Regulation and incentives to foster flexibility in Europe's low-carbon transition

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Flexibility – on the Top of the Agenda

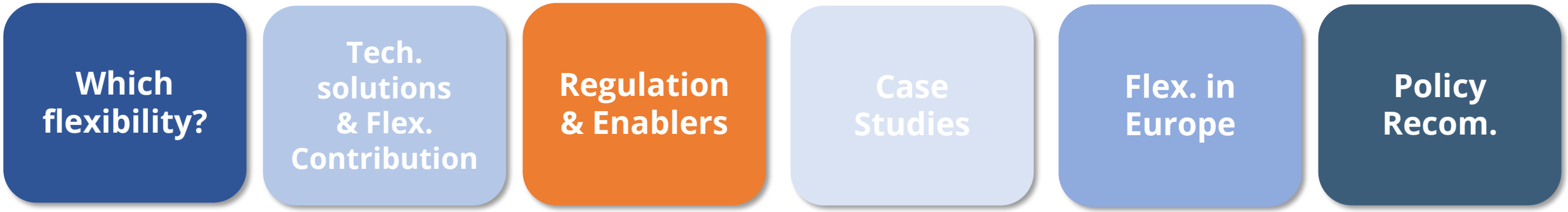
The energy system's overall **ability** to **cost**-effectively manage

variability and uncertainty of demand, supply, and grid availability

across **all relevant timeframes** within the context of decarbonisation

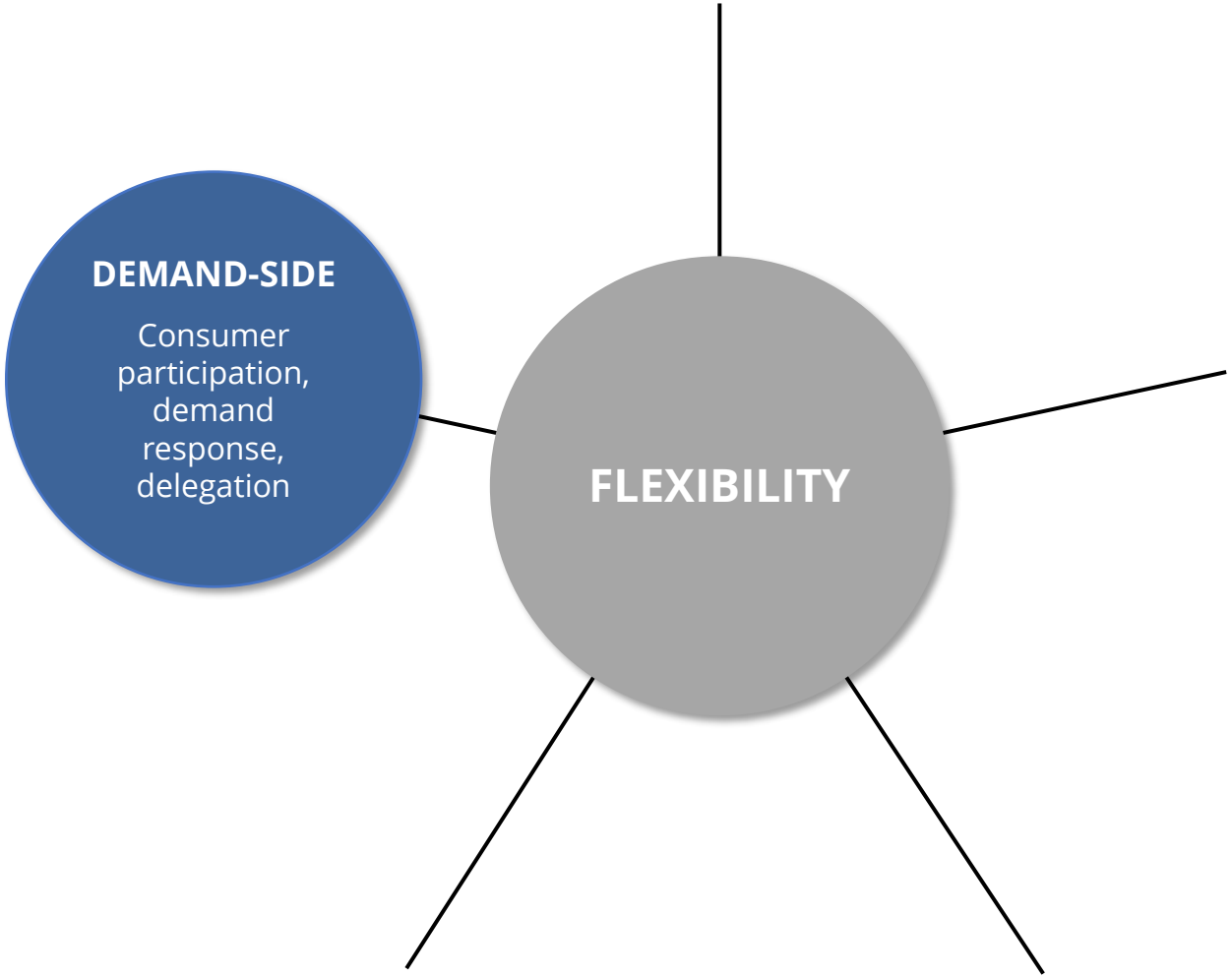
The Flexibility Challenge in the Energy Sector, **CERRE report**, 2025

