2018 Future Energy Scenarios

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Roisin Quinn

Head of Strategy, System Operator, National Grid

System Operator

We have listened

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Two scenarios that meet the **2050** target

Exhibitions and a more visible team at the Conference

Continued development of models

Increased communication on our work and our events

Morning agenda

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Time	Activity	Speaker
9.30-10.30	Welcome	Roisin Quinn: Head of Strategy, System Operator, National Grid
	Opening address	Fintan Slye: Director of System Operator, National Grid
	Overview of our 2018 Scenarios	Marcus Stewart: Head of Energy Insights, System Operator, National Grid
10.30-11.10	Electric Dreams	Baroness Worthington: Executive Director of Environmental Defense Fund
	World Energy Scenarios — Implications for UK Energy Strategy	Ged Davis Executive Chair of the World Energy Scenarios
11.10-11.30	Refreshments and FES 2018 & SO team exhibitions	
11.30-12.20	Q&A Panel	All speakers
12.20-13.00	Lunch and FES 2018 & SO team exhibitions	

Afternoon agenda

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Time	Activity	Speaker
1.00 – 1.30	FES 2018 transport presentation and Q&A	Alex Haffner and team
1.45 – 2.20	FES 2018 electricity Supply & Demand presentation and Q&A	Andy Dobbie and team
2.35 – 3.10	FES 2018 gas supply & heat presentation and Q&A	Neil Rowley and team
1.00 – 3.15	FES 2018 and SO team exhibitions	
3.30	CLOSE	

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Fintan Slye

Director of System Operator, National Grid

System Operator

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1 A new energy world

We are entering a new world of energy. The expected growth of low carbon and decentralised generation means the electricity system will need to change.

Increase in capacity from 103GW today to between 189GW and 268GW by 2050.

Up to 65%
Percentage of generation capacity which could be local by 2050.

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2 Electric vehicle growth

Electric vehicle growth goes hand in hand with electricity decarbonisation. Smart charging and vehicle-to-grid can actively support the decarbonisation of electricity.

Electricity demand is expected to grow significantly by 2050.

36m
Potential number of electric vehicles (EVs) by 2040.

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3 Action on heat

Action on heat is essential and needs to gather pace in the 2020s to meet carbon reduction targets. A mix of low carbon heating solutions and better thermal efficiency of buildings is needed.

There are different ways to decarbonise heating.

Up to **60%** of homes could be using heat pumps by 2050.

Or hydrogen could heat **one third** of homes by 2050.

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4 A role for gas

Gas will play a role in providing reliable, flexible energy supplies for the foreseeable future. New technologies and sources of low carbon gas can decarbonise the whole energy sector.

Gas continues to provide **more energy than electricity** by 2050 in three of our four scenarios.

Gas usage patterns are changing, **providing flexibility** for heat and generation.

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1 A new energy world

2 Electric vehicle growth

3 Action on heat

4 A role for gas

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Marcus Stewart

Head of Energy Insights, System Operator, National Grid

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FES 2018 Overview

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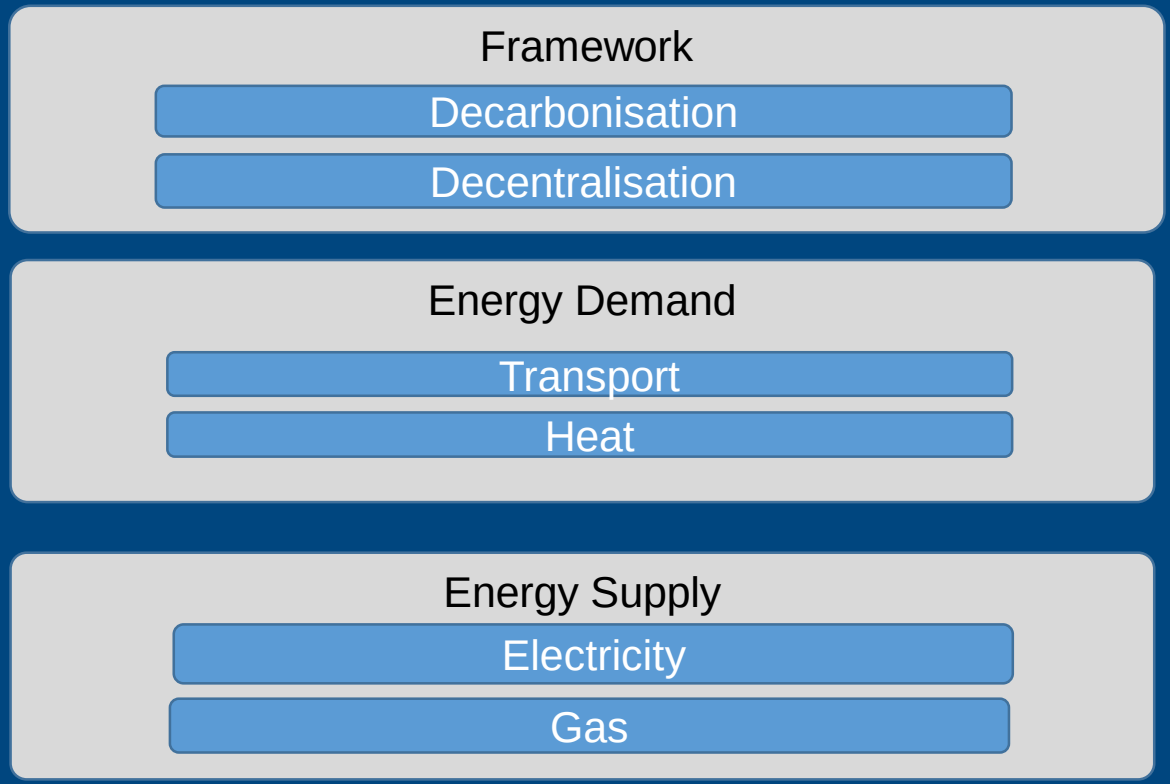

