Energy Technology Perspectives 2012

Pathways to a Clean Energy System

Tapping technology's potential to secure a clean energy future

Integration of Renewable Energies by Distributed Energy Storage Systems Workshop

18- 19 September 2012

International Energy Agency

ETP 2012 – Choice of 3 Futures

ETP 2012

2DS

a vision of a **sustainable** energy system of reduced Greenhouse Gas (GHG) and CO_2 emissions

The 2°C Scenario

4DS

reflecting pledges by countries to cut emissions and boost energy efficiency

The 4°C Scenario

6DS

where the world is now heading with potentially **devastating** results

The 6°C Scenario

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Sustainable future still in reach

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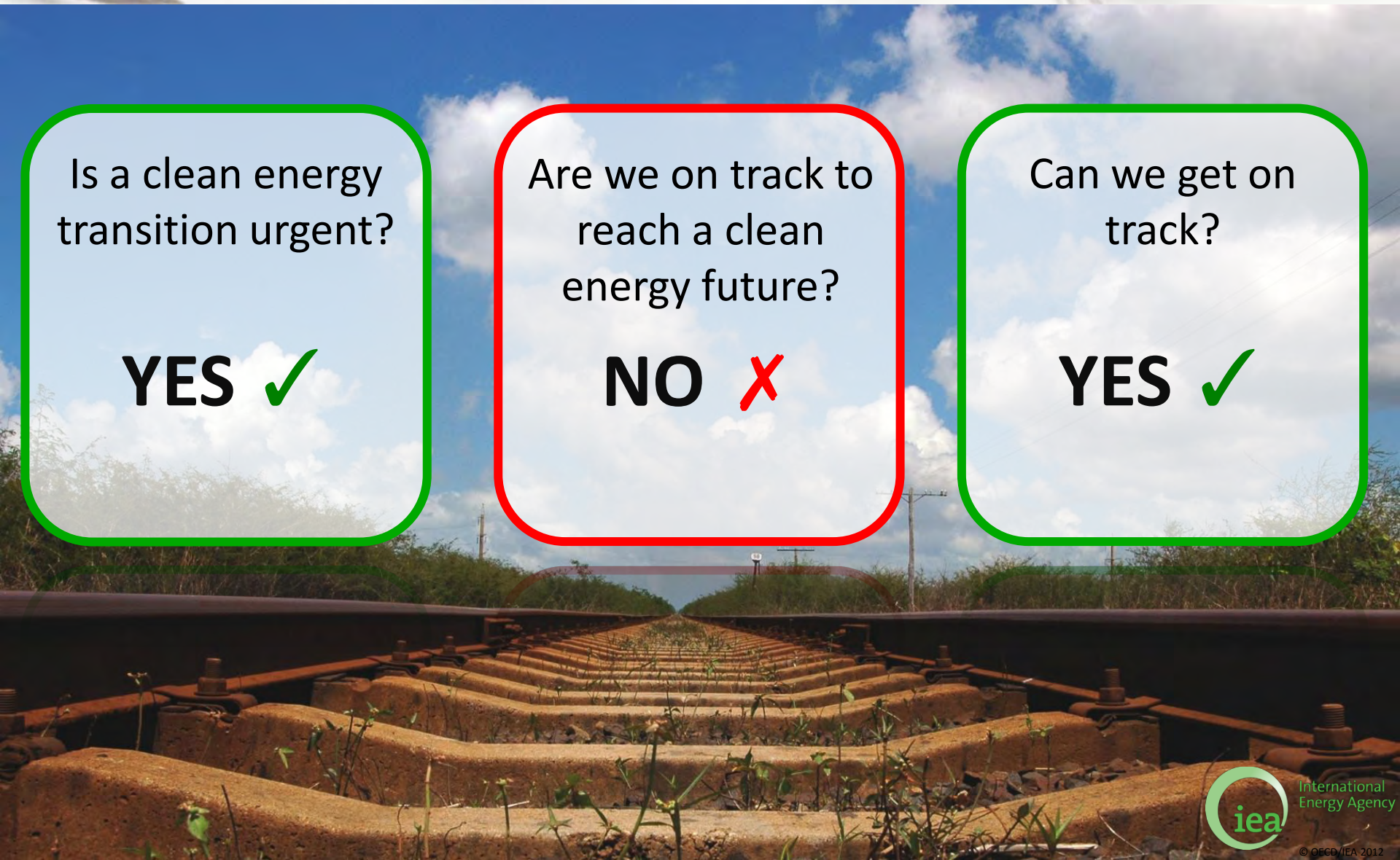

Is a clean energy transition urgent?

YES ✓

Are we on track to reach a clean energy future?

NO ✗

Can we get on track?

YES ✓

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Recommendations to Governments

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1. Create an investment climate of confidence in clean energy

2. Unlock the incredible potential of energy efficiency – “the hidden” fuel of the future

3. Accelerate innovation and public research, development and demonstration (RD&D)

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A smart, sustainable energy system

