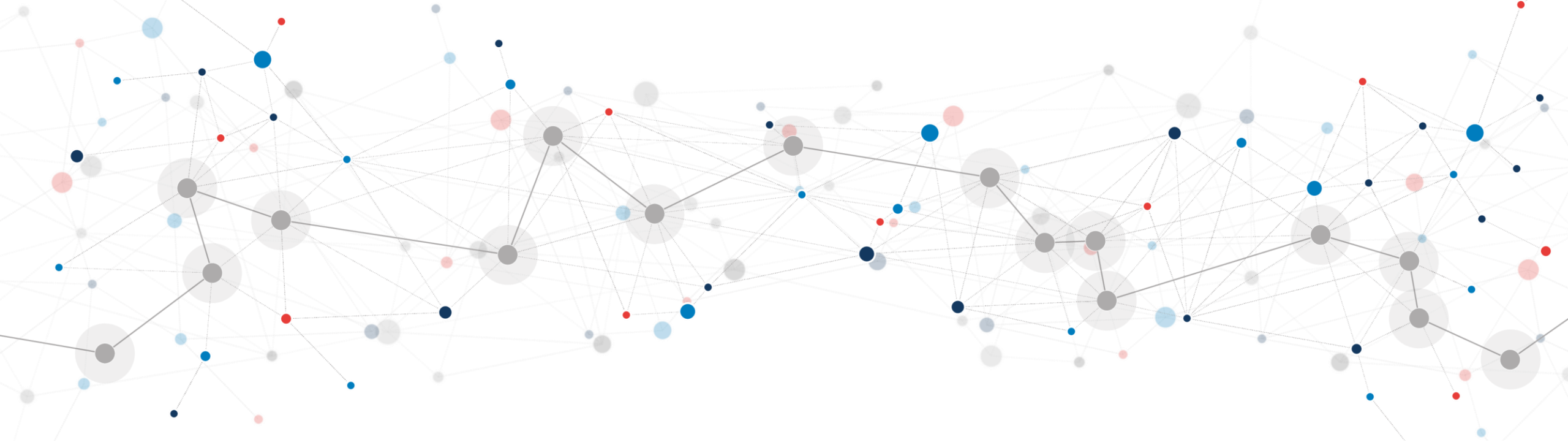

Capacity markets and beyond – lessons learnt and recent developments

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30 September 2024

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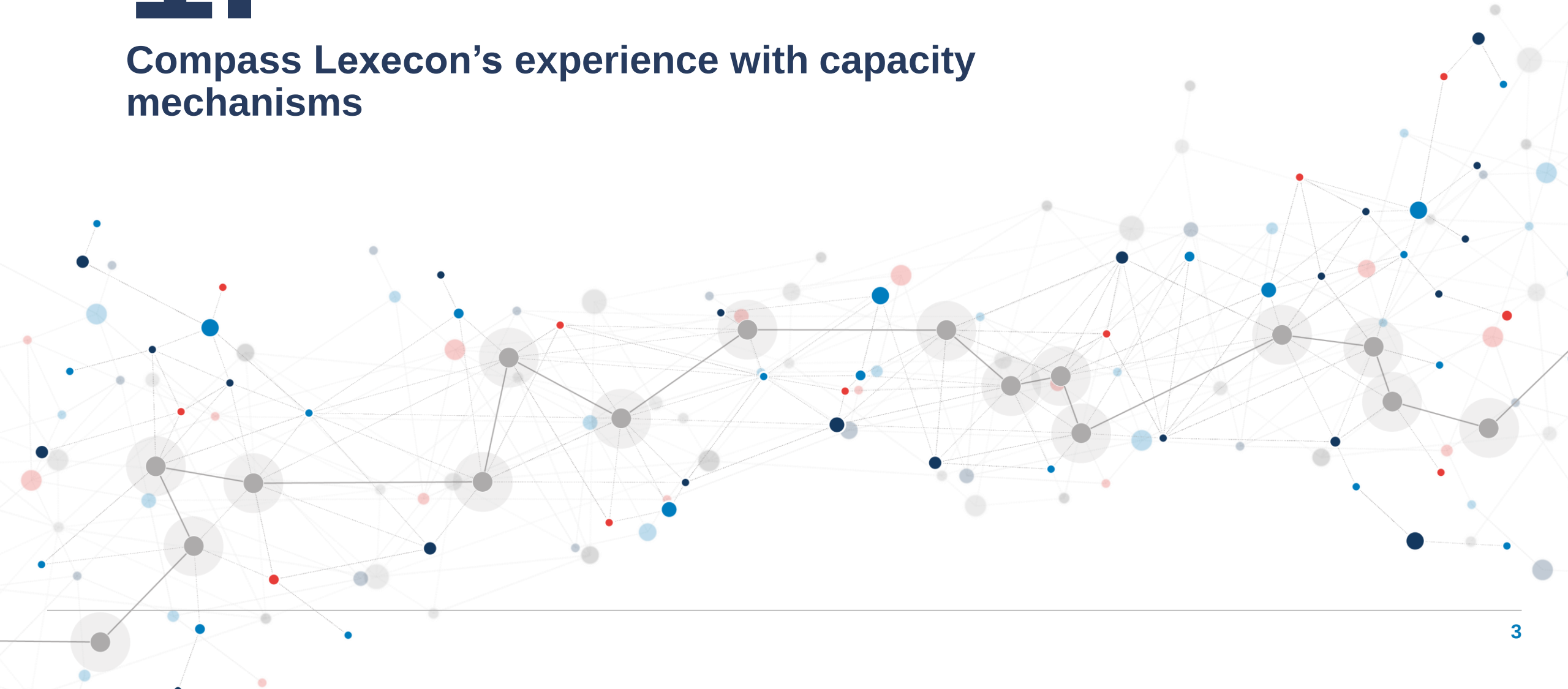
Outline

