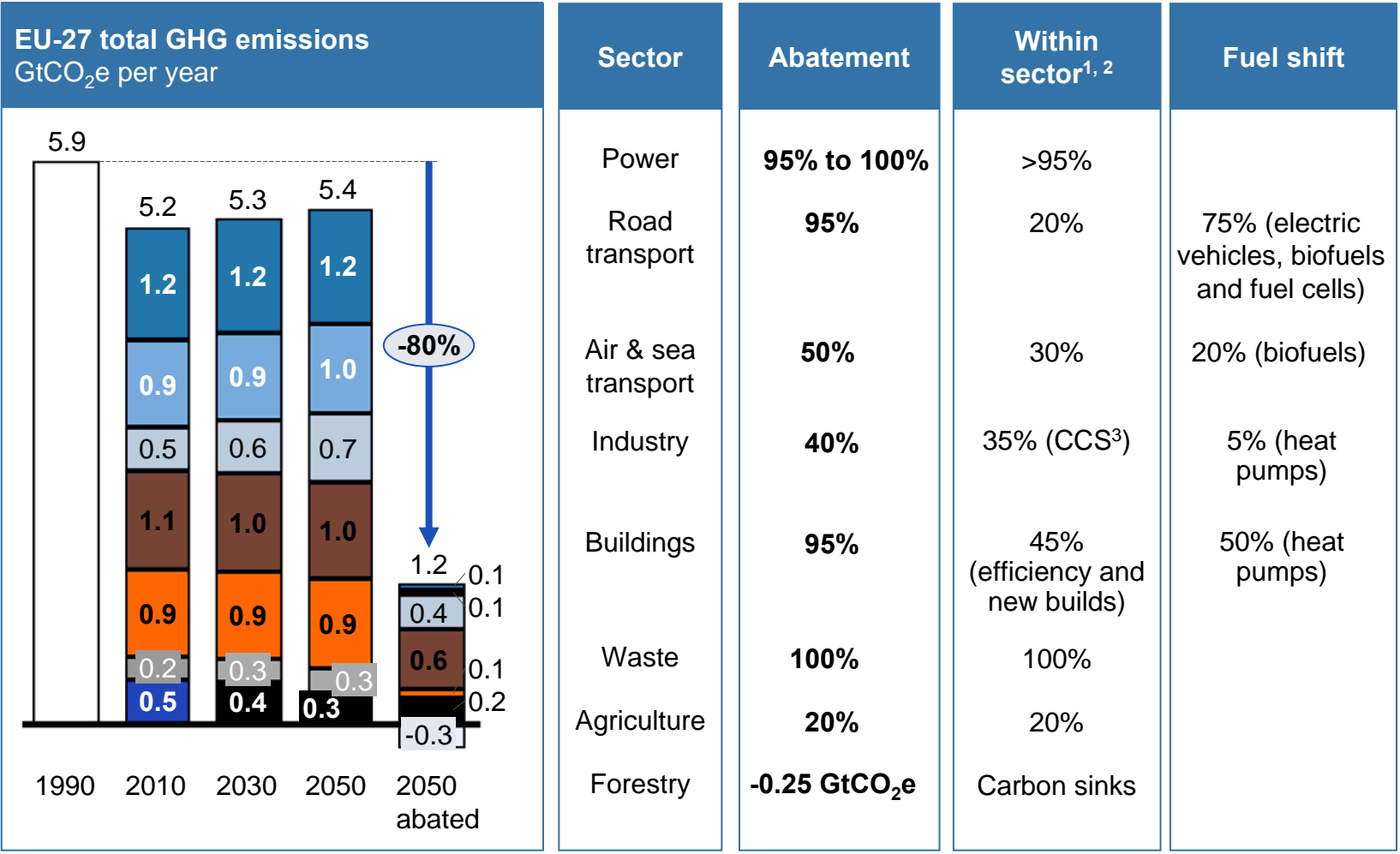


Roadmap 2050: A practical guide to a prosperous, low-carbon Europe

Highlights - Draft
March, 2010

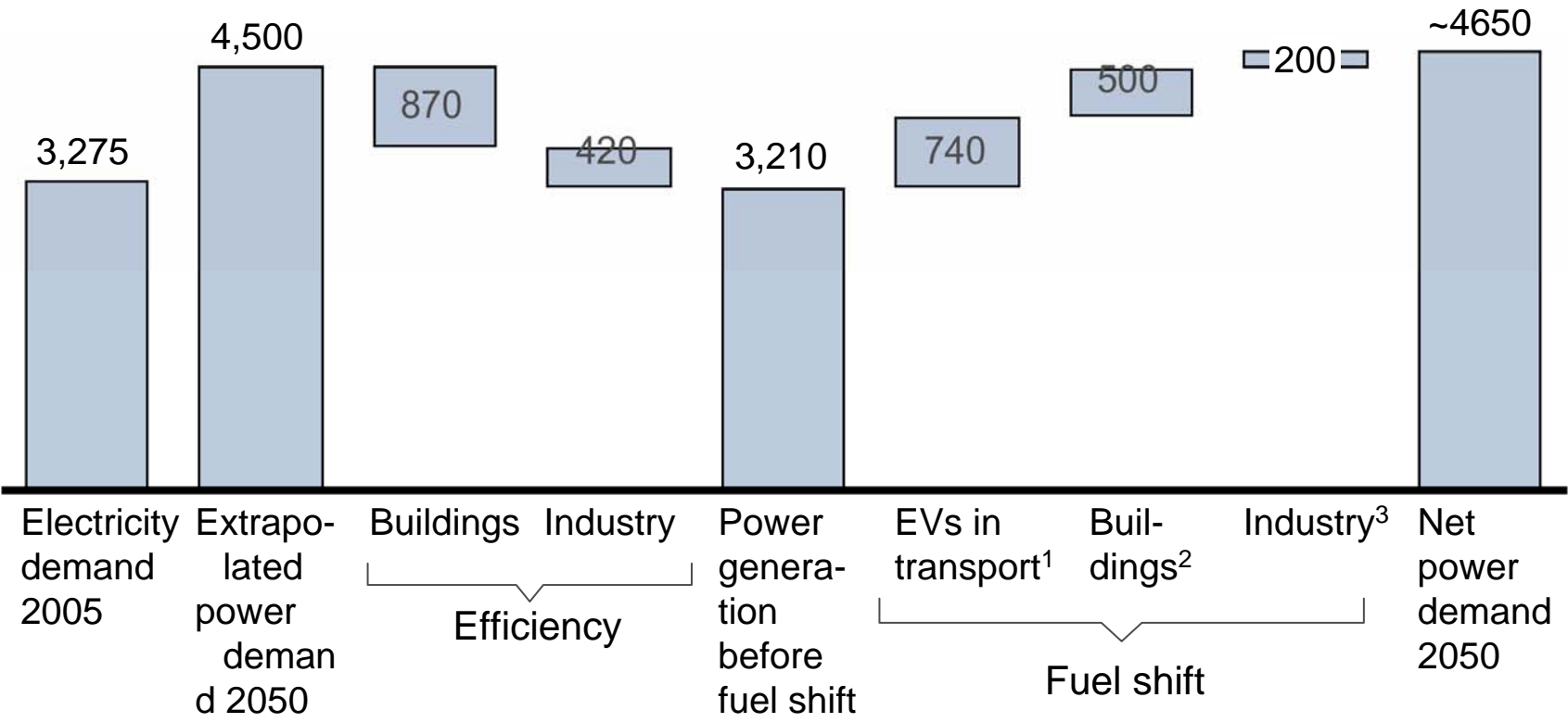
80% by 2050 only possible with zero-carbon power supply



1 Based on the McKinsey Global GHG Abatement Cost Curve
 2 Large efficiency improvements already included in the baseline
 3 CCS applied to 50% of industry (cement, chemistry, iron and steel, petroleum and gas, not applied to other industries)