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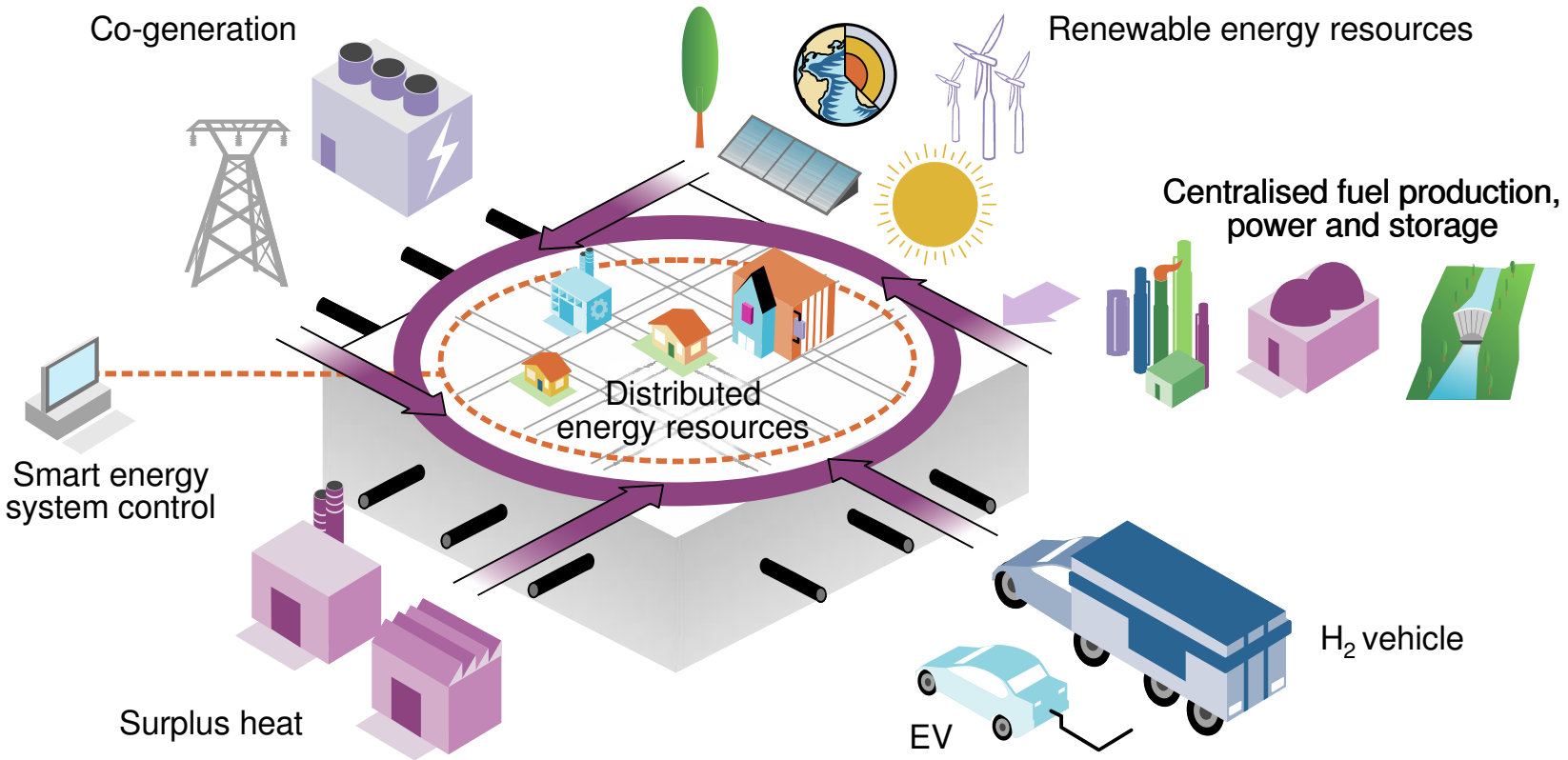

A sustainable energy system is a smarter, more unified and integrated energy system

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The Global Energy system today

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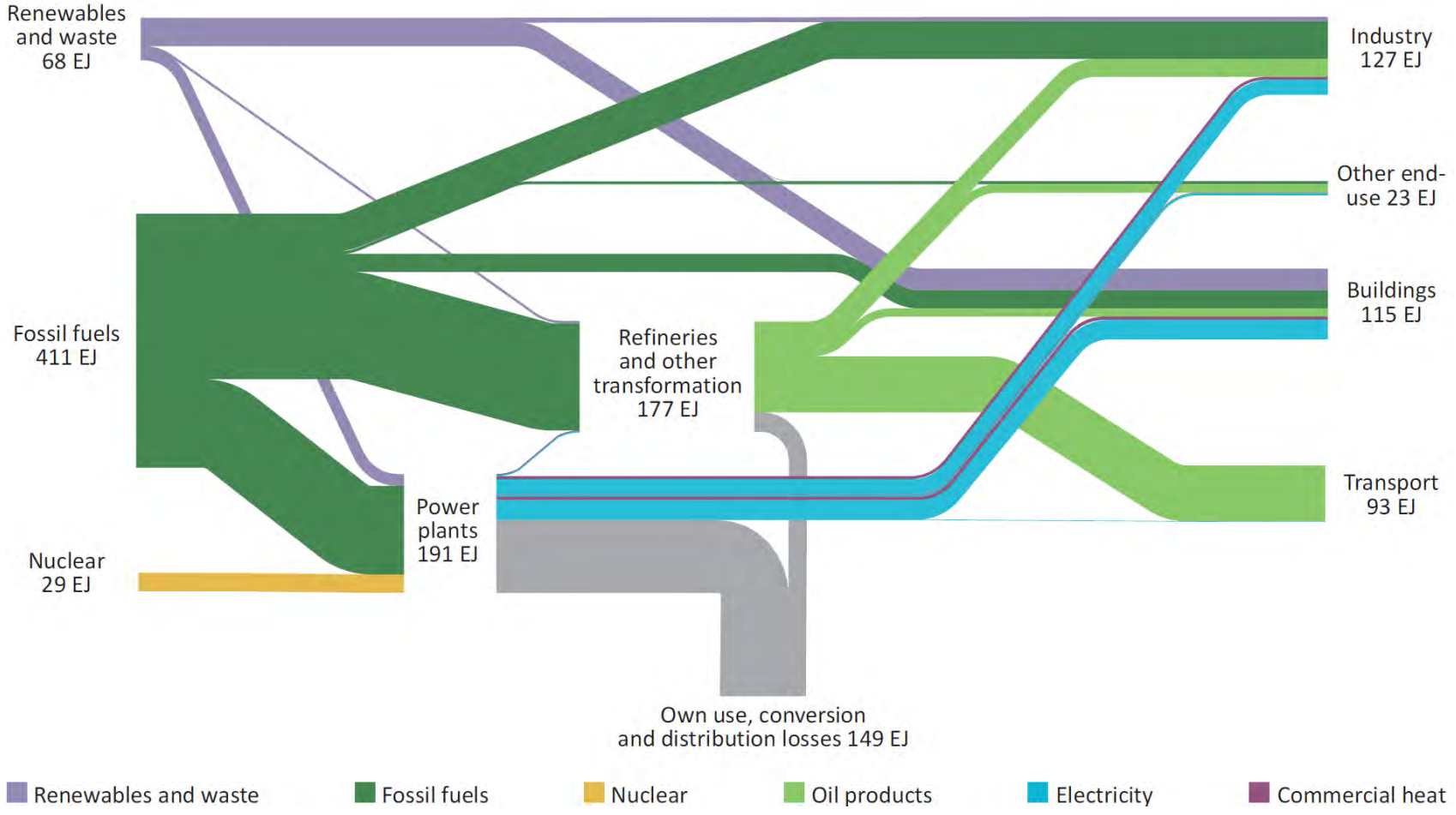