- Trends and drivers of capacity mechanisms
- Existing and new solutions to ensuring security of supply
- Conclusions

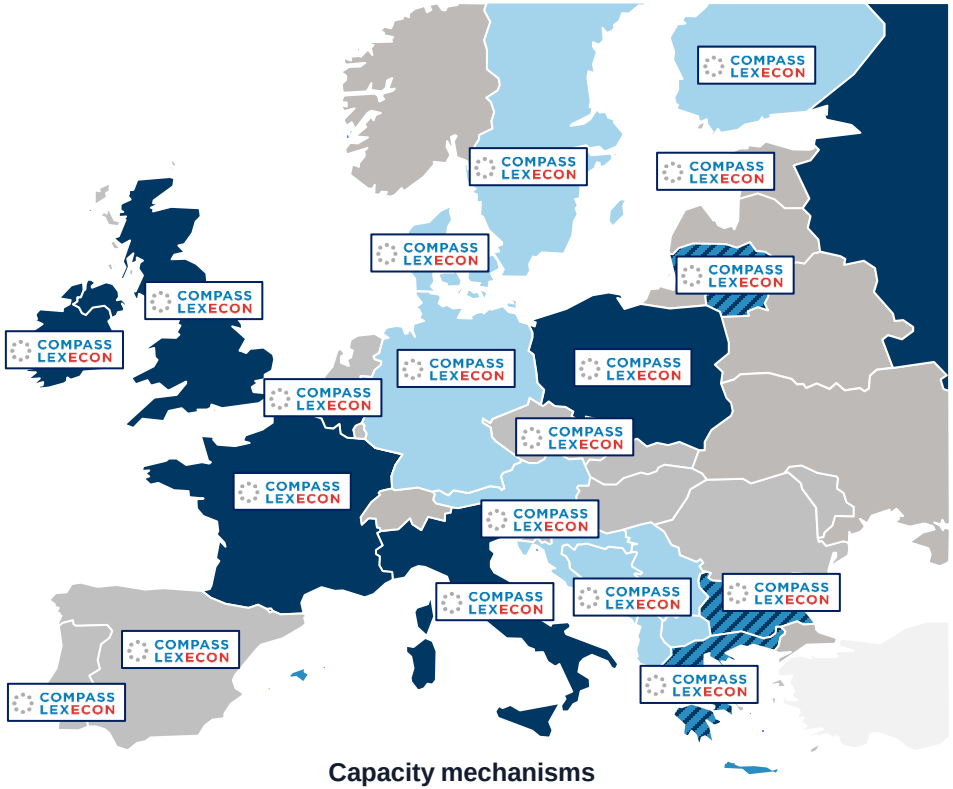
1.

Compass Lexecon’s experience with capacity mechanisms



Our team has been involved in the design of almost all the capacity mechanisms implemented in Europe over the last 10 years

We have been **directly involved in more than 20 missions related to capacity remuneration mechanisms (CRM) in Europe, and more than a dozen outside Europe** (notably US - CAISO, PJM, MISO, NYISO, ISO New England, ERCOT...- Canada and Australia).



Capacity mechanisms

Capacity market

Capacity payment

Strategic reserve

No CRM

COMPASS LEXECON Countries where Compass Lexecon has conducted studies on capacity mechanisms

Our contributions

- **Definition of the need for intervention** (definition of the reliability standard, assessment of the adequacy of resources)
- **Market analysis and recommendations for CRM or scarcity pricing design** (Justification of the type of capacity mechanisms proposed, Implementation plan)
- **Detailed CRM or scarcity pricing design, implementation and market rules** (Drafting of detailed rules, Details of parameters)
- **Evaluation of the impact of CRM** (Study of the implication on neighbouring MS, Analysis of the impact on competition)
- **Support in the EC notification procedure on State aid**

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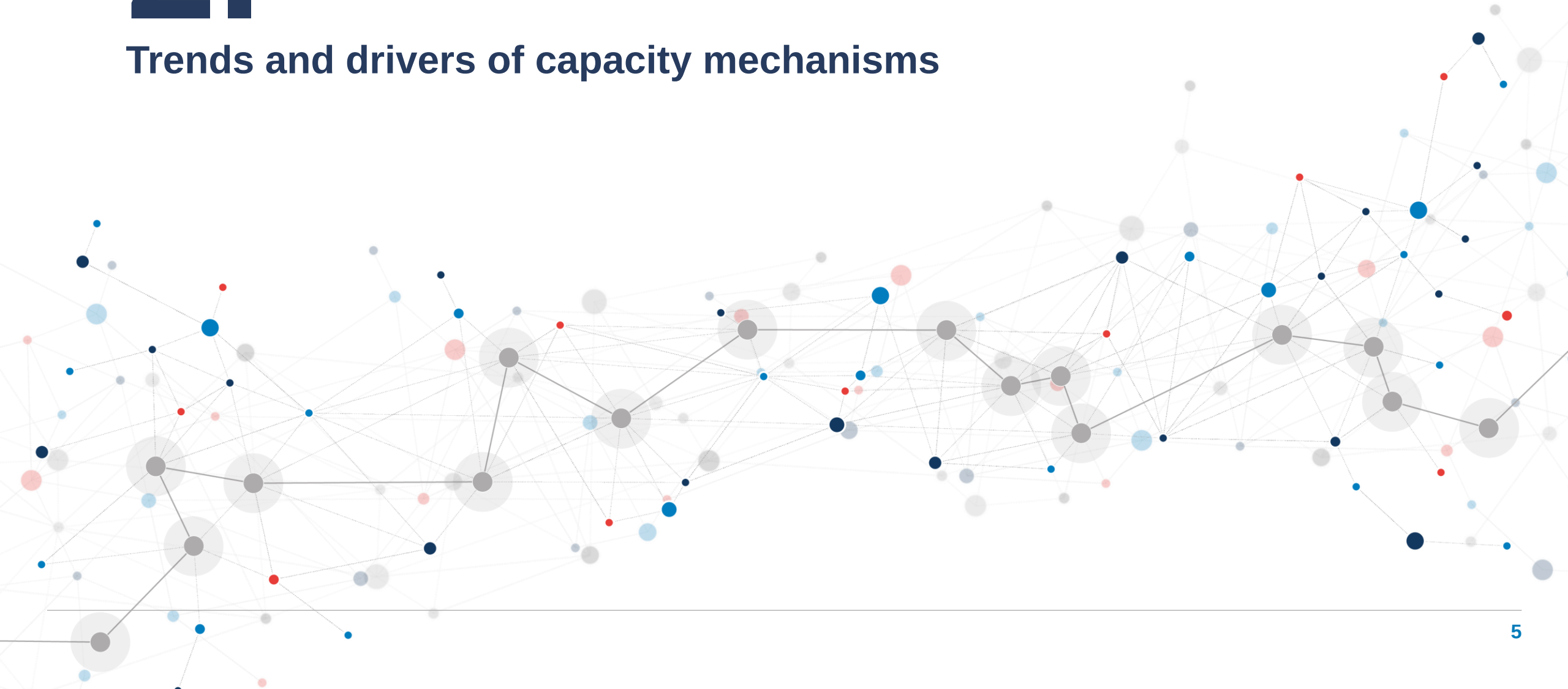
Source: Compass Lexecon, European Commission - Final Report of the Sector Inquiry on Capacity Mechanisms, European Commission - Final Report of the Sector Inquiry on Capacity Mechanisms, CEEM - Capacity Remuneration in power markets: an empirical assessment of the cost of production