A. Bennato, D.Duma, E.Lazarczyk, C. Le Coq



Flexibility and regulatory framework

Textual analysis of EU legislative acts and strategy documents



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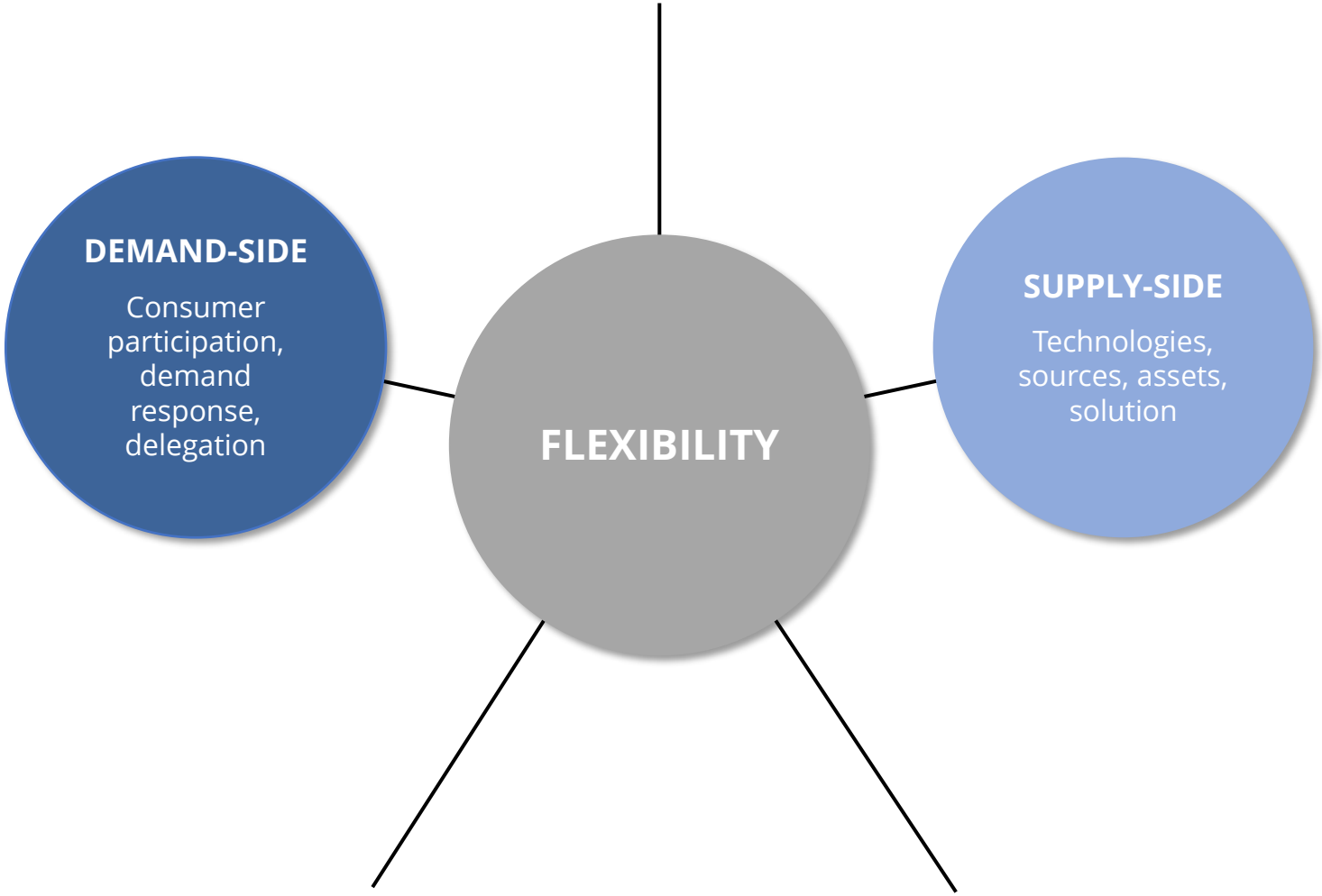