Dominated by fossil fuels in all sectors

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The future low-carbon energy system

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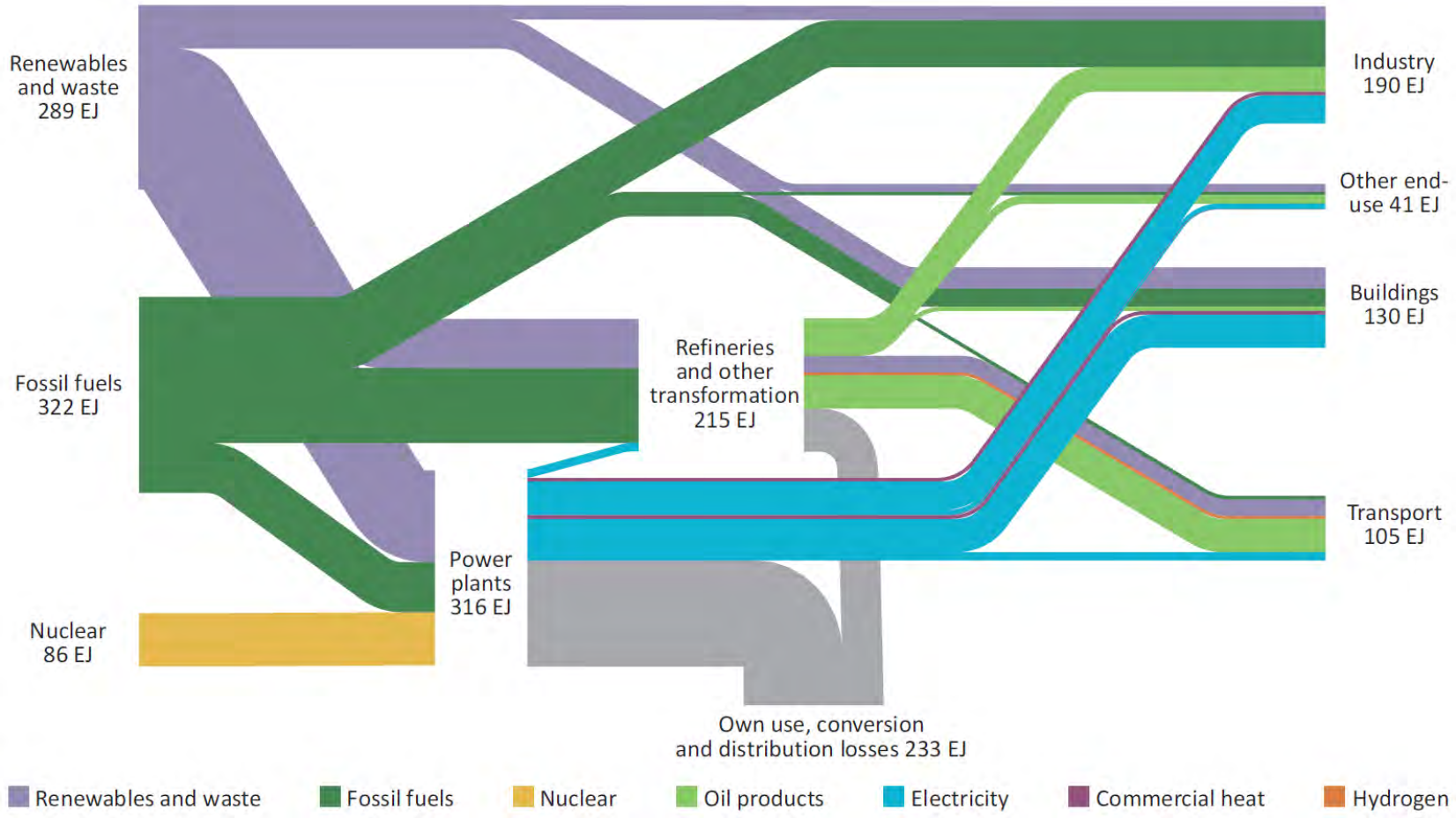

The 2DS in 2050 shows a dramatic shift in energy sources and demands

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Pathways to a Clean Energy System

Flexible Electricity Systems

Chapter 6

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Global Electrical Energy Generation

