D research schemes
- High CO_2 prices and low primary energy prices (IEA – WEO 2010 450 scenario)

Vision 4: "Green Revolution"

- Favourable economic and financial conditions
- European energy policy
- European R&D research scheme
- High CO_2 prices and low primary energy prices (IEA – WEO 2010 450 scenario)

Vision 1: "Slow Progress"

- Less favourable economic and financial conditions
- Reinforced national energy politics
- Parallel national R&D research schemes
- Low CO_2 prices and high primary energy prices (IEA – WEO 2010 current policies scenario)

Vision 2: "Money Rules"

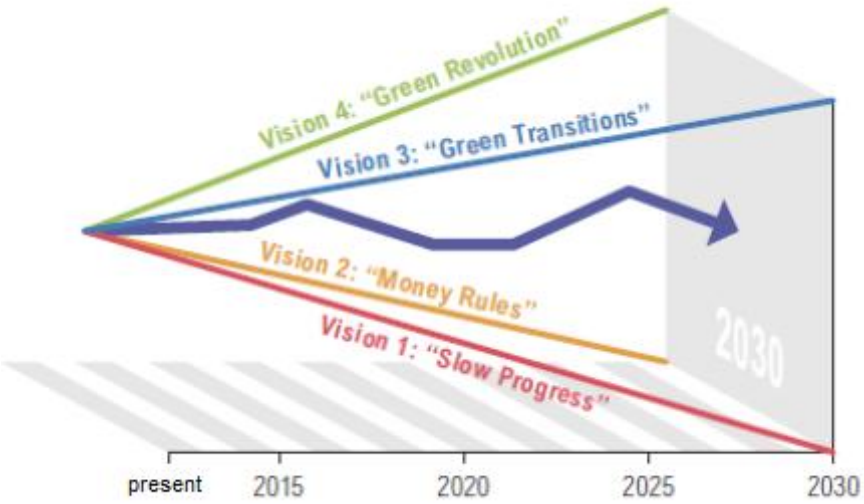
- Less favourable economic and financial conditions
- European energy policy
- European R&D research scheme
- Low CO_2 prices and high primary energy prices (IEA – WEO 2010 current policies scenario)

Delay of
Energy Roadmap 2050

ENTSO-E long-term visions

Long-term scenarios (2030)

- Bottom-up and top-down approach
- Extensively consulted
- Highly depend on reliable input data from all Stakeholders
- Impact of EU energy policy for 2030



Long-term assessment

- Needs a different approach than short- or medium-term adequacy assessment
- There is no single adequacy criterion to be used throughout Europe in very different generation structures