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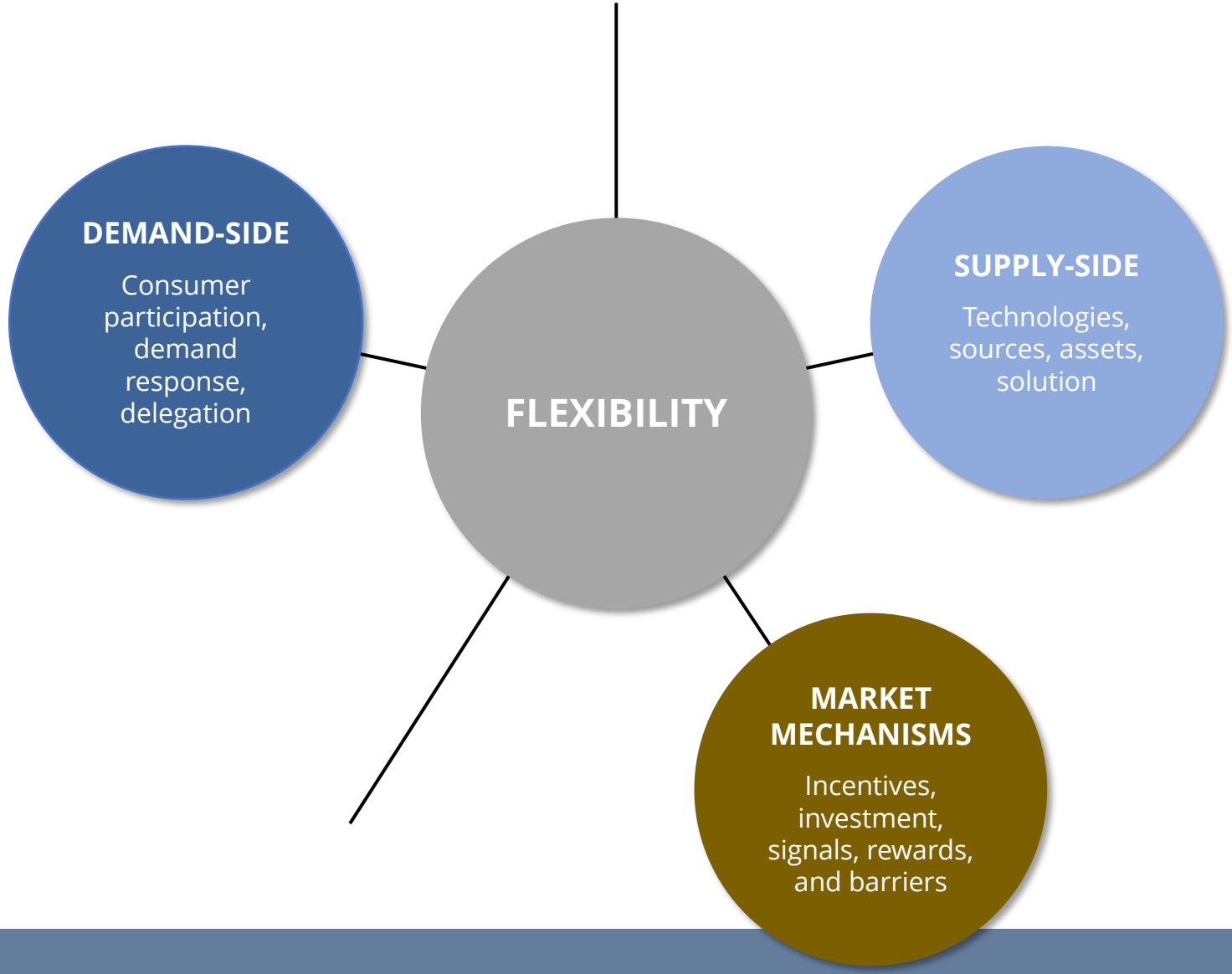