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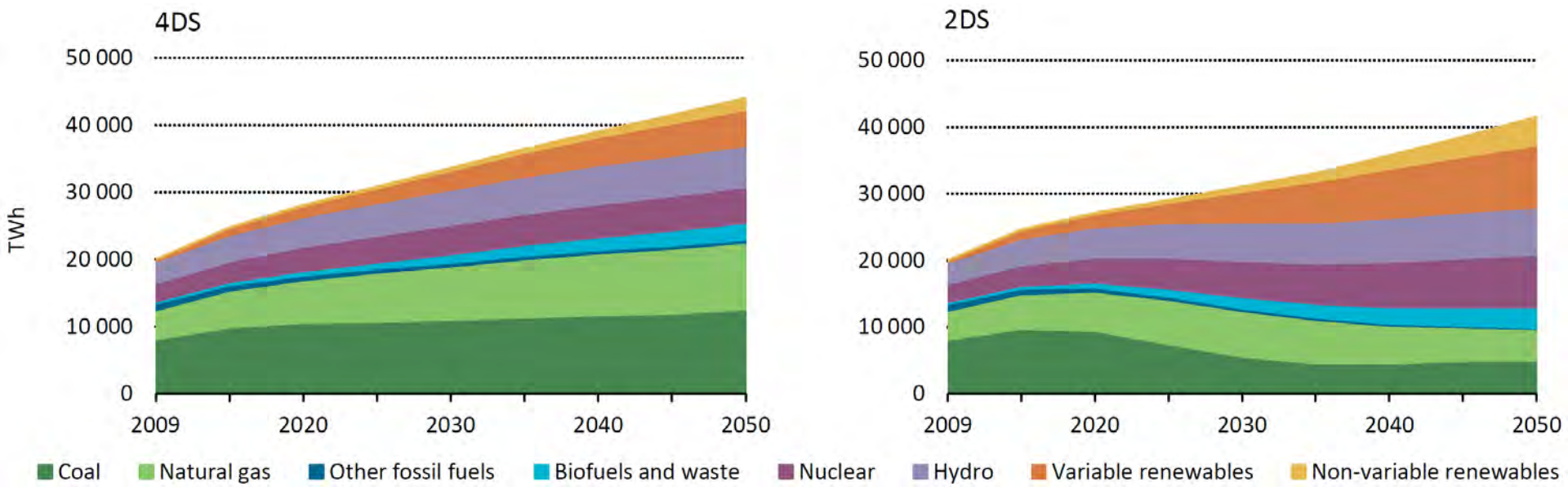

Lower electrical energy demand in 2DS even though electricity is larger proportion of overall energy demand.

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Electricity generation capacity

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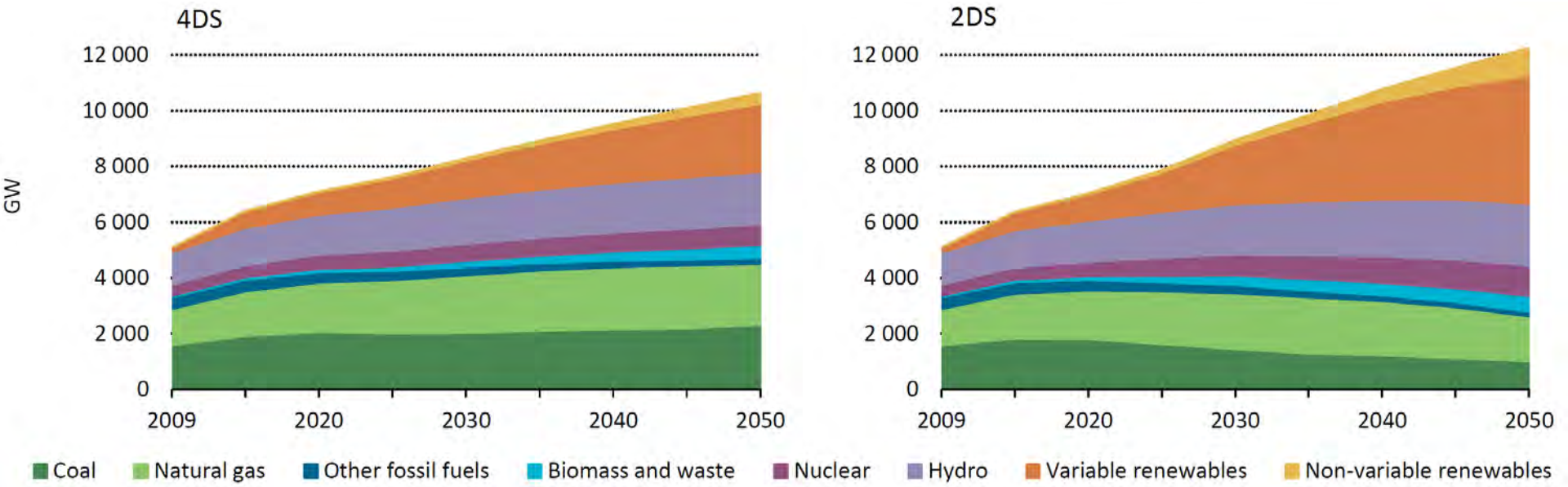

Generation capacity is higher in the 2DS due to great deployment of variable renewables with lower capacity factors.

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Electricity system flexibility

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Power system flexibility expresses the extent to which a power system can modify electricity production or consumption in response to variability, expected or otherwise.

± MW / time

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Flexibility needs and resources