FES 2017 to FES 2018

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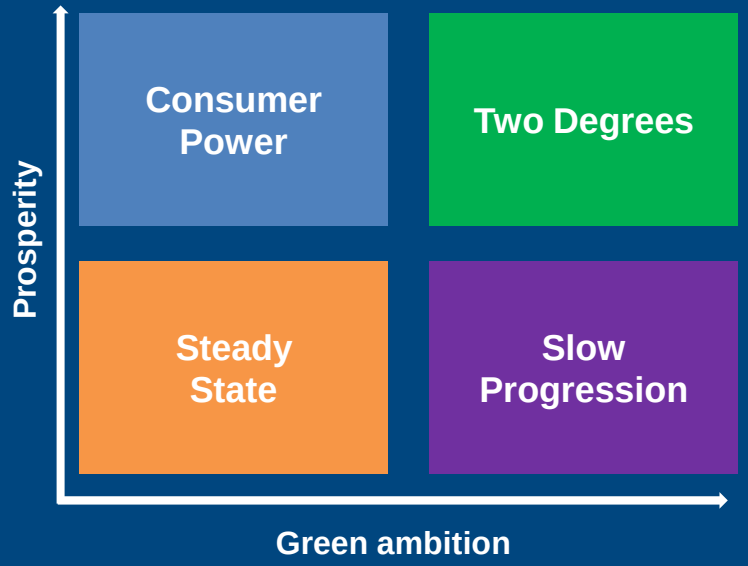
FES 2017



FES 2018

Decentralisation

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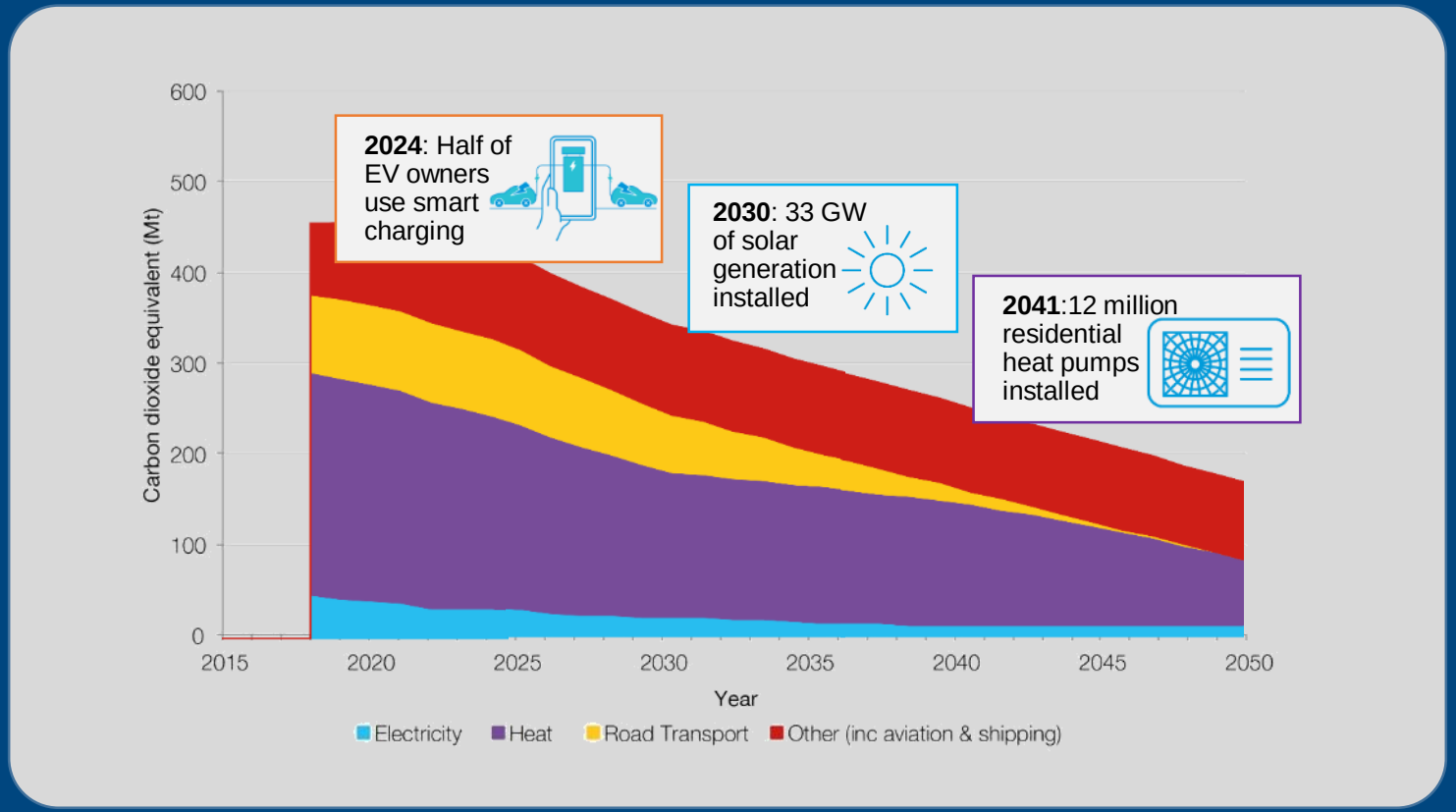
Decentralised