Scenario Outlook and Adequacy Forecast 2013-2030

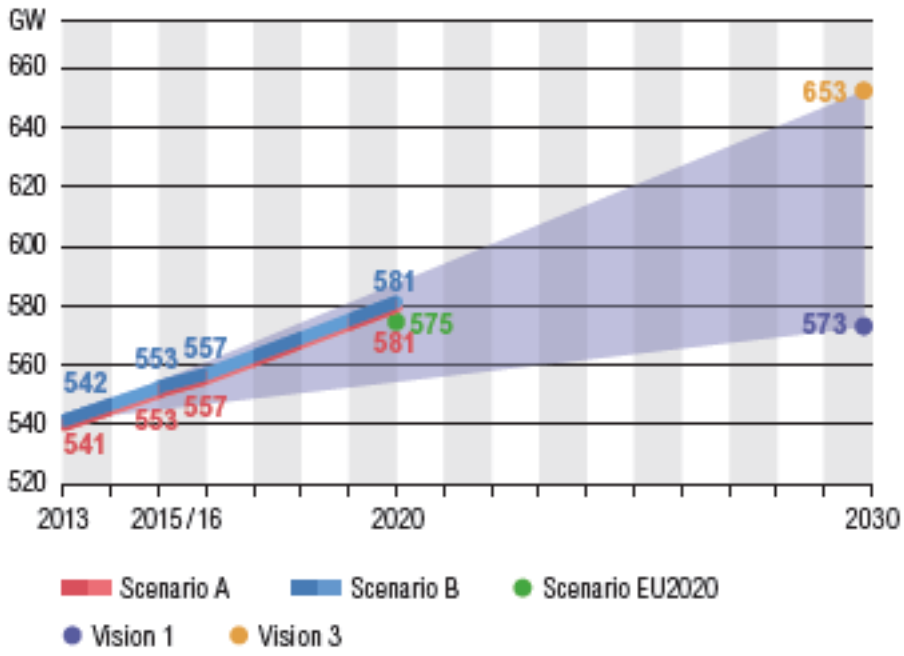


Figure 1.1a:
Load (all Scenarios, January)

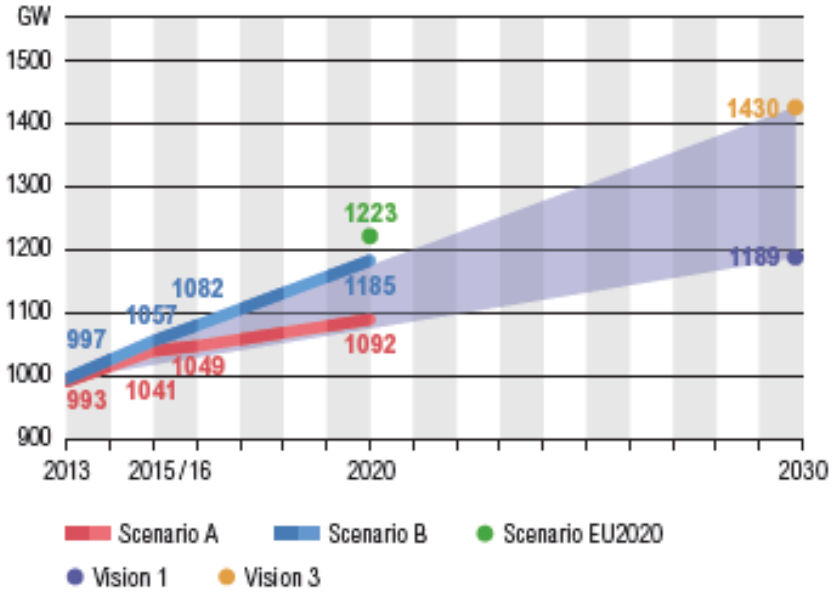
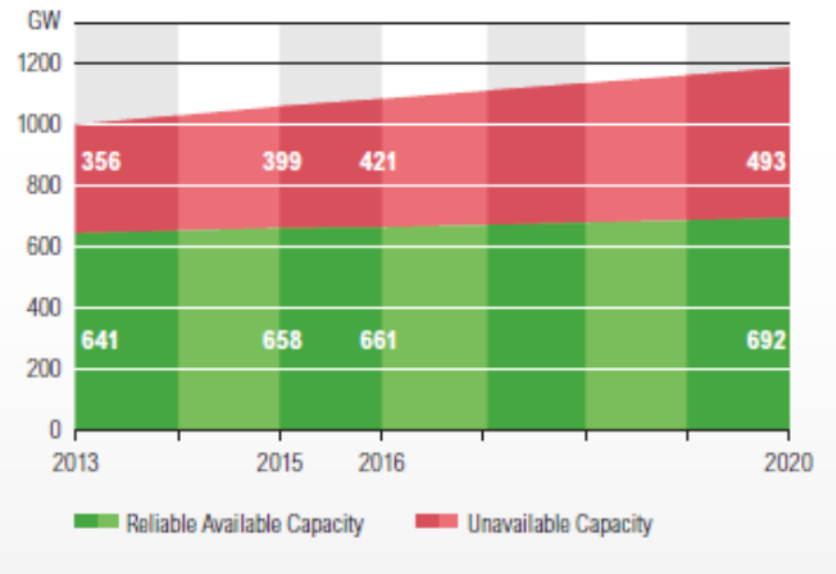
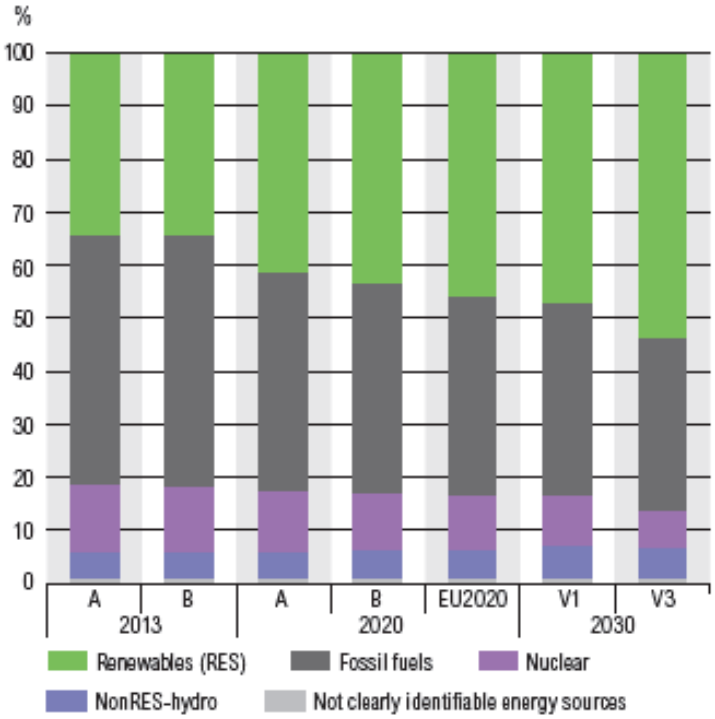