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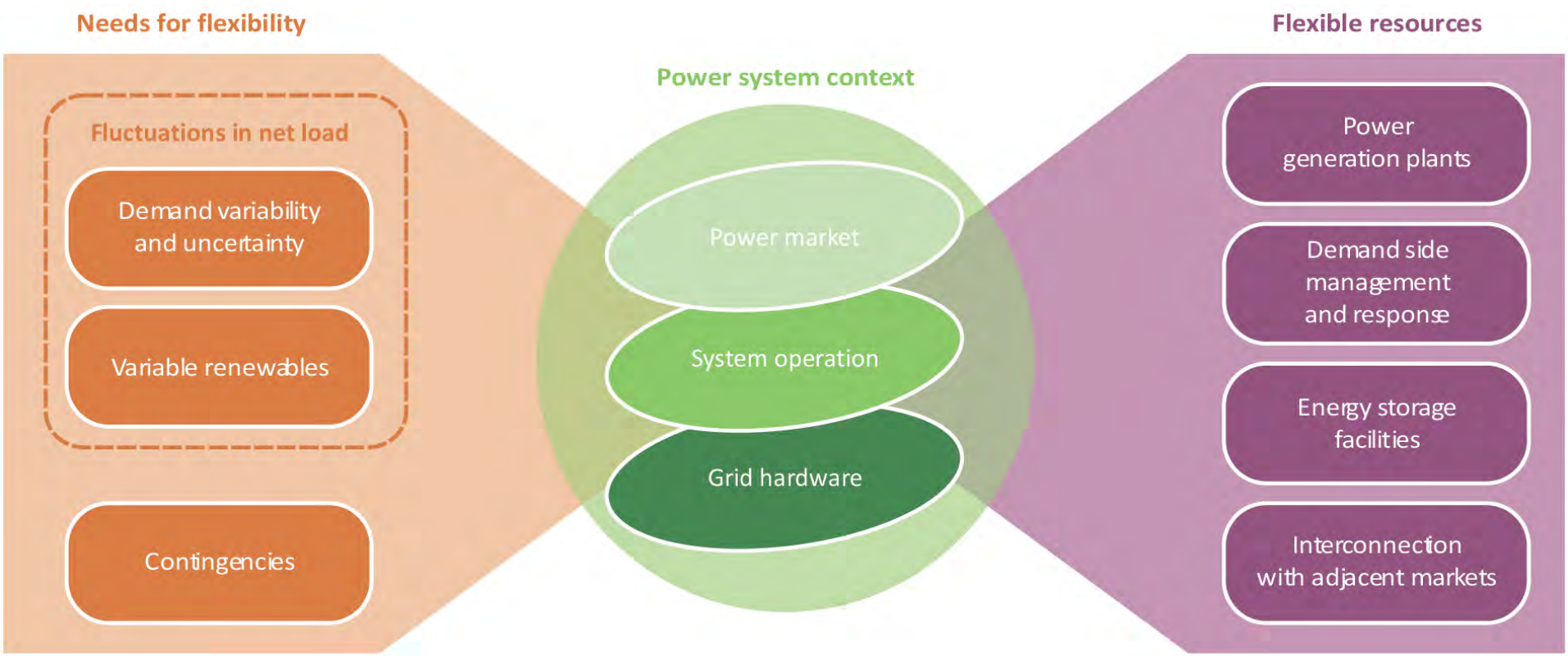

Existing and new flexibility needs can be met by a range of resources in the electricity system – facilitated by power system markets, operation and hardware.

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No “one-time” fits all

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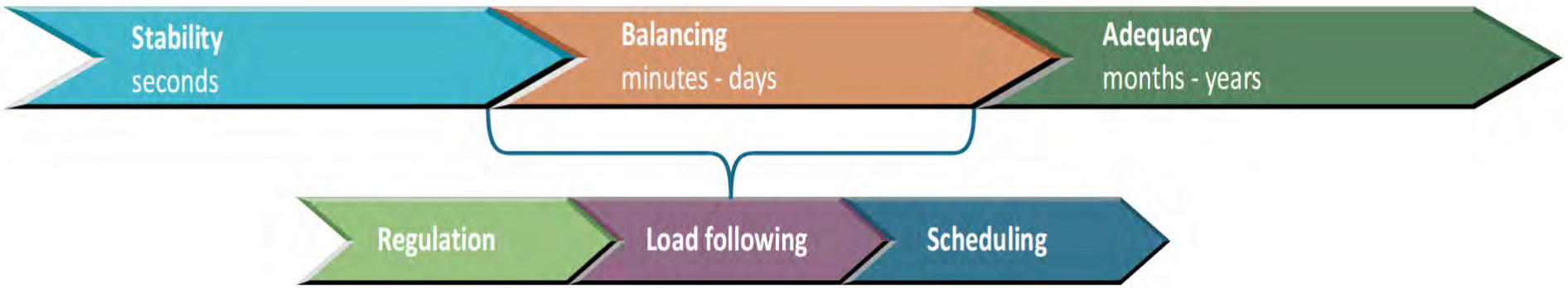

	Response time	Duration
Regulation	~ 1 minute	10 minutes
Load-following	~10 to 30 minute	1 hr
Scheduling	~ 1 day	6 hrs

Balancing of the electricity system needs to address several time frames for response and duration, impacting choice of technology.

The need for flexibility is increasing

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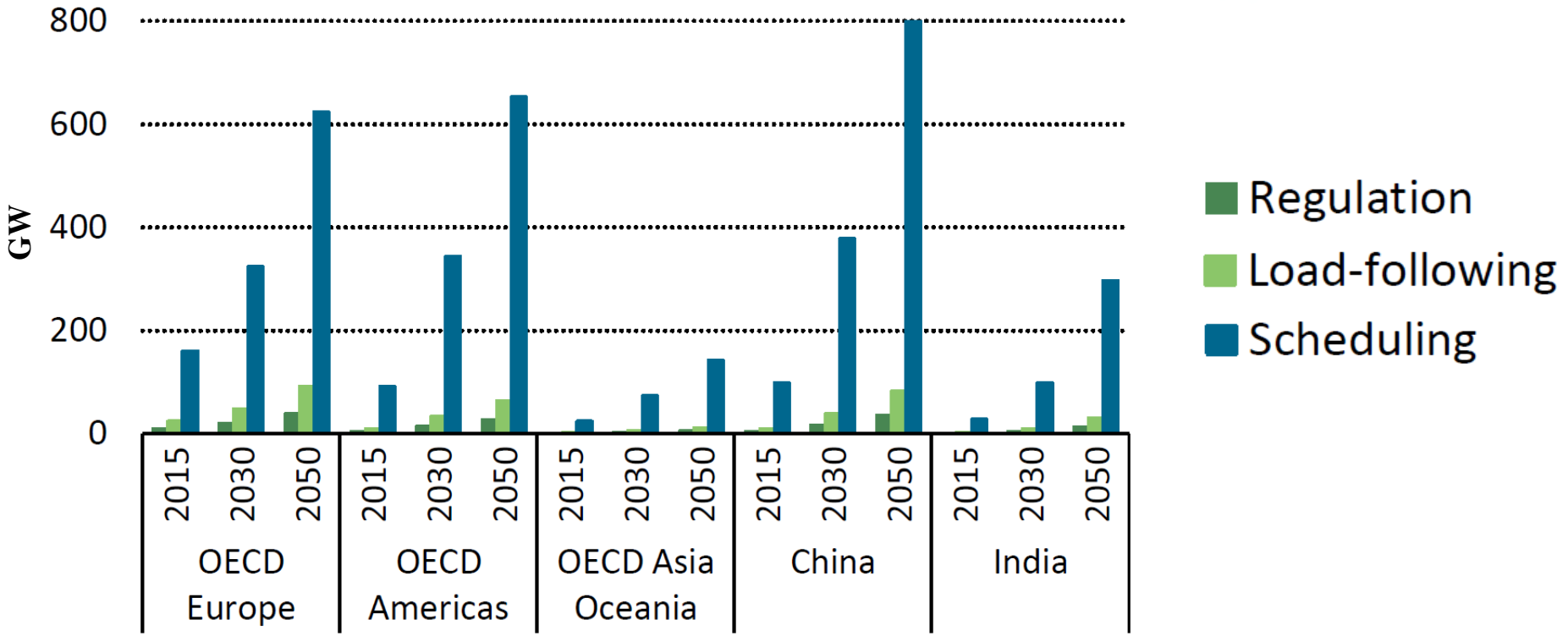