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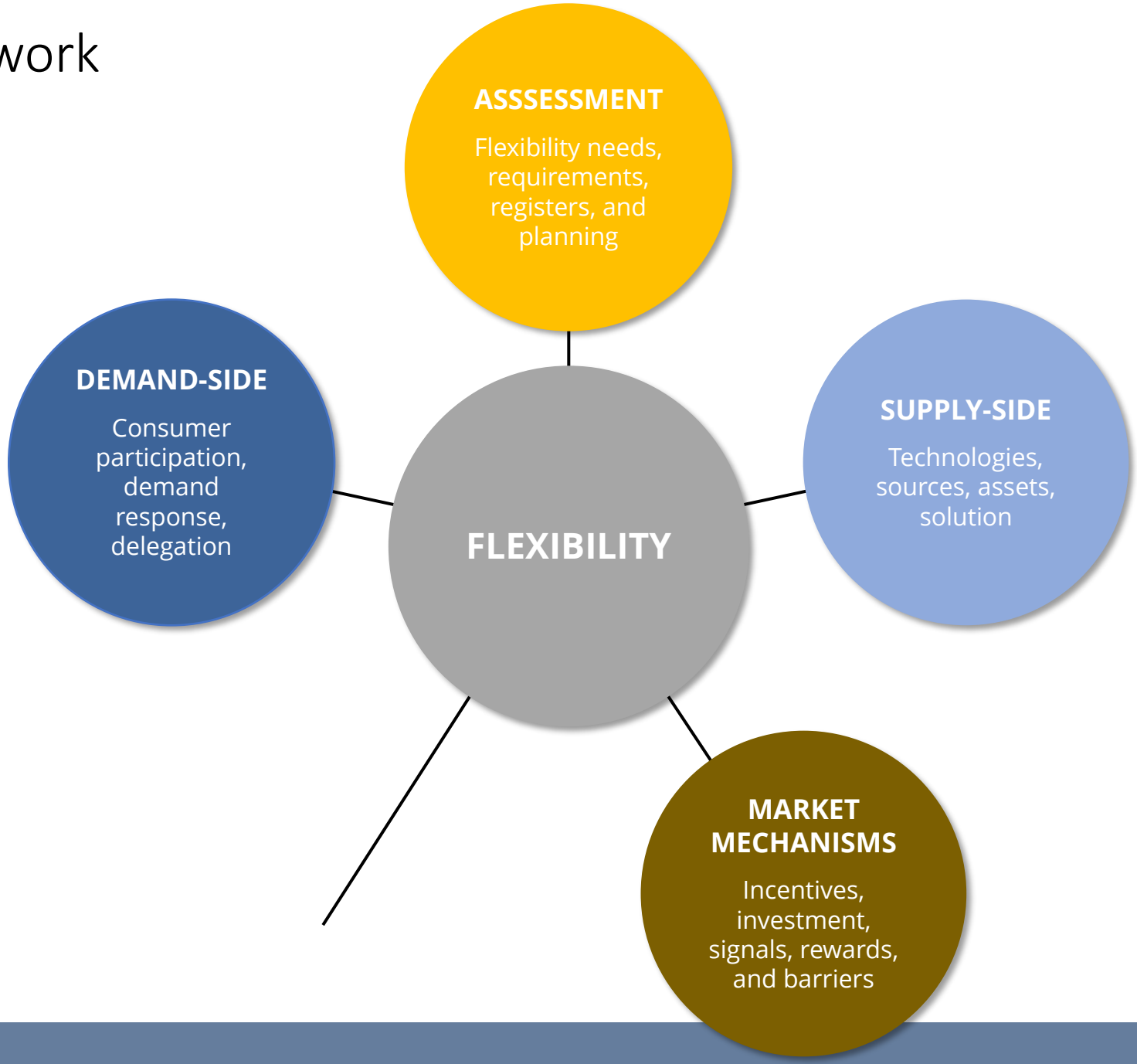