Centralised

Decarbonisation in Community Renewables



Decarbonisation in Two Degrees

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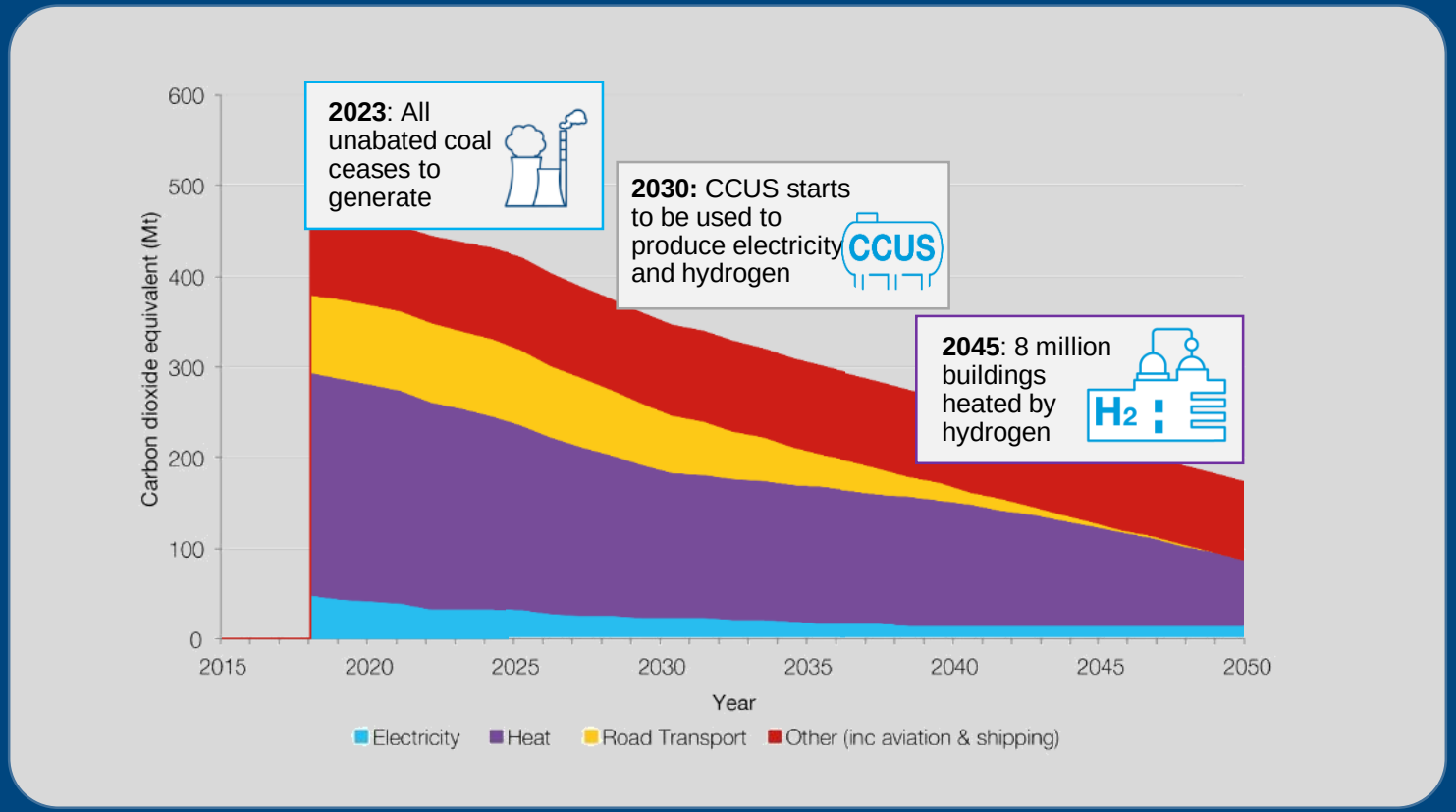
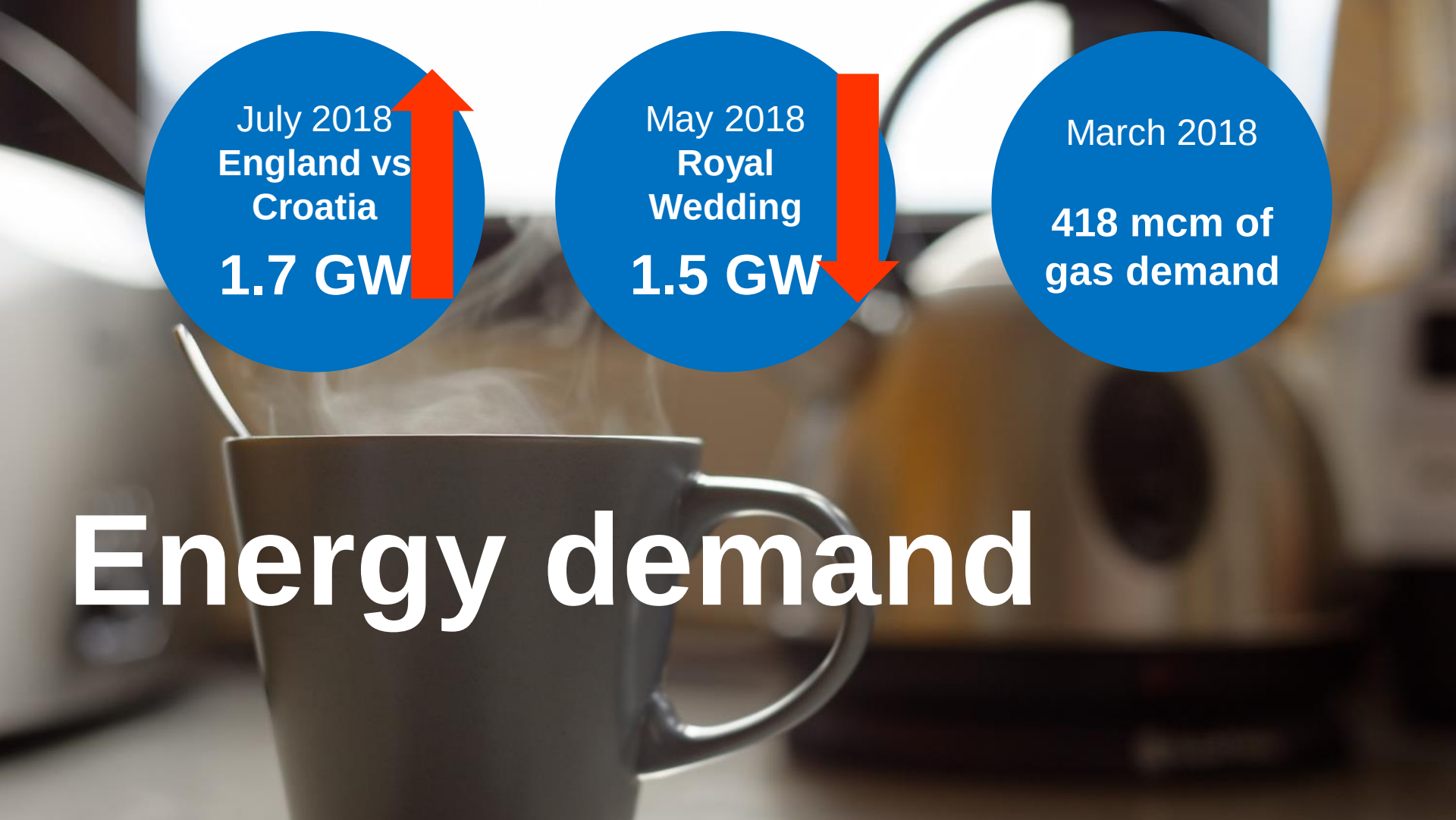



July 2018
England vs Croatia
1.7 GW
May 2018
Royal Wedding
1.5 GW
March 2018
418 mcm of gas demand
Energy demand

Gas & electricity demand: key takeaways

Cars largely electrified by 2050

TCOE Tipping Point (year)