All regions under all scenarios show an increasing need for electricity system flexibility.

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North American sectoral resource

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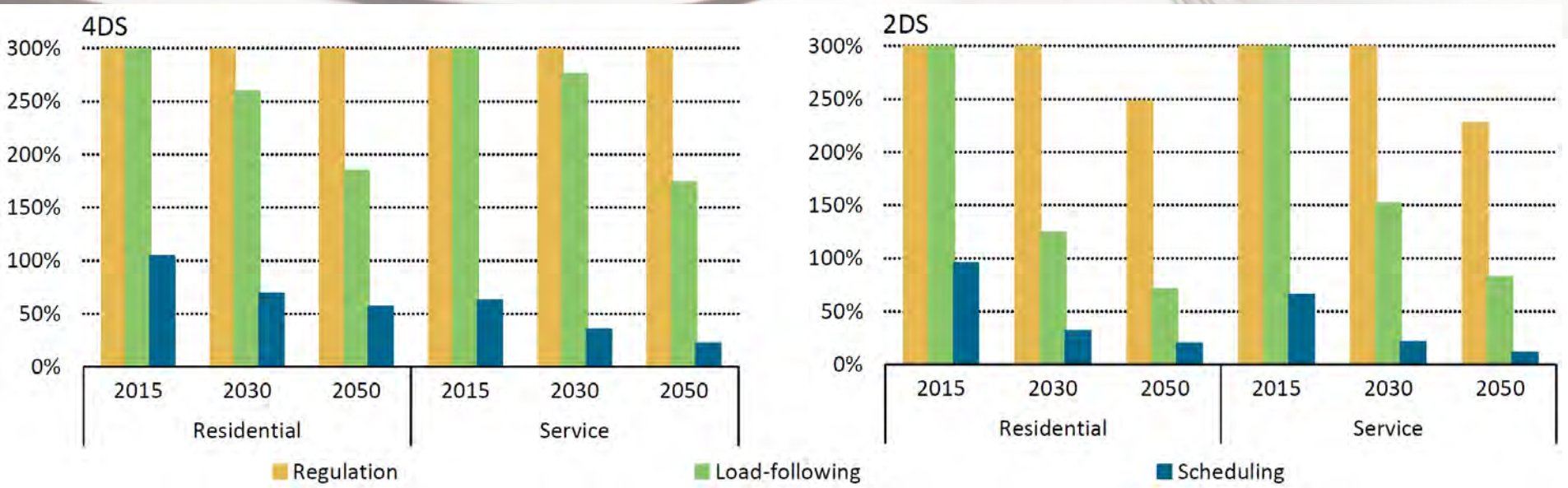

[GW]	4DS						2DS					
	Residential			Service			Residential			Service		
	2015	2030	2050	2015	2030	2050	2015	2030	2050	2015	2030	2050
Regulation	57.9	73.0	90.3	50.8	69.3	88.7	54.6	60.9	67.4	31.6	48.4	61.8
Load-following	32.9	42.9	54.9	17.3	24.6	30.2	31.1	36.4	42.1	9.5	14.9	18.3
Scheduling	95.8	140.4	198.5	57.7	71.2	77.9	87.4	108.3	129.2	60.6	71.8	73.5

Note: The respective regulation, load-following and scheduling balancing values of the residential, and service sectors can be added to indicate the total flexibility for each balancing type.

Demand-side energy efficiency decreases resource.

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Storage – a game changer or niche player?