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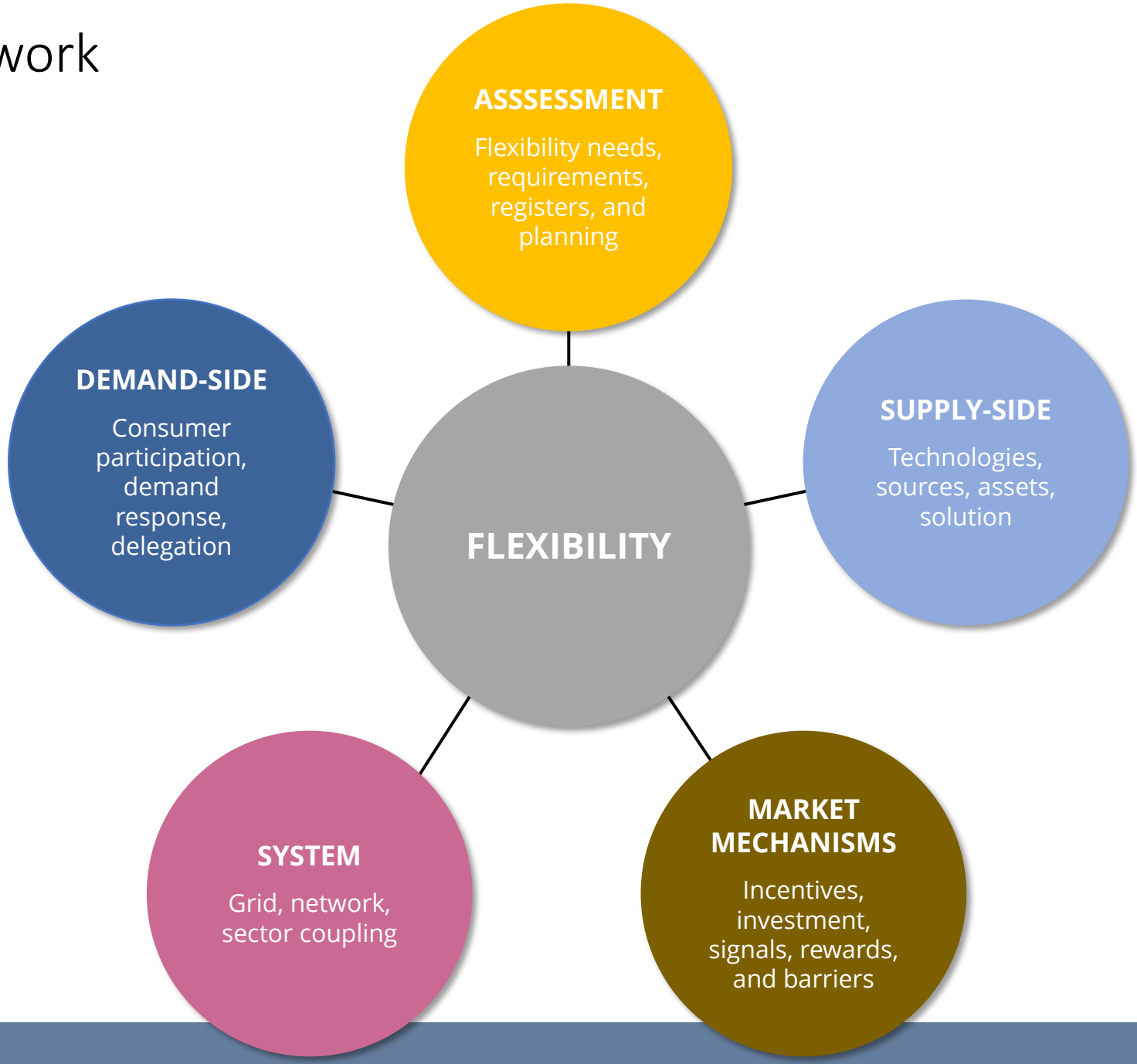
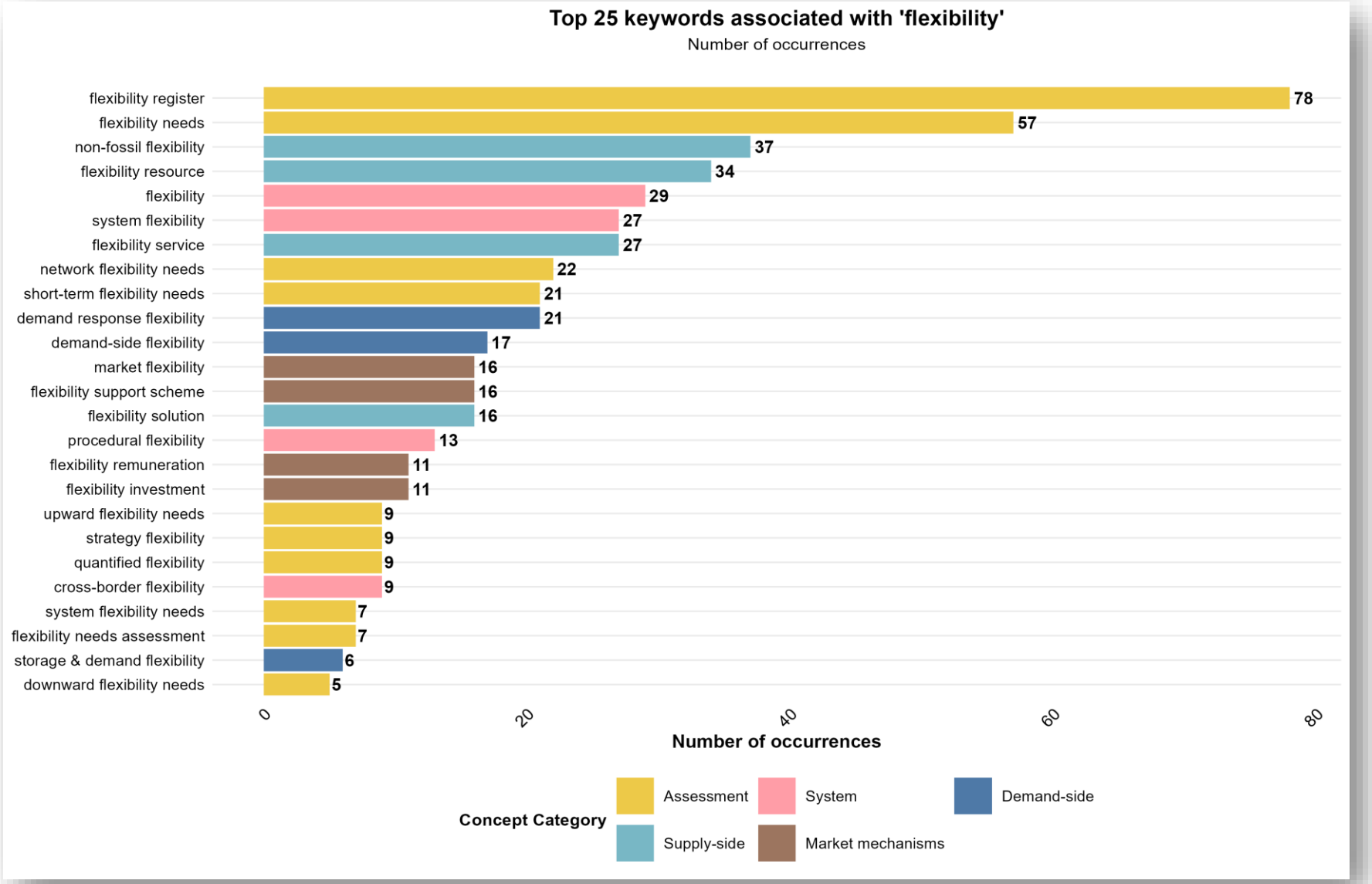