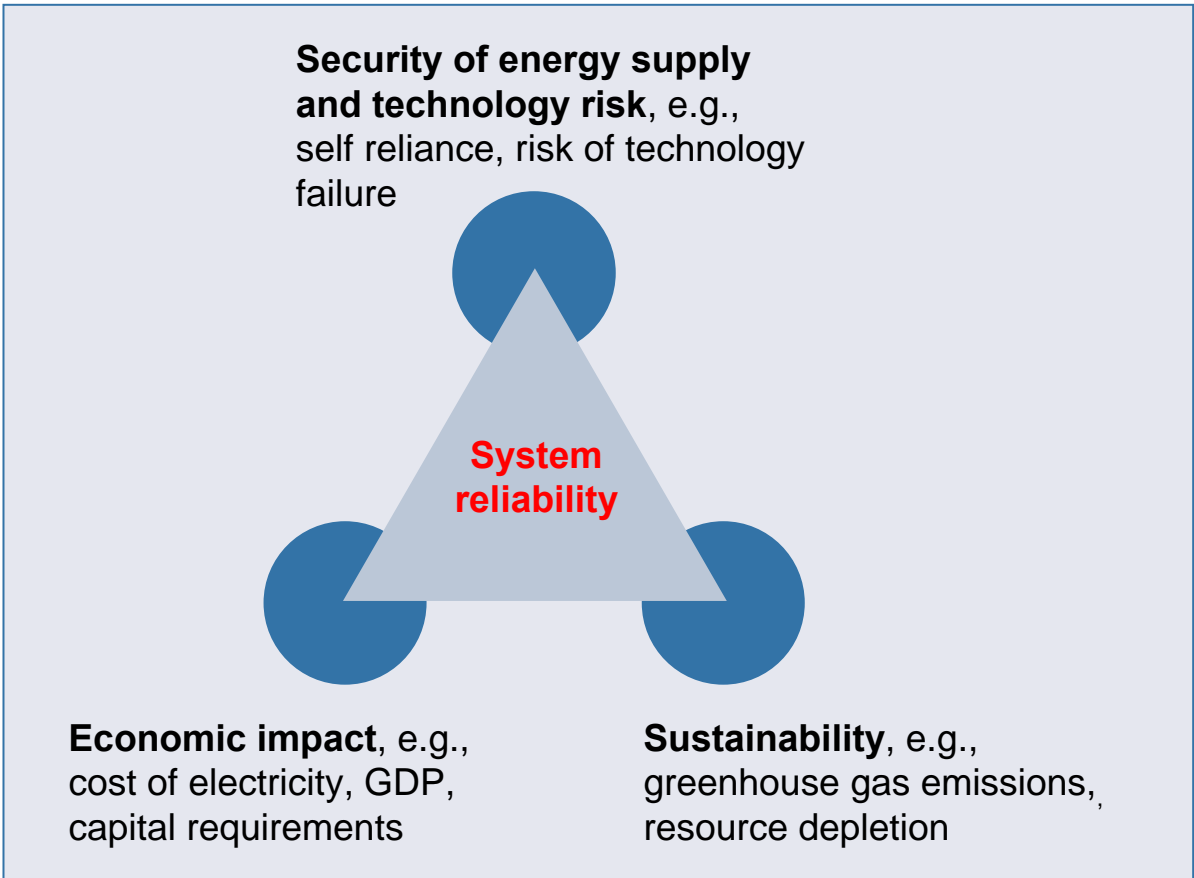
Efficiency flattens demand growth, 'fuel shift' drives it back up to the same level as 'BaU', but far less energy intensive

EU-27 power demand, TWh per year



1 Assumption: electrification of 100% LDVs and MDVs (partially plug-in hybrids); HDVs remain emitting ~10% while switching largely to biofuel or hydrogen fuel cells
 2 Assumption: 90% of remaining primary energy demand converted to electricity usage in buildings for heating/cooling from heat pumps; assumed to be 4 times as efficient as primary fuel usage
 3 Assumption: 10% fuel switch of remaining combustion primary energy demand converted to electricity in industry for heating from heat pumps; assumed to be 2.5 times as efficient as primary fuel usage