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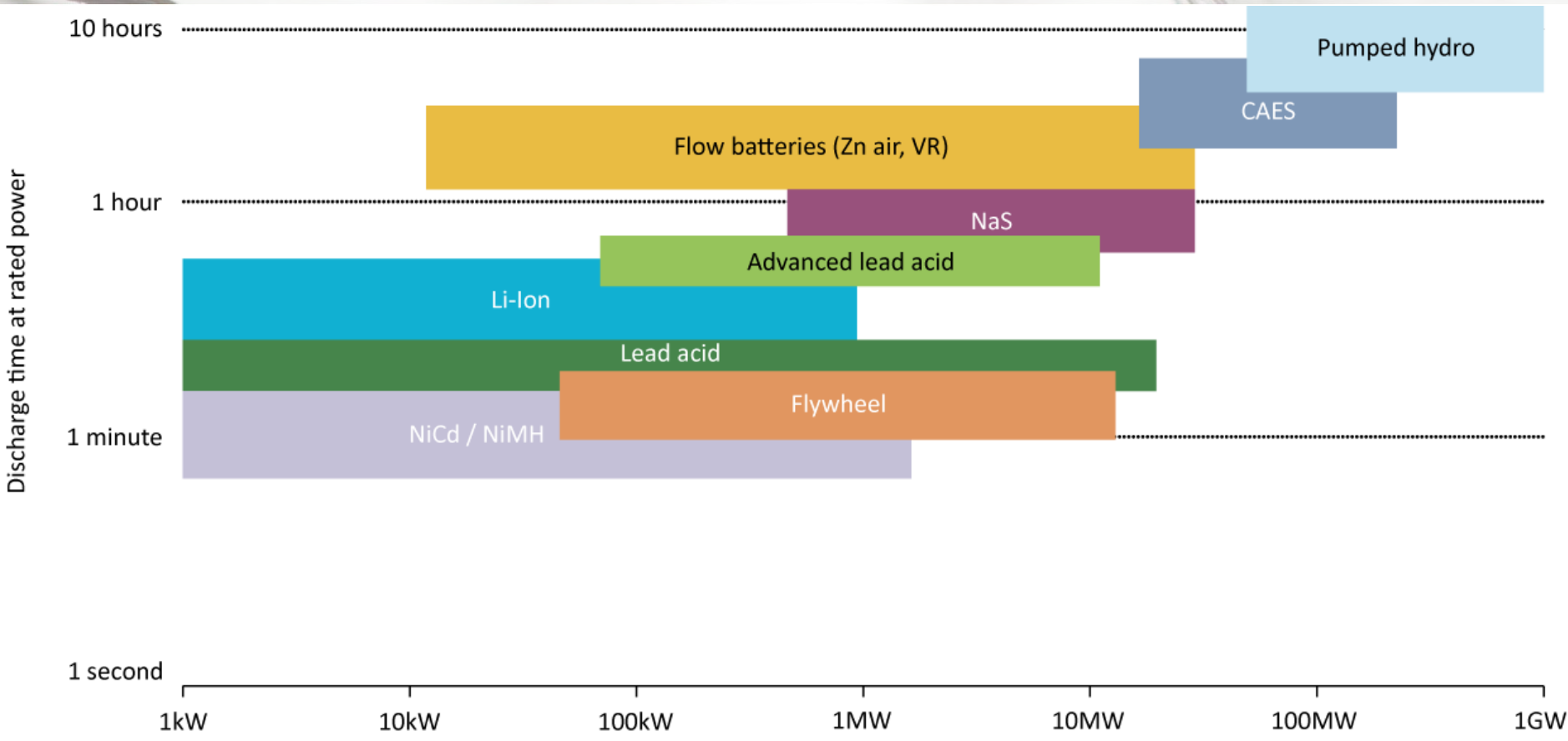

Existing installations and niche applications will play a definite role in the future, but cost concerns exist for new deployments.

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Storage technology cost vary widely

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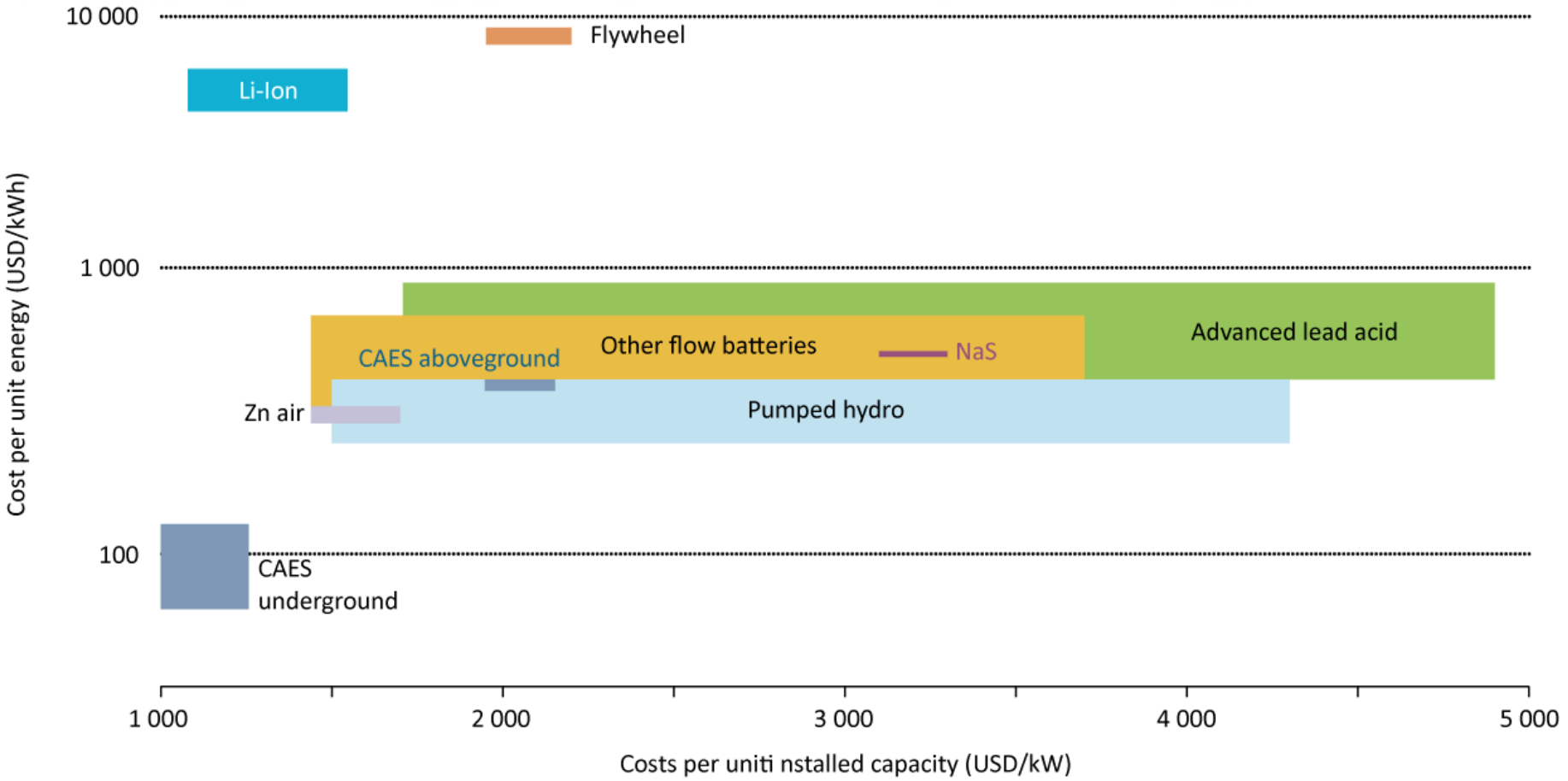

Application specific deployment is key for successful business case development.