Flexibility and regulation- **Embedding-based textual analysis**



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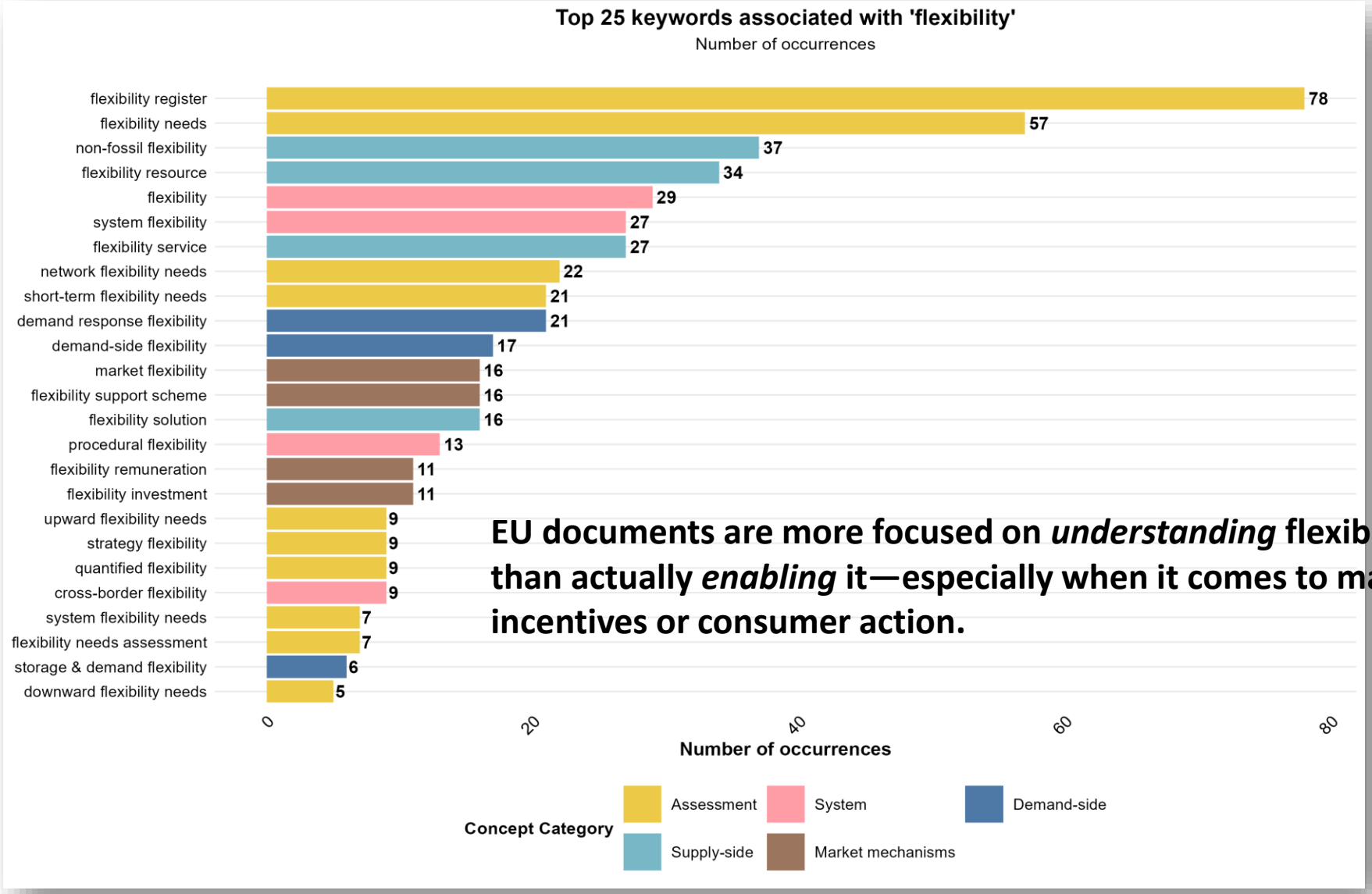

EU documents are more focused on *understanding* flexibility than actually *enabling* it—especially when it comes to market incentives or consumer action.