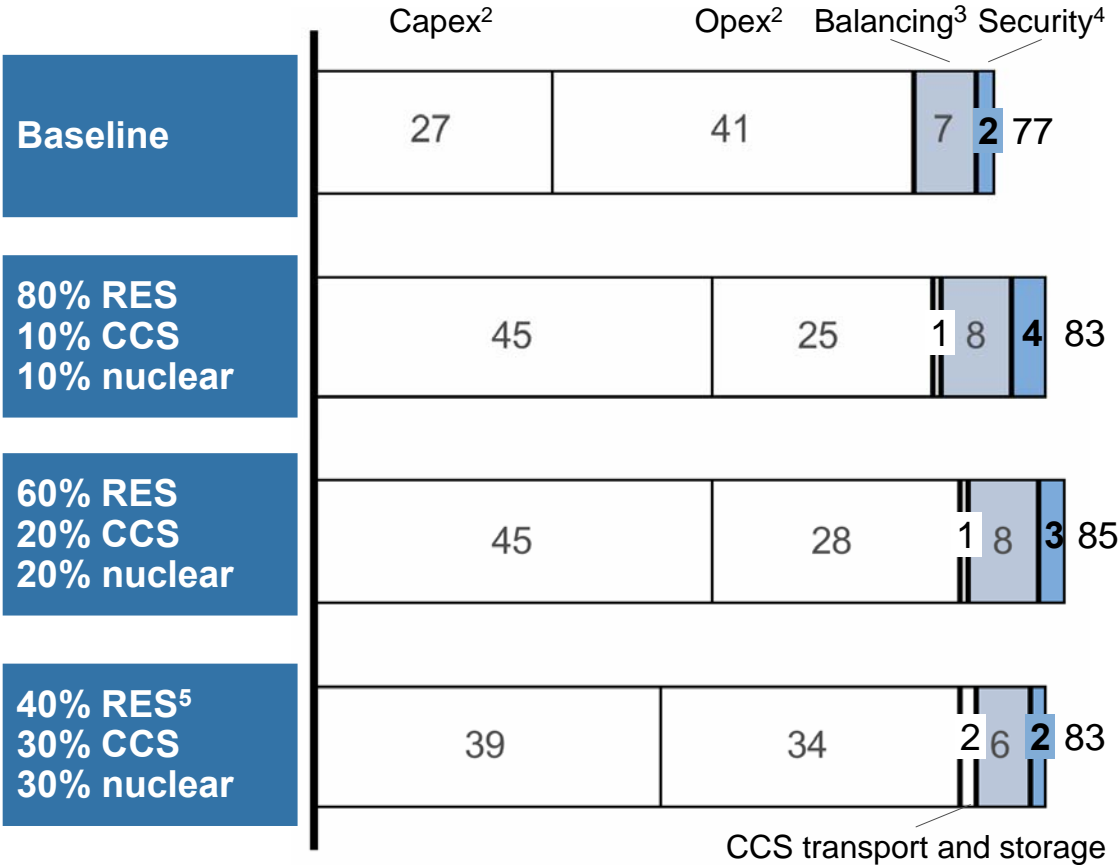
Assessment criteria



All pathways can deliver power with roughly the same cost and reliability as the baseline with carbon price $\leq \text{€}50/\text{tCO}_2$



Average new built CoE from 2010 to 2050¹, EUR/MWh (real terms)



1 Weighted average based on the CoE in each 10-year time frame (2010, 2020, 2030, 2040, 2050)
 2 Generation only
 3 Cost related to non optimal plant use, system dispatch cost for secure operation, running backup plants, storage losses, reserve and response cost
 4 Transmission and additional generation capex as well as fixed opex for transmission and backup
 5 Grid not modeled by KEMA yet, impact estimated by interpolation from the other pathways