2.

Trends and drivers of capacity mechanisms



It is necessary to consider security of supply alongside other key energy policy objectives, also ensuring clean and affordable energy supply

Security of supply

"**Physical**" security = ability of the electricity system to guarantee the supply of electricity to consumers with a clearly established level of performance

+

"**Clean**" security = clean electricity supply to ensure a decarbonised system and reduce dependency to fossil fuels

+

"**Economical**" security = affordability of the electricity supply available to consumers to protect against demand destruction

> ***Clean energy investment*** *and energy efficiency are key to a secure exit from today's crisis*

> *Energy security is* ***not just about having uninterrupted access to energy, but also about securing energy supplies at an affordable price****. It is a topic of perennial importance, and is once again high on the policy agenda.*

Source: IEA, WEO2022.

Variable RES increase will increase the need for flexibility

Decarbonized scenarios show a rapid upward trend in installed renewable energy capacity

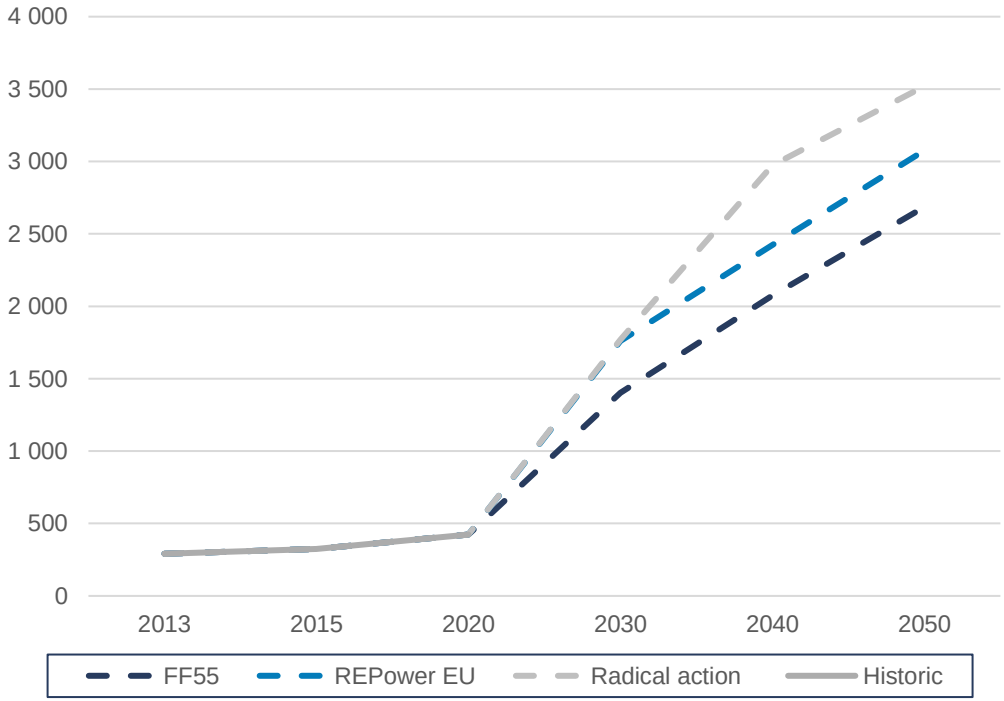
- **In every decarbonization scenarios**, as an essential way to reduce GHG emissions, renewable energy are expected to grow significantly.
- In the Fit for 55 scenario, renewable energy sources reach between **75%-82%** of the electricity generation in 2050.

The variability of renewable energies will increase pressure for flexibility

- Because RES are variable and mostly not dispatchable, the share increase has a significant impact on **short-term variability** of the net load.
- The rise of RES also increases **the difficulty to forecast** electricity generation because of the variability, for wind especially.

With a growing share of RES in energy consumption, the power system will need flexibility to adapt to high short-term variability, in order to ensure security of supply.