CE **2023**	CR **2020**
SP **2023**	TD **2020**

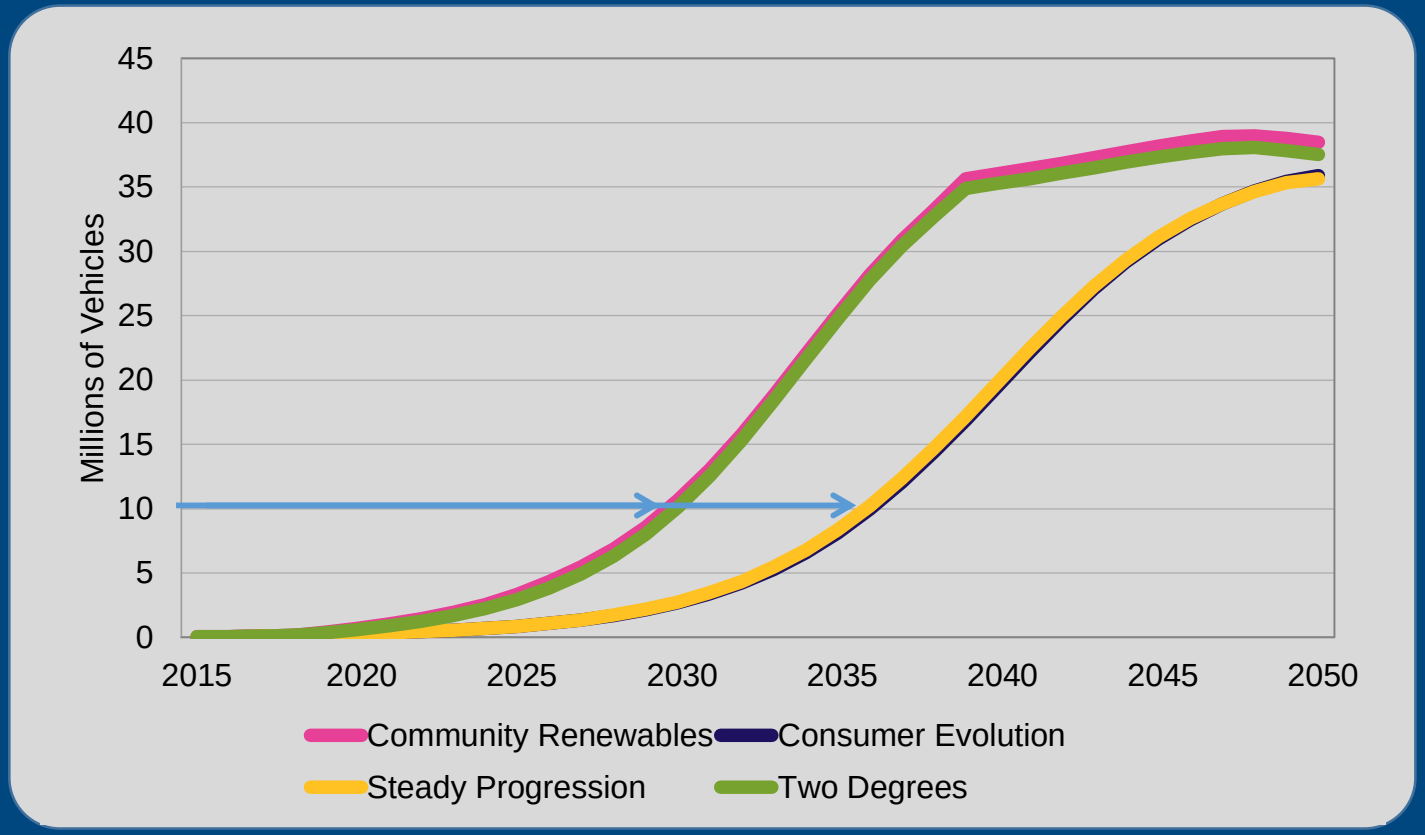
Natural Gas for residential heating must reduce to meet carbon target