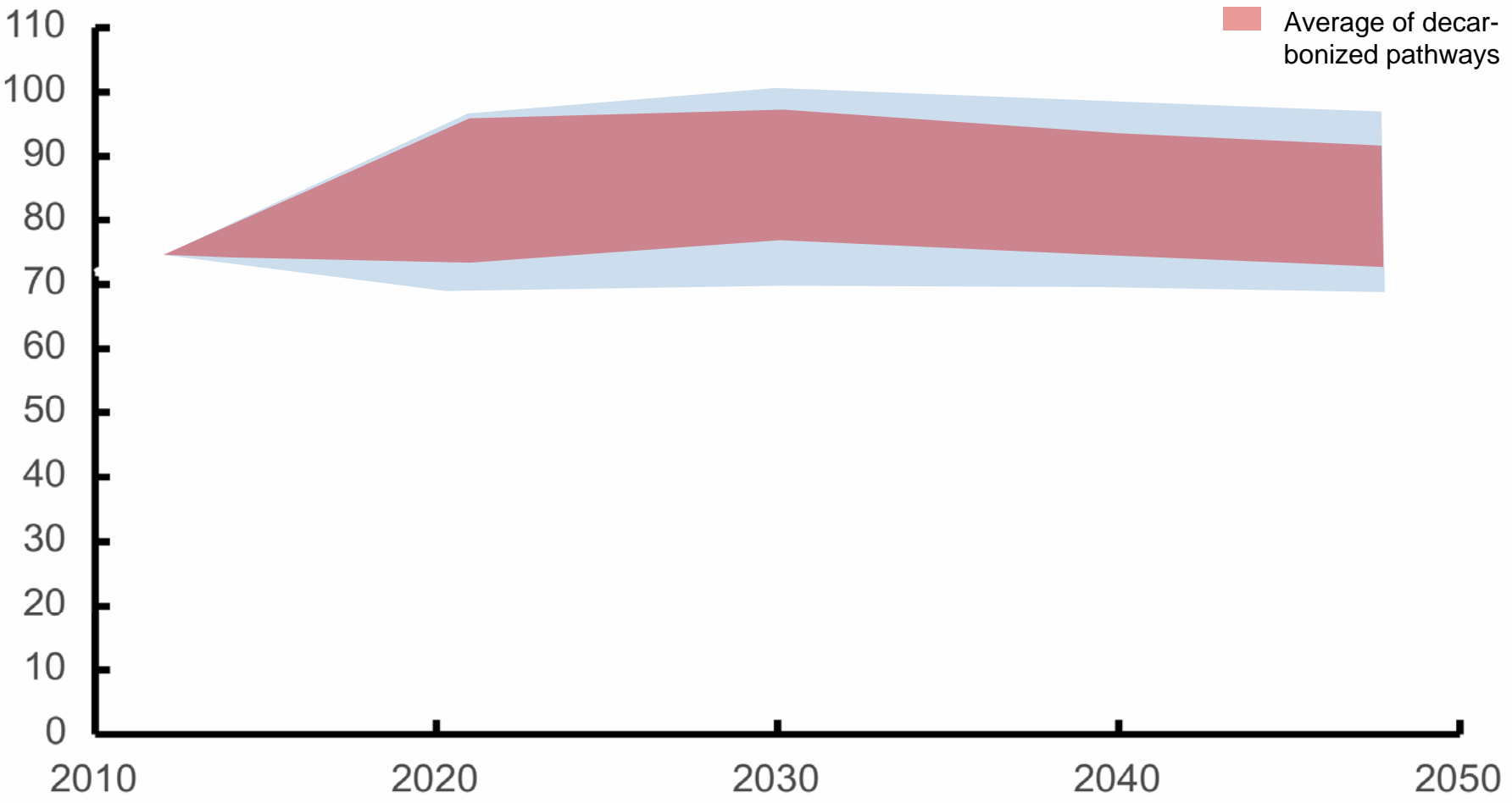
SOURCE: Team analysis

Confidence ranges for assumptions: likely outcomes are within 10-15% of each other across all pathways