Renewable capacity installed in Europe - GW

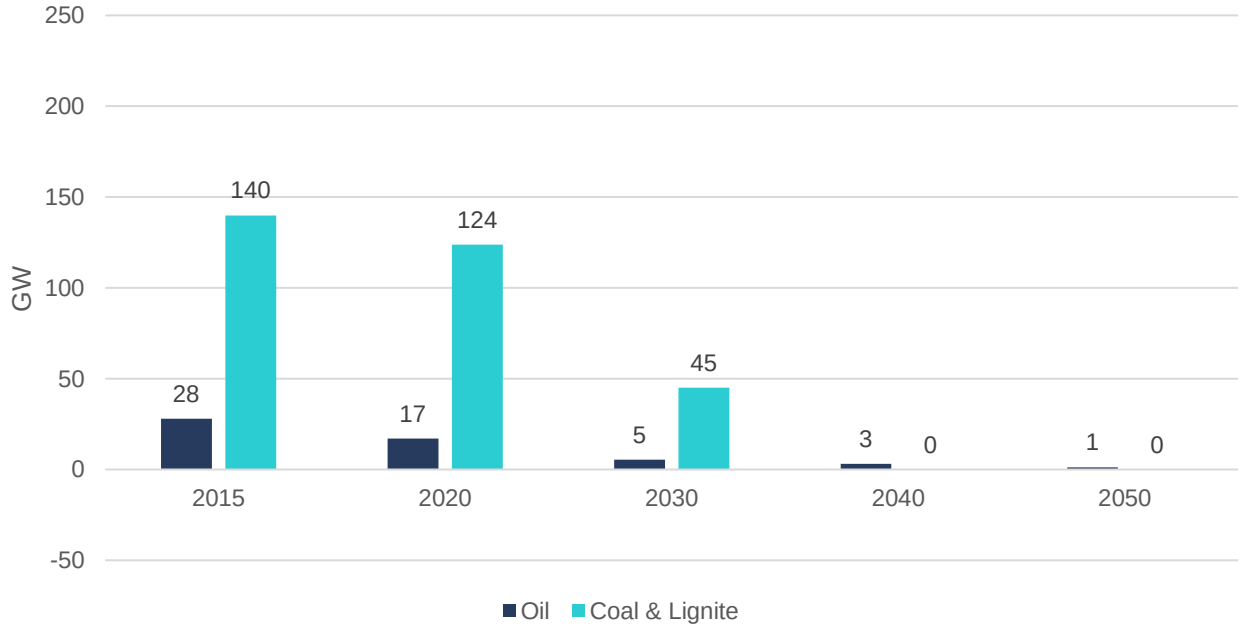


Source: [1] Renewable Capacity Statistics 2023, Irena, [2] Eurelectric Decarbonisation Speedways.

Note: The expected RES share (75-82%) for 2050 in the Decarbonisation Speedways is lower than in European Commission scenario for 2040.

The reduction of fossil power plants leads to a loss of dispatchable/ firm capacity

Installed fossil fuel capacity in Europe, historical and forecasted in the Eurelectric scenario REPowerEU, 2015-2050 (GW)



Dispatchable fossil fuel power plants will not be sufficient to manage the high short-term volatility of RES. Other flexibility solutions are necessary.

Despite an increase in gas capacities, the reduction of other fossil fuel capacity has already started and is expected to continue in decarbonization scenarios.

- The shares of **most polluting** electricity sources need to decrease radically to meet the Fit for 55 target.
- Coal power plants have drastically reduced since 2015, and its use is expected to **cease after 2040**.
- Oil production has already low level of electricity production in Europe and will almost **completely phase out after 2030**.
- Gas capacities*, including turbines for natural gas, hydrogen and biomethane, **increase to 2050**.

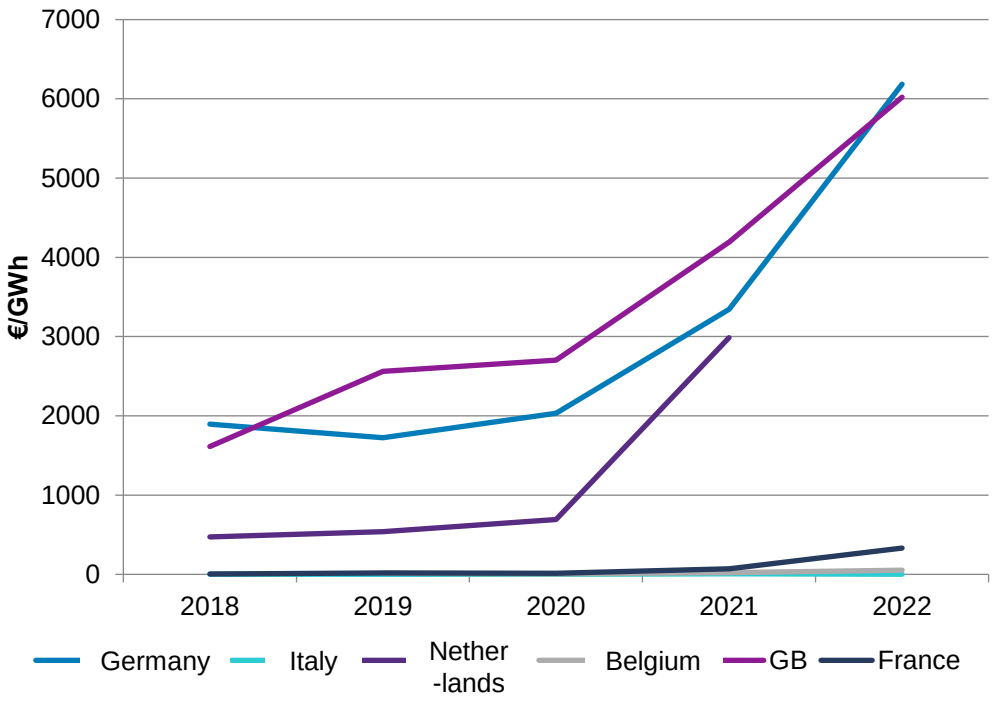
With fewer dispatchable and base-load generation plants, the need for flexibility increases even more.