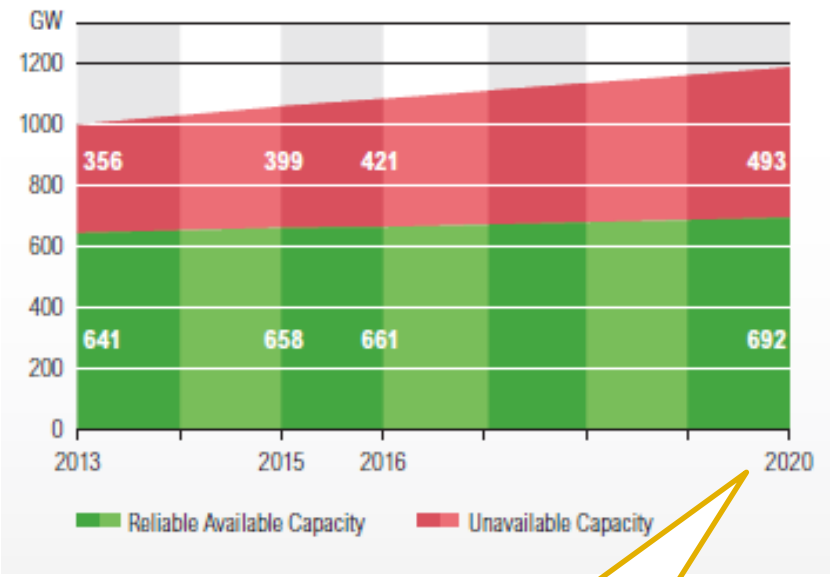
Figure 1.2:
ENTSO-E total NGC development (all Scenarios; January 7 p.m.)