**Ranges of the levelized cost of electricity of new builds¹,
€ per MWh (real terms)**

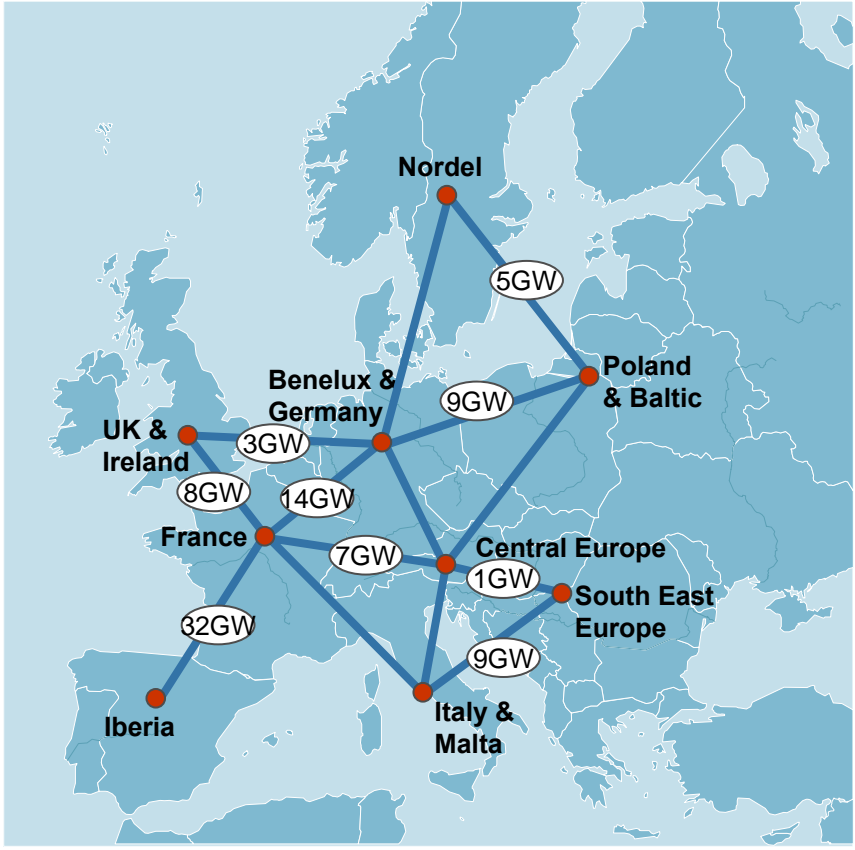
DRAFT

- Baseline
- Average of decarbonized pathways



¹ Based on a WACC of 7% (real after tax), computed by technology and weighted across technologies based on their production; including grid. COE ranges are based on: Carbon price from €0 to 35 per tCO₂e; Fossil fuel prices: IEA projections +/- 25%; Learning rates: default values +/- 25%