2017 = 320 TWh
2050

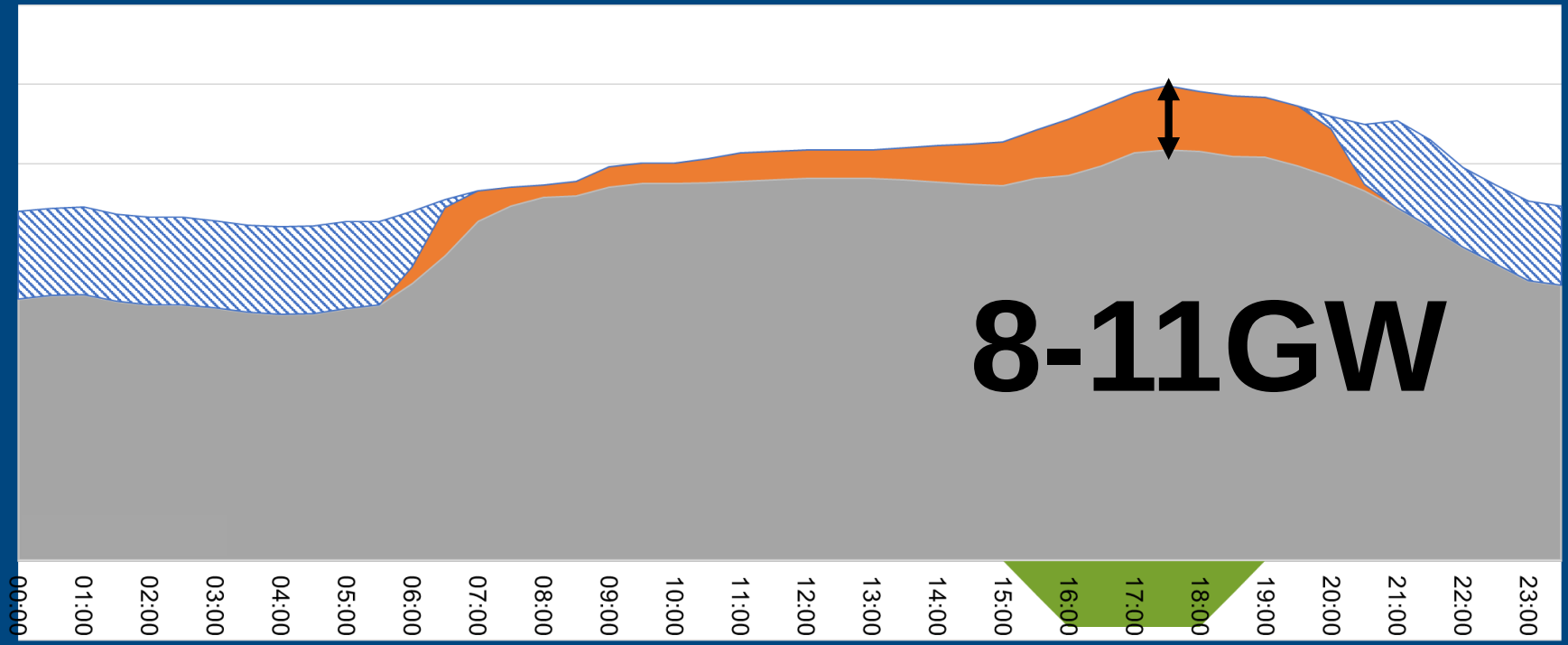
CE **239 TWh**	CR **77 TWh**
SP **256 TWh**	TD **68 TWh**

Transport

EV take-up – all transport



Smart charging - 2040 winter's day




Meals on wheels …

Heat

Gas boilers 80%

Oil or wood 12%

Electric heaters 8%

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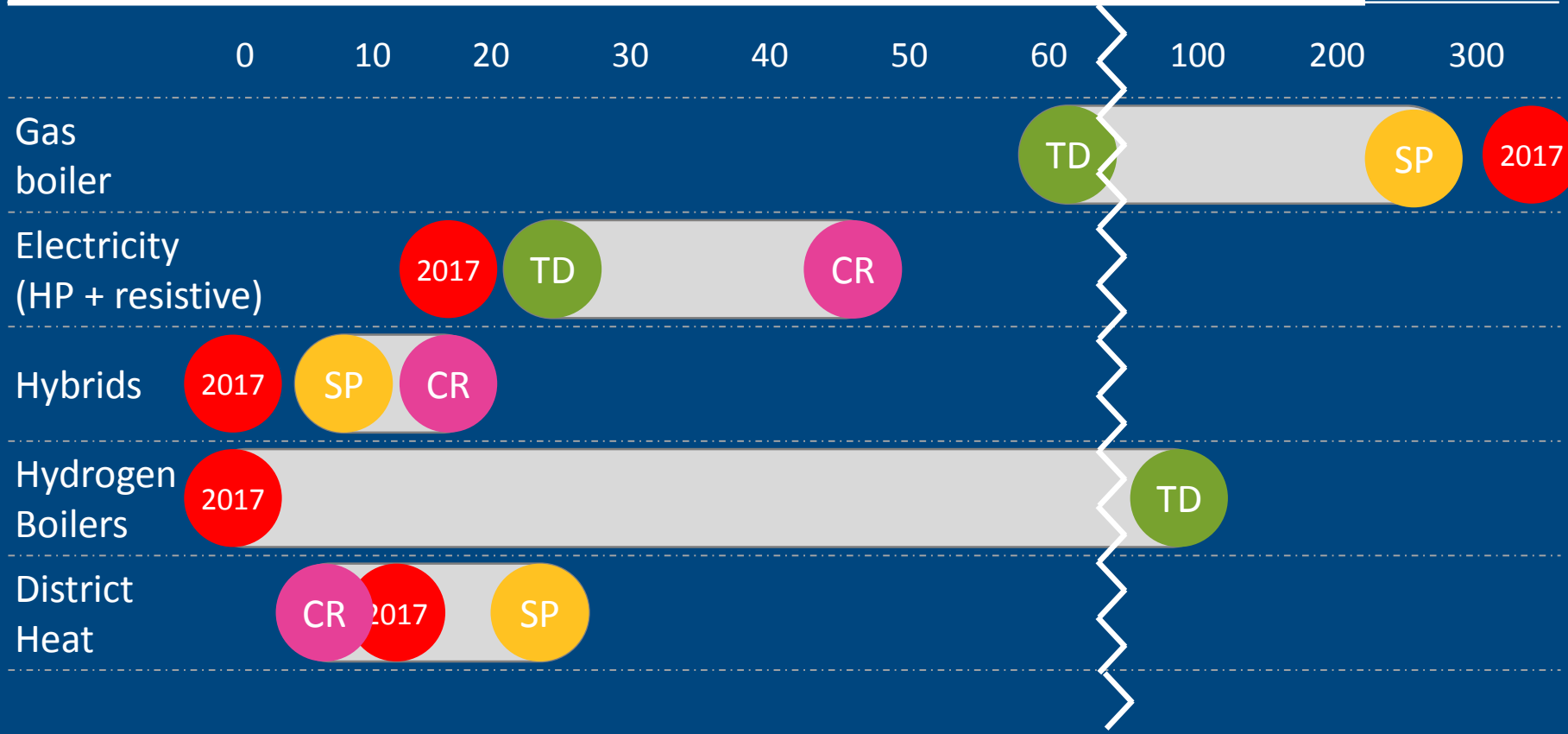
Residential heat: TWh provided in 2050