Scenario Outlook and Adequacy Forecast 2013-2030

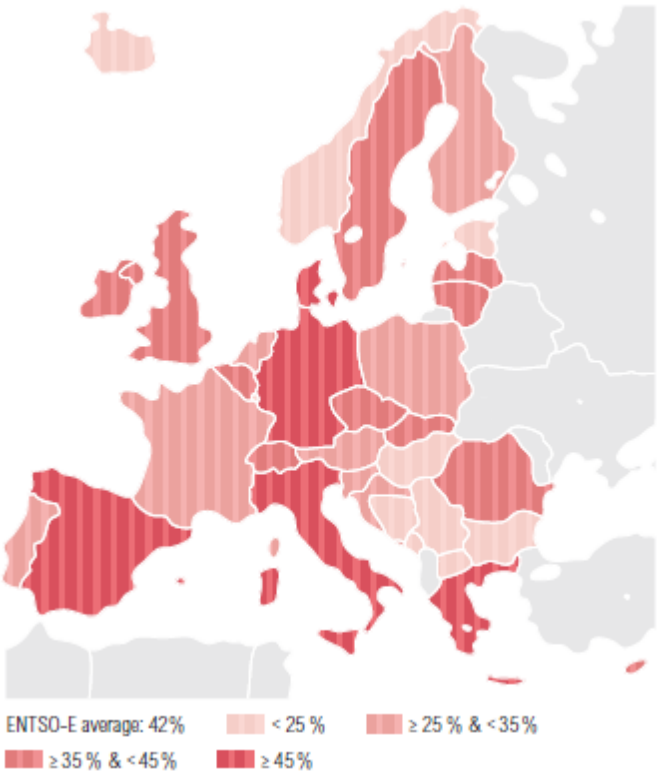




SO&AF results – Reliably available capacity share

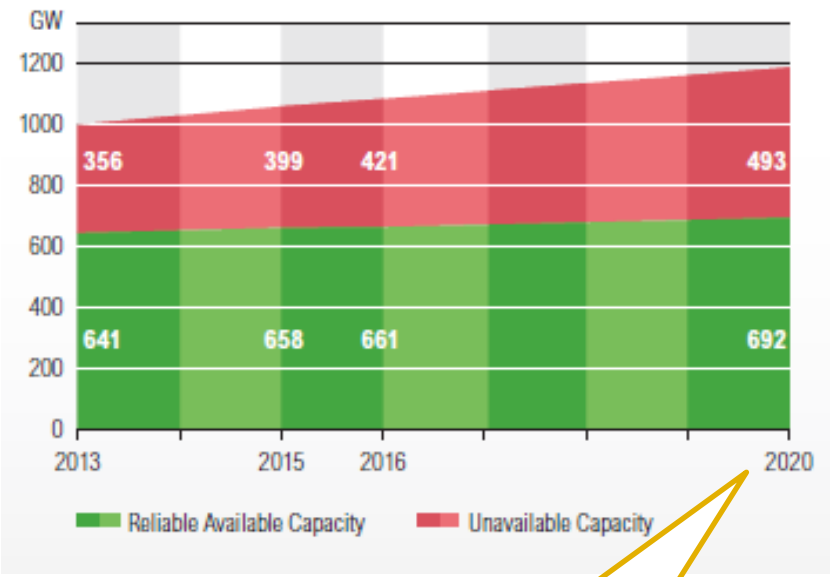


Share of reliably available capacity decreasing (mainly due to RES)



Unavailable capacity share in NGC 2020 – Best estimate Scenario ENTSO-E average: 42%