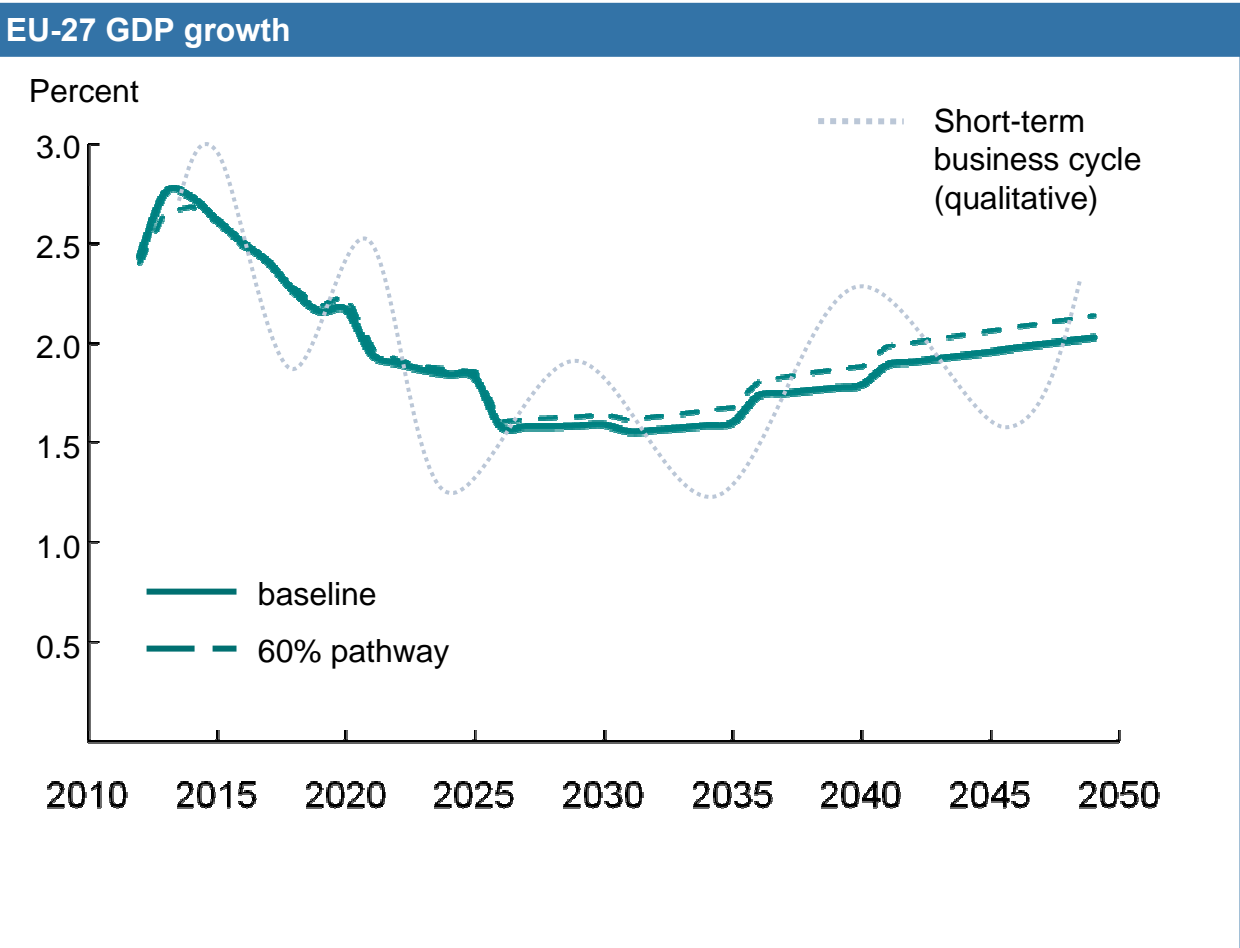
New inter-regional transfer capacity required (60% RES)



● Centre of gravity

Interconnection	Capacity additional (existing) [GW]	Annual utilization [%]
UK&Ireland-France	8 (2)	75
UK&Ireland-Nordel	0 (0)	0
UK&Ireland-Benelux&Germany	3 (0)	83
France-Iberia	32 (1)	83
France-Benelux&Germany	14 (6)	78
France-Central-Europe	7 (3)	93
France-Italy&Malta	0 (3)	92
Nordel-Benelux&Germany	0 (3)	75
Nordel-Poland&Baltic	4 (1)	60
Benelux&Germany-Central-EU	0 (4)	74
Benelux&Germany-Poland&Baltic	9 (1)	81
Central-Europe-Poland &Baltic	0 (2)	77
Central-South East EU	1 (2)	80
Central-Europe-Italy	0 (5)	58
South East EU-Italy	9 (1)	79
Total	87 (34)	

Despite slightly higher initial unit costs for power, impact on overall economic performance is neutral to positive