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Technology choices in electricity system flexibility

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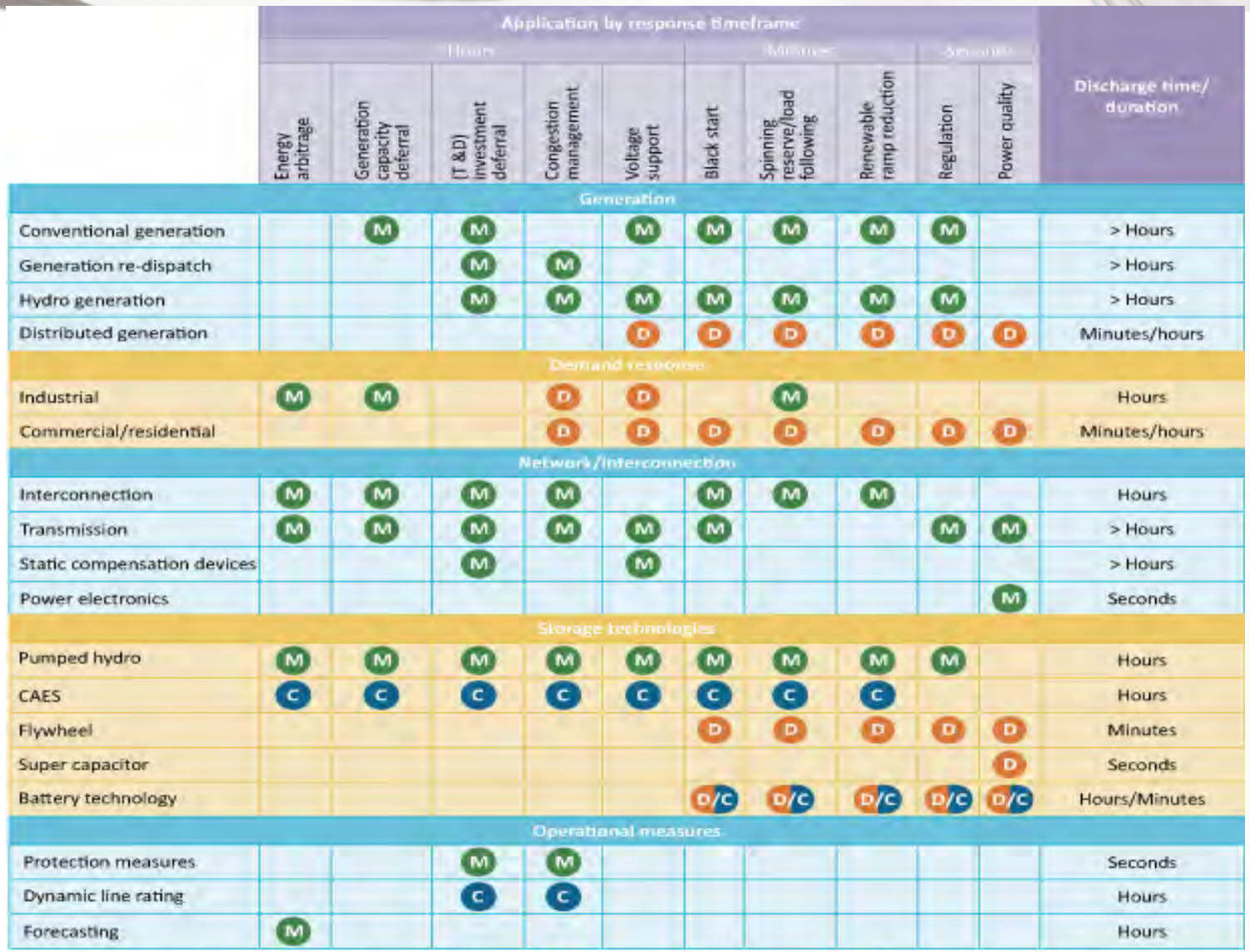

	Application by response timeframe: Hours					Minutes			Seconds		Discharge time/ duration
	Energy arbitrage	Generation capacity deferral	(T &D) investment deferral	Congestion management	Voltage support	Black start	Spinning reserve/load following	Renewable ramp reduction	Regulation	Power quality	
Generation											
Conventional generation		M	M		M	M	M	M	M		> Hours
Generation re-dispatch			M	M							> Hours
Hydro generation			M	M	M	M	M	M	M		> Hours
Distributed generation					D	D	D	D	D	D	Minutes/hours
Demand response											
Industrial	M	M		D	D		M				Hours
Commercial/residential				D	D	D	D	D	D	D	Minutes/hours
Network/interconnection											
Interconnection	M	M	M	M		M	M	M			Hours
Transmission	M	M	M	M	M	M			M	M	> Hours
Static compensation devices			M		M						> Hours
Power electronics										M	Seconds
Storage technologies											
Pumped hydro	M	M	M	M	M	M	M	M	M		Hours
CAES	C	C	C	C	C	C	C	C			Hours
Flywheel						D	D	D	D	D	Minutes
Super capacitor										D	Seconds
Battery technology						D/C	D/C	D/C	D/C	D/C	Hours/Minutes
Operational measures											
Protection measures			M	M							Seconds
Dynamic line rating			C	C							Hours
Forecasting	M										Hours

Technology maturity key: M Mature C Commercial D Demonstration

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What do we need to do? Barriers?

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- Use systems based approaches – utilise flexibility resources from all parts of the electricity system
- Learn by doing - increased pilot and demonstration projects will enable of real-world solutions for flexibility
- Support new technology deployment – develop regulatory and market solutions that allow new technologies and new actors to support system operation
- Determine regulatory approaches that support conventional and new technologies – and adequately share costs, benefits and risks.