SO&AF results – Reliably available capacity share



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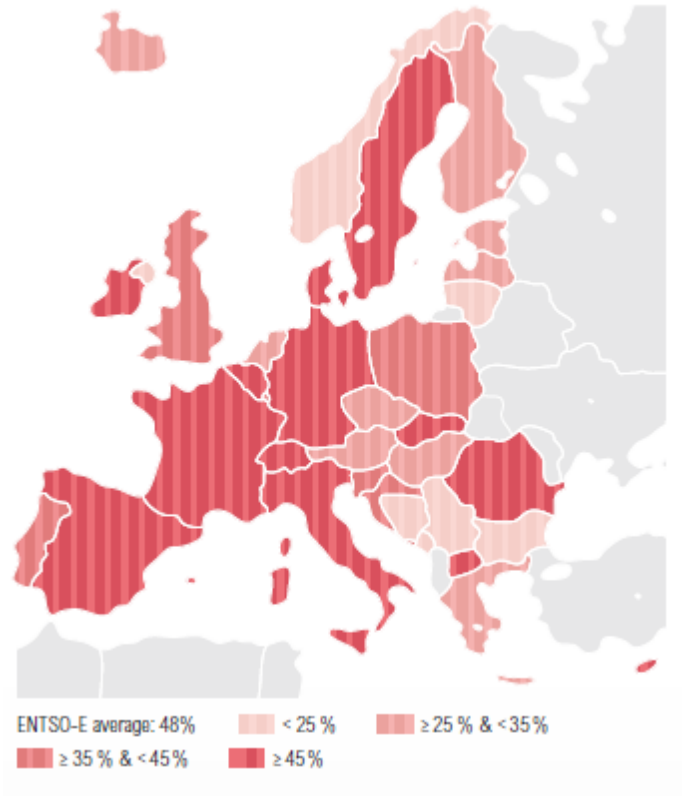
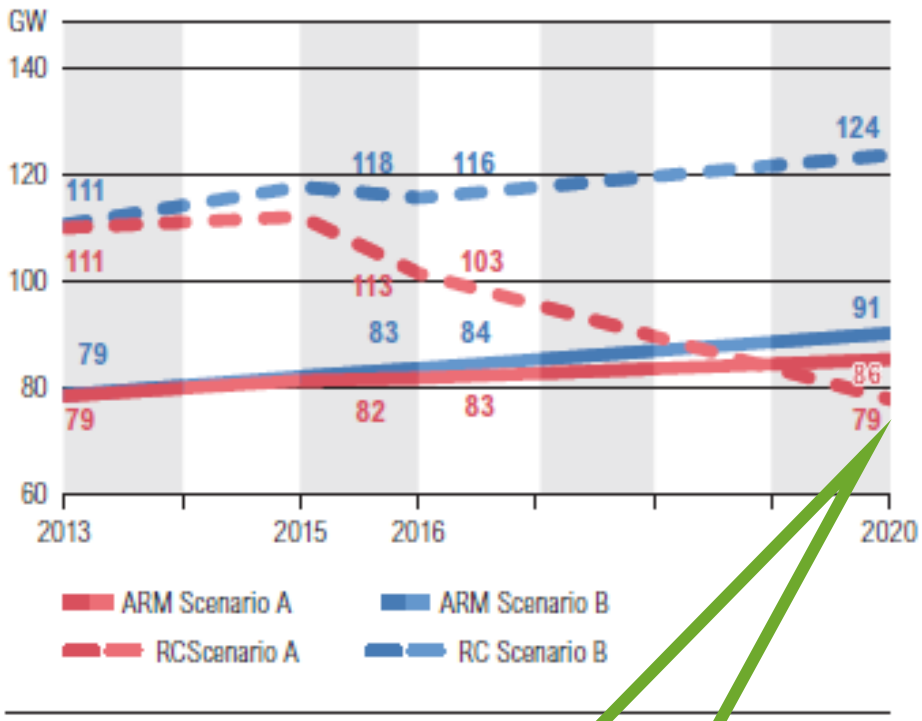


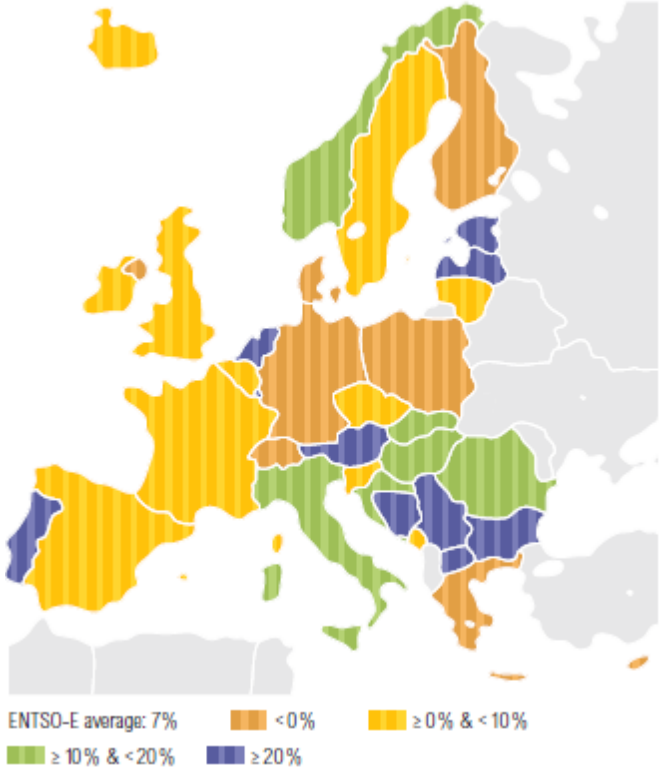
Unavailable capacity share in NGC 2030 – Green Transition Vision ENTSO-E average: 48%