- The rise of RES share in electricity generation would require an increase in dispatchable capacity to easily adapt production to variability of RES. However, because of the objective of GHG emissions reduction, fossil fuel **dispatchable capacity are also required to decrease**.

Note: *Natural gas is not represented on the graph as “gas” includes both fossil and non-fossil fuels (natural gas, hydrogen and biomethane).
Source: Eurelectric Decarbonisation Speedways.

Rising network congestions increases the necessity to adapt the system

Congestion management costs relative to total electricity demand in selected European countries (€/GWh)



Congestion of the network has increased significantly in some European countries

- The network was constructed to meet a certain demand, but electricity demand and production is **transforming rapidly** for the energy transition.
- The rising share of RES amplifies the **localised network connections**, as well as the variability of production. Besides, electricity demand may increase **above current networks sizing**.

As a result, network infrastructure development is required alongside and flexible assets which can help alleviate congestions

- The transformation of electricity production mix and demand will require for **new infrastructure development** in a pro-active way to avoid congestion.
- **Flexible assets** will also be needed to relieve congestion temporarily, or in some cases as interim solutions until network reinforcements can be carried out

Source : ENTSO-E Transparency (France, Germany, Italy and Belgium), NGESO (GB) and Tennet (Netherlands)

The electrification of uses will create new challenges for adequacy and presents opportunities for demand side flexibility.

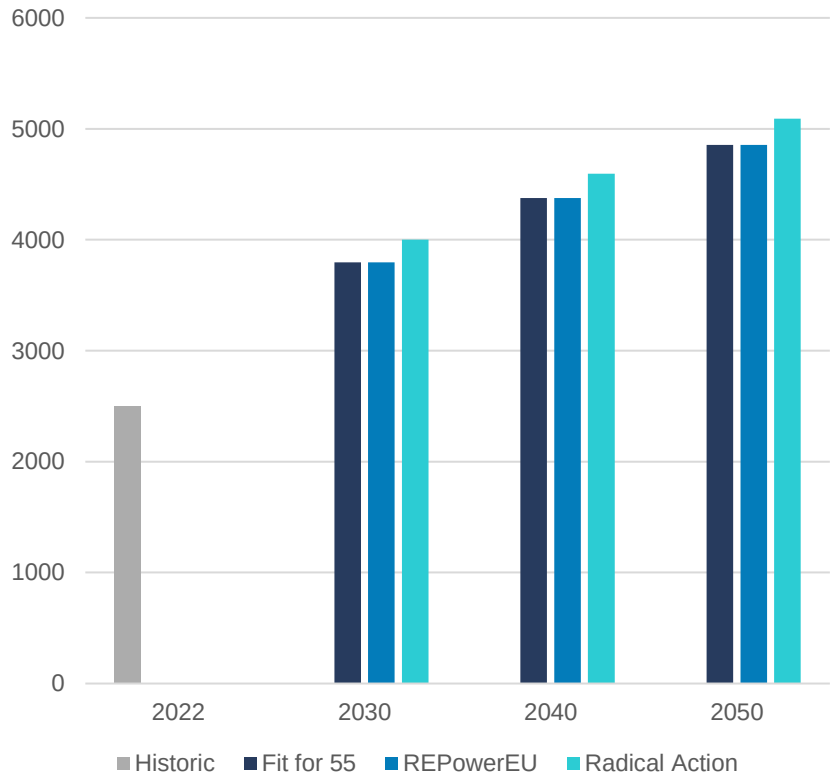
The rise of electricity demand intensifies the adequacy risk for the electric system

- To meet decarbonization targets, **electrification is necessary** in Europe according to all scenarios. It could lead to additional adequacy needs for the electric system.
- Electrification of uses also means a need for **seasonal flexibility** with long term solutions, to meet higher winter demand for example, as well as **weekly/ daily flexibility** solutions to bridge demand gaps.

However, electrification also creates opportunities for flexibility solutions

- New electricity usage may also be flexible, and an adequate use of their flexibility could mitigate or even address some of the rising adequacy and flexibility needs.
- A rising electricity demand can enhance a **market for flexible solutions** by creating demand as well as offer.

Final electricity demand in Europe - TWh



Source: [1] Enerdata, European Union Key Figures. [2] Eurelectric Decarbonisation Speedways

The electrification of demand is granting new opportunities for the development of demand side response

Electrification of demand drives DSR potential in Europe

- While industrial consumers are currently the most engaged with DSR, the **participation of small consumers is just emerging**, with most aggregator services focusing on large customers rather than residential consumers
- By 2030, the DSR potential is expected to increase, driven by the **electrification of new end-uses in transports, buildings, and in the industry**, and could reach 130 to 160 GW according to the European Commission

Industry

Electrification of industrial heating is underway, but some industries are still challenging to electrify and decarbonise