Remaining Issues & Case Studies

	Flexibility Type	Focus Area	Impact	Actors & Country
Generation /Upstream				
Storage				
Demand side				
Transmission & Distribution				
System				

Remaining Issues & Case Studies

	Flexibility Type	Focus Area	Impact	Actors & Country
Generation /Upstream	Supply-side (Generation)	Flexible CHP Operation	Enhanced VRE integration and grid balancing	CHP Plants, Wind Sector Policies (Denmark)
	Supply-side (Bioenergy)	Biogas Plant Flexibility	Enabling biogas plants in reserve markets	Next Kraftwerke, Biogas Sector (Germany)
Storage	Mobile Storage (EVs)	Vehicle-to-Grid (V2X) Storage	Distributed peak shaving and emergency grid support	PG&E, CPUC (USA - California)
	Stationary Storage	Community Battery Storage	Improved local grid stability and solar integration	Ausgrid, ARENA (Australia)
	Hydrogen Storage & Grid Services	Hydrogen Electrolysis Flexibility	Dual-revenue model; participation in PCR market	Shell Rhineland, REFHYNE Project (Germany)
Demand side	Demand-side Response	Dynamic Pricing & Demand Response	Consumer load shifting; energy bill savings	National Utilities and Consumers (Sweden)
	Demand-side Enabling Technology	Smart Meter Rollout & DR	Consumer engagement in dynamic tariffs and DR programs	ARERA, Italian DSOs (Italy)
Transmission & Distribution	Distributed Energy Resources (DER)	Dynamic Operating Envelopes	Increased DER integration and deferred investments	Australian DSOs, National Guidelines (Australia)
	Local & National Flexibility Market	DSO-TSO Coordination	Coordinated flexibility procurement across grids	Svenska Kraftnät, Vattenfall, Ellevio (Sweden)
System	Integrated Gas-Electricity Demand Shifting	Dual-Energy Heating Program	Peak demand reduction and deferred investments	Hydro-Québec, Energir (Canada - Québec)
	System-wide Market Coordination	Aggregator Participation Platform	Simplified registration of distributed flexibility assets	Ofgem, Elexon (United Kingdom)

Policy Recommendations

	Low structural change	High structural change
Low uncertainty	• Technological uncertainty, e.g. will methane really be out, if so when? • Is CCS credible? • Hydrogen will certainly have role, but what role?	
Adaptive approach		

Policy Recommendations

	Low structural change	High structural change
Low uncertainty	• Technological uncertainty, e.g. will methane really be out, if so when? • Is CCS credible? • Hydrogen will certainly have role, but what role? • Trade-off between short and long term price and investment signals (including political challenges) • Centralized vs decentralized approaches	
Adaptive approach		

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	Low structural change	High structural change
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Adaptive approach		

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Adaptive approach		

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Adaptive approach	AALS1. **Keep options** open and adopt selectively	AAHS1. Take an **adaptive approach to green hydrogen** (and other power to x)

Conclusions

1. **Regulation promotes flexibility**, but effective implementation and supporting enablers are essential to deliver it.

2. **Emerging tech** (like batteries, hydrogen, aggregator…) show promise but remain mostly at **pilot stage**.

3. **Progress varies widely across countries** due to diverse national contexts, leading to significant regional asymmetries.

4. **Proven solutions** like digitalisation, storage, interconnections, and market design should be scaled up, while more uncertain options like green hydrogen and power-to-X are trialled prudently.

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The report can be dowloaded at the following link

Chloé Le Coq

http://chloelecoq.org