SO&AF results – ENTSO-E scenarios on remaining capacity vs. adequacy reference margin



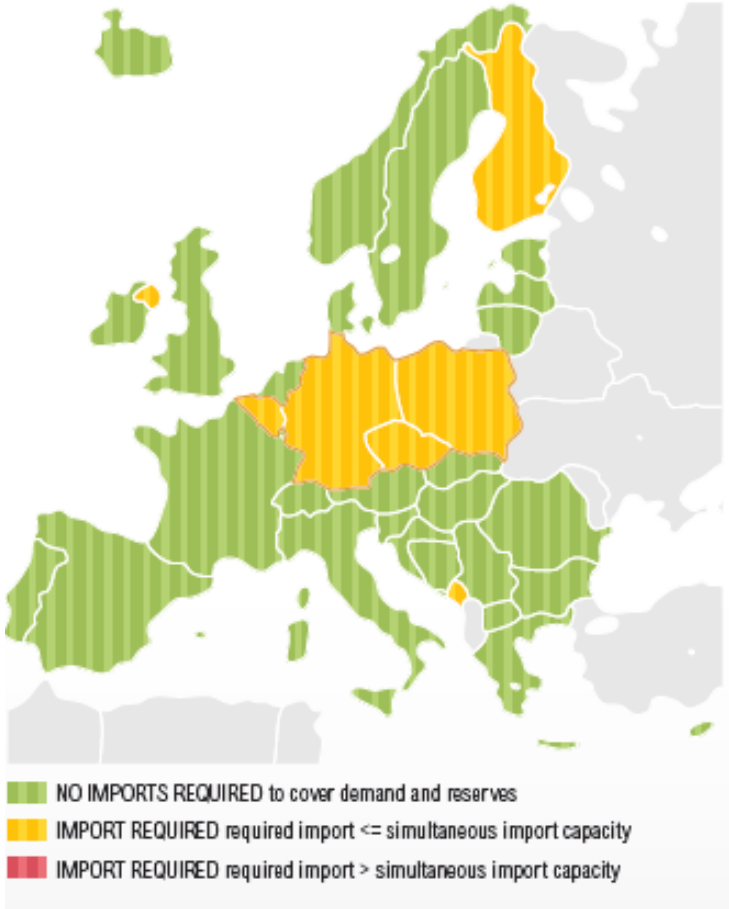
ENTSO-E RC and ARM comparison, Scenarios A&B

ONLY confirmed new capacities are less than sufficient for 2020



Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country
Best estimate Scenario for January 2020

SO&AF results – Simultaneous imports



2020

Import capacity for the CE countries (26 GW) can cover the necessary forecast amount of imports (7 GW)

Conclusion

- ENTSO-E has the legal mandate and expertise for conducting system adequacy assessments both short and long-term
- We are continuously improving our methods for always more detailed, relevant and reliable data, recently among others by:
  - Assessment of renewable infeed
  - Downward regulation and flexibility

- However, it is not in the scope of the reports (and TSO activities) to analyse the reasons for investment patterns or to give indications of preference for one or another generation type or geographical distribution of investments.

- Nevertheless, always open for consulting both our methodological choices and our assessment of the situation.

Thank you for your attention!

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