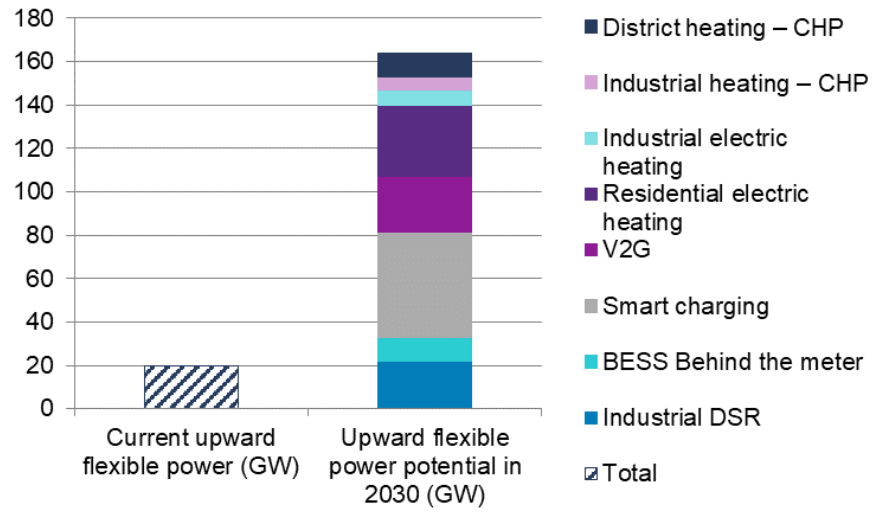
Transport

EVs are a key enabler of deep decarbonisation of the transport sector, while electrification of heavier transports is more challenging

Buildings

Decarbonisation of buildings relies on electrification through heat pumps and smart electrical appliances

Current and projected DSR capacity in the EU, GW



Sources: IEA, Demand Response, SmartEN, 2022, 2030 demand-side flexibility – quantification of benefits in the EU, European Commission (2023) Commission Staff Working Document – Reform of Electricity Market Design.

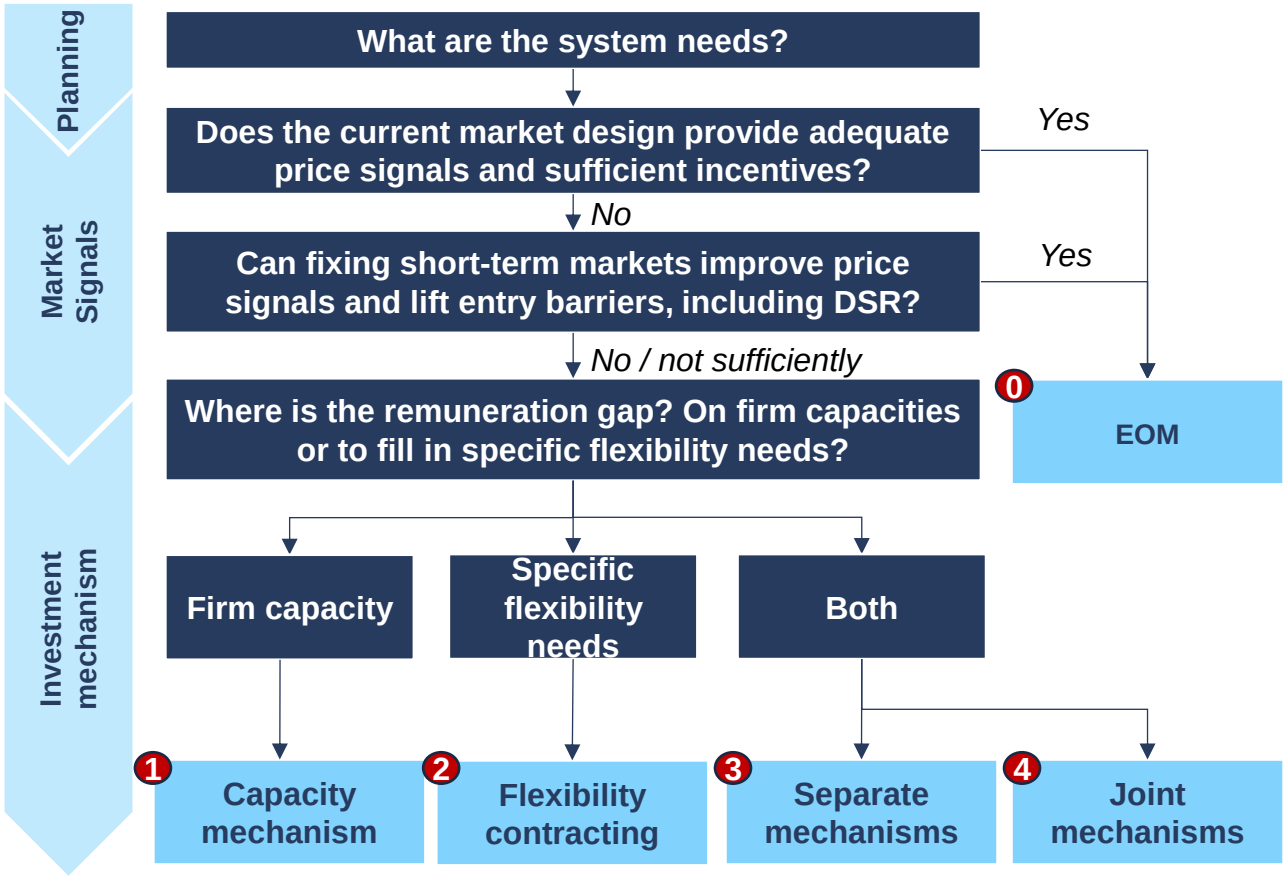
Note: Upward flexibility corresponds to the ability of consumers to decrease their load to answer system needs.

3.

Existing and new solutions to ensuring security of supply

Overview – Different market design approaches can be considered to ensure sufficient firm and flexible capacities for security of supply

Rational and process driving the implementation of an investment mechanism



1 Capacity mechanism – Over the past decade, CRMs objectives have evolved from managing capacity exit, to supporting new firm capacity

A brief history of capacity mechanism design trends

Early 2000s and 2010s: overcapacity situation in Europe, leading to economic viability issues and a risk of uncoordinated exit of ageing thermal plants.