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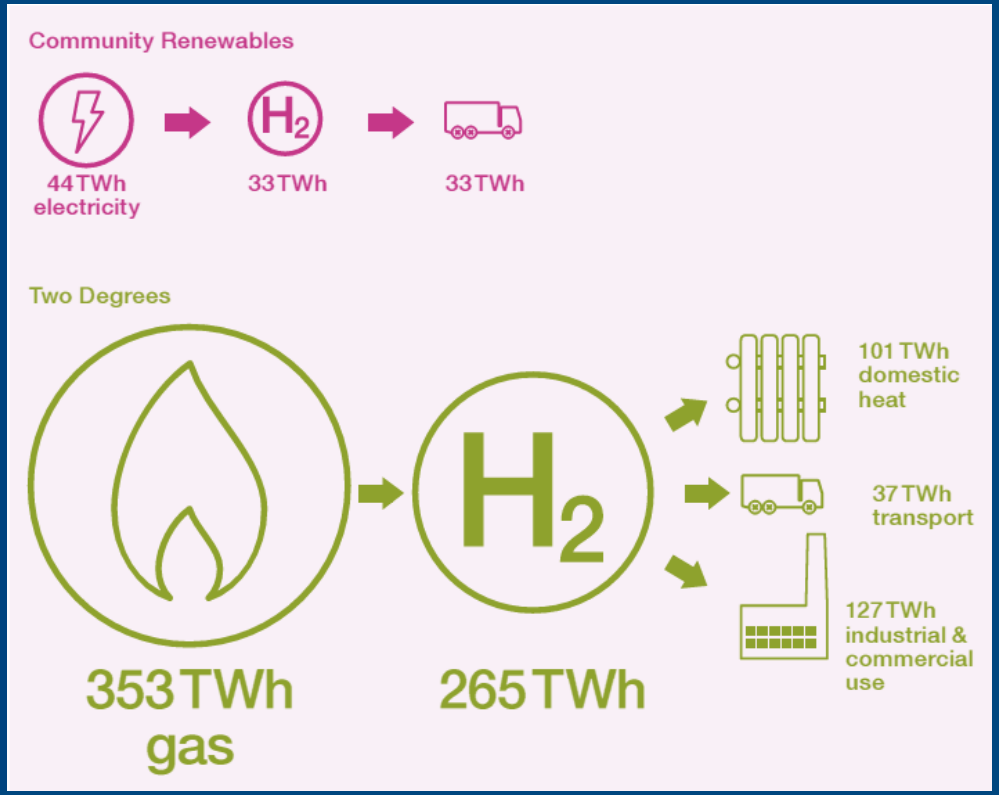
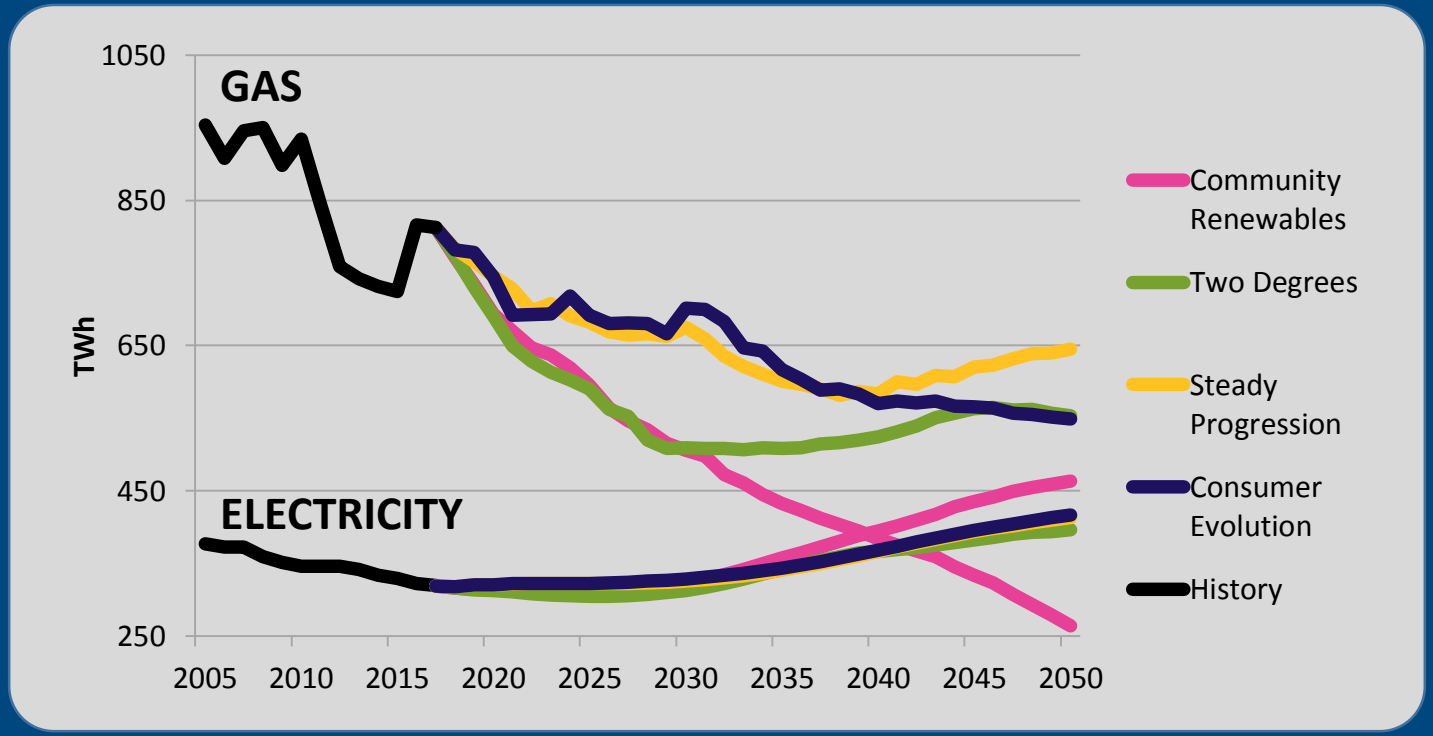
Energy demand for hydrogen in 2050