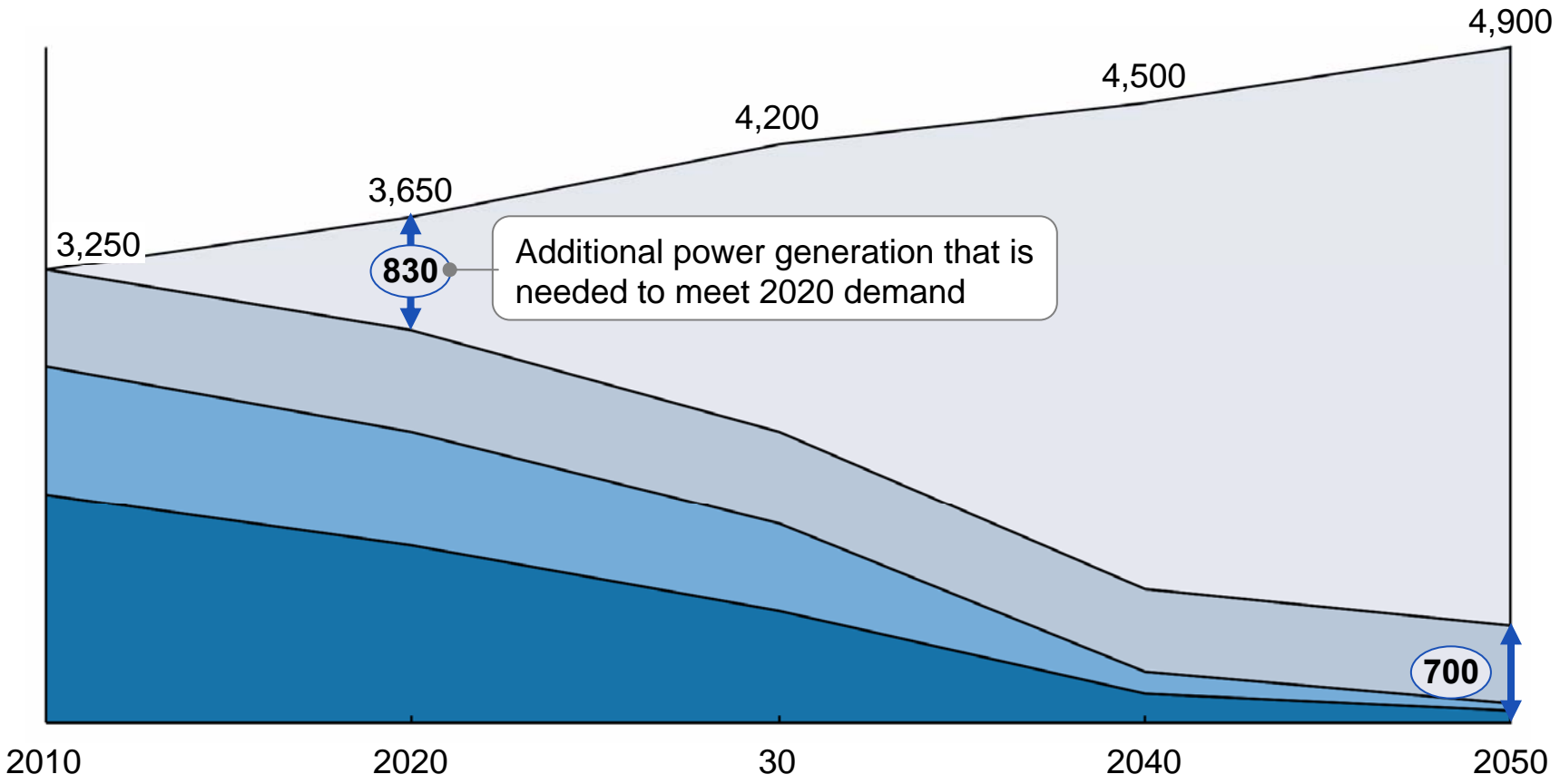


SOURCE: Team analysis

Critical market 'pull' for low-carbon resources is driven by steady, timely retirement of existing high-carbon assets

Power supply by existing and currently planned power plants and forecasted power demand, TWh

- Total power demand
- Existing nuclear
- Existing *1
- Existing fossil



SOURCE: Team analysis