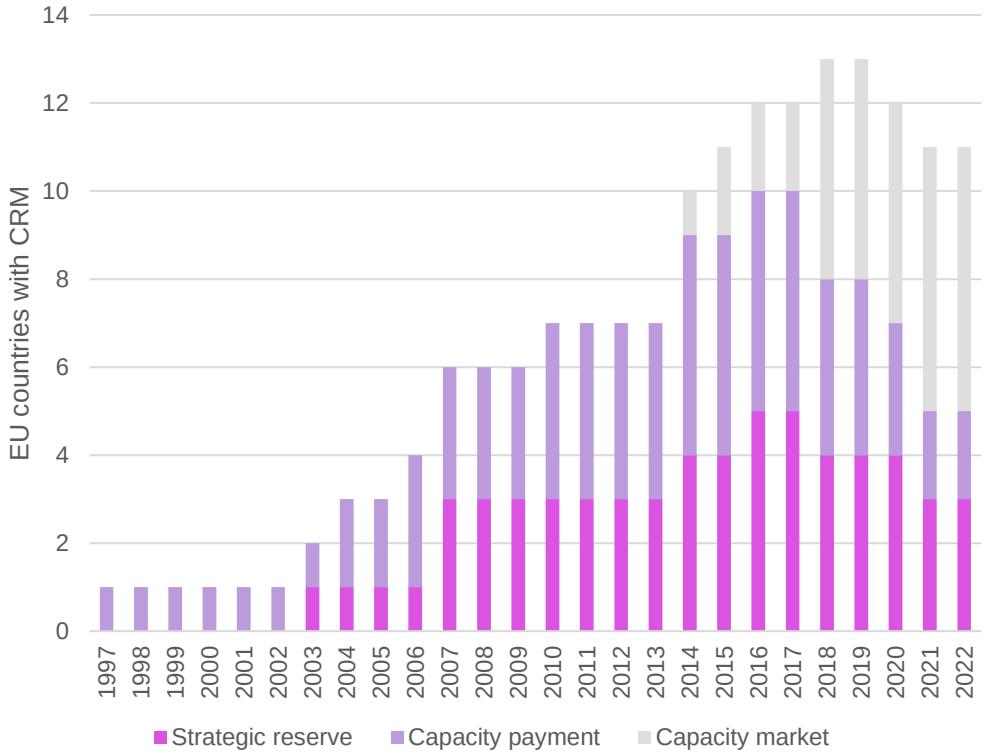
→ implementation of **strategic reserves in some countries** (e.g. Germany, Belgium, Finland) made it possible to manage the exit of old thermal plants while maintaining security of supply.

From 2010 to today: revived need for investment in new capacity, but missing money issue due massive subsidised RES additions, among others

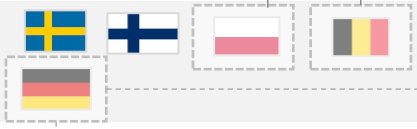
→ introduction of **capacity markets** in an increasing number of European countries to address “energy-only” markets failures and missing money issue

Future: in addition to triggering investment in new (decarbonised) firm capacity, growing intermittent RES create a challenge for addressing other system needs (flexibility, ramping, congestion, inertia, etc.). Avoiding overcompensation and overcapacity resulting from CRM cumulation with upcoming schemes dedicated to DSR, storage and flexible assets is also key.

Growth in the number of capacity remuneration mechanisms in the EU + GB (1997-2022)



1 Capacity mechanism – Various types of CRMs have been implemented, as the system needs differ substantially across countries and over time

			Mechanism	Description	Implemented in	Under consideration
European taxonomy - Capacity mechanisms	Market-wide *Open to all capacity providers in principle*	Based on price[2]	**Market-wide capacity payments**	**Not active anymore** for competition reasons		
		Based on volume[1]	**Capacity market, with decentralised capacity obligation**	Based on retail suppliers – like French CRM, unique in Europe		
			Capacity market with centrally managed auctions	Large majority for capacity markets in Europe		
	Targeted *Limited to some capacity providers*	Based on price[2]	**Targeted capacity payments**	**Not active anymore** for competition reasons, still some legacy contracts apply		
		Based on volume[1]	Strategic reserve	Ensuring the economic viability of existing plants put in reserve		
			Call for tenders for new capacity	Typically, in specific local situations, often not exclusively for adequacy reasons **Germany now pushing for a national tender**		

Note: 1) Fixed volume and market-determined capacity remuneration price; 2) Capacity remuneration price fixed administratively

1 Capacity mechanism – Recent developments as part of the European Market Design reform streamline CRM approval and foster flexibility and decarbonisation

The European Market Design reform contains several features relevant for introducing CRMs

- The market reform that was triggered by the energy crisis has been officially adopted by the European Council in May 2024.

- Features of the reform relevant for the introduction of CRMs in the EU include:

  - **Streamlining the procedure** for **state aid approval** of CRMs

  - **Permanent and structural market component** - Capacity mechanisms should no longer be considered as measures of last resort (even though their necessity and design should be periodically assessed considering the evolving regulatory framework and market circumstances)

  - Member States could set technical performance standards and **more stringent CO2 emission limits** that restrict participation in capacity mechanisms to flexible, fossil-free technologies

  - Opens a door for **valuing (non-fossil) flexibility** within the CRMs or as a separate mechanism.

Sources: [1] *EC, 2024.*

2 Flexibility mechanism – The EMD reform plans the introduction of support schemes for non-fossil flexible resources

- The European Commission seeks to improve the Union's electricity market design. A central element has been the introduction of **flexibility support payments**
- When capacity mechanisms are in place, flexibility support schemes can be introduced:
  - through additional criteria within the CRMs or
  - through a **separate scheme**
- The Commission foresees for the flexibility scheme similar design criteria as for CRM, but adds additionally:
  - The requirement for **cost-effective** selection processes
  - The requirement to set out **minimum levels of participation**
  - The addition that **exposure to price variation and market risk** shall be preserved

Introduction of new **flexibility criteria** / features to **Capacity mechanisms**

Flexibility support payments for available capacity

Should

- Selection process should be open, transparent, competitive, voluntary, non-discriminatory, **cost-effective**
- Set out a **minimum level of participation**
- Provide incentives for **integration**
- Consider locational criteria to ensure investments in optimal locations
- Prevent undue distortions and **preserve the exposure to price variation and market risk**
- Be limited to **new investments**
- Apply appropriate penalties which do not respect the minimum level of participation
- Be open to cross-border participation

Should not

create undue **market distortions** nor **limit cross-zonal trade** or **imply starting fossil fuel-based generation BtM**

Go beyond what is necessary

Note: new to the requirements known for CRM

4 Joint mechanism – A CRM 2.0 can integrate adequacy and flexibility remuneration, either as double product system or through de-rating factors

Firm and flexible capacities could be procured jointly within a single investment mechanism, with two main implementation options :

A ‘Single-product’ option

- A single adequacy product defined based on the contribution of each technology to reaching the security of supply target (e.g. the overall goal is to keep LOLE below a certain threshold)
- Single derating factor assessed for each technology based on the modelled contribution to the security of supply target calculated using the security of supply model – this can account for factors beyond peak demand
- Demand for the adequacy product derived from the system needs assessment study
- Single auction for the clearing of the adequacy product

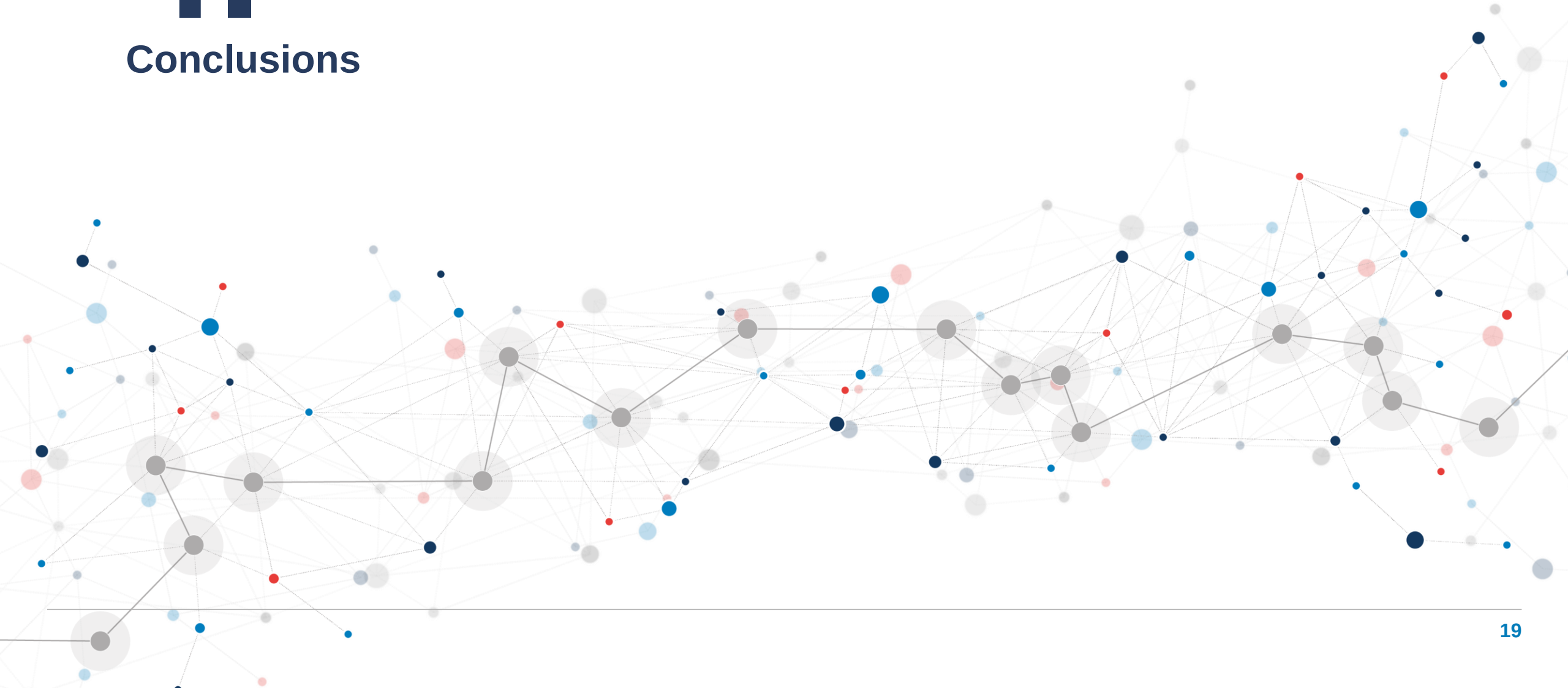
B ‘Two-products’ option

- Two products, for firm and flexible capacity, are defined separately based on the objective criteria
- Normative derating factors for each product are fixed for technology classes
- Demand for each product derived from the system needs assessment study
- Specific arrangements for the clearing of the auctions for each product accounting for substitutability and complementarity between the two products, either in separate mechanisms or through joint procurement

More generally, capacity mechanisms can also adapt to account for other dimensions such as decarbonisation (e.g. CO2 emission participation restrictions, ex-post CO2 constraints on CRM results, clean energy product optimisation…)

4.

Conclusions



Conclusions

- Capacity mechanisms are **part of broader long-term contracting mechanisms**, such as PPAs and forwards markets
- Capacity mechanisms **beyond adequacy** and towards system needs view
- The **European Market Design** reform contains new features relevant for the introduction of CRMs:
  - **Streamlining the procedure for state aid approval of CRMs**
  - **Permanent market component**
  - **Technical performance standards and more stringent CO2 emission limits**
  - **Valuing flexibility within the CRMs or as a separate mechanism**

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