Gas & Electricity Annual Demand (TWh)



Electricity supply

266gCO_2/kWh

Carbonintensity.org.uk

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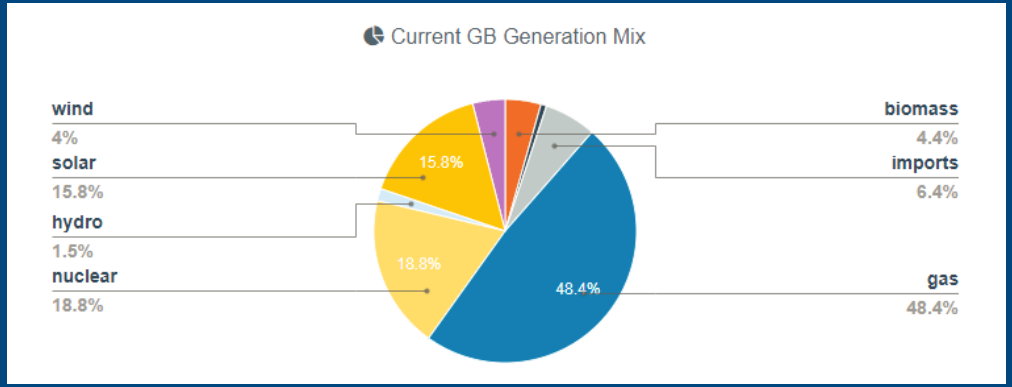
#	Region	Forecast Carbon Intensity (gCO_2/kWh)	Index
1	North East England	5	very low
2	South Scotland	69	very low
3	North West England	89	low
4	South West England	148	low
5	East England	148	low
6	South East England	154	low
7	London	206	moderate
8	West Midlands	237	moderate
9	Yorkshire	274	moderate
10	South England	288	high
11	North Scotland	318	high
12	East Midlands	356	high
13	South Wales	368	high
14	North Wales and Merseyside	376	high



Electricity supply: installed capacities in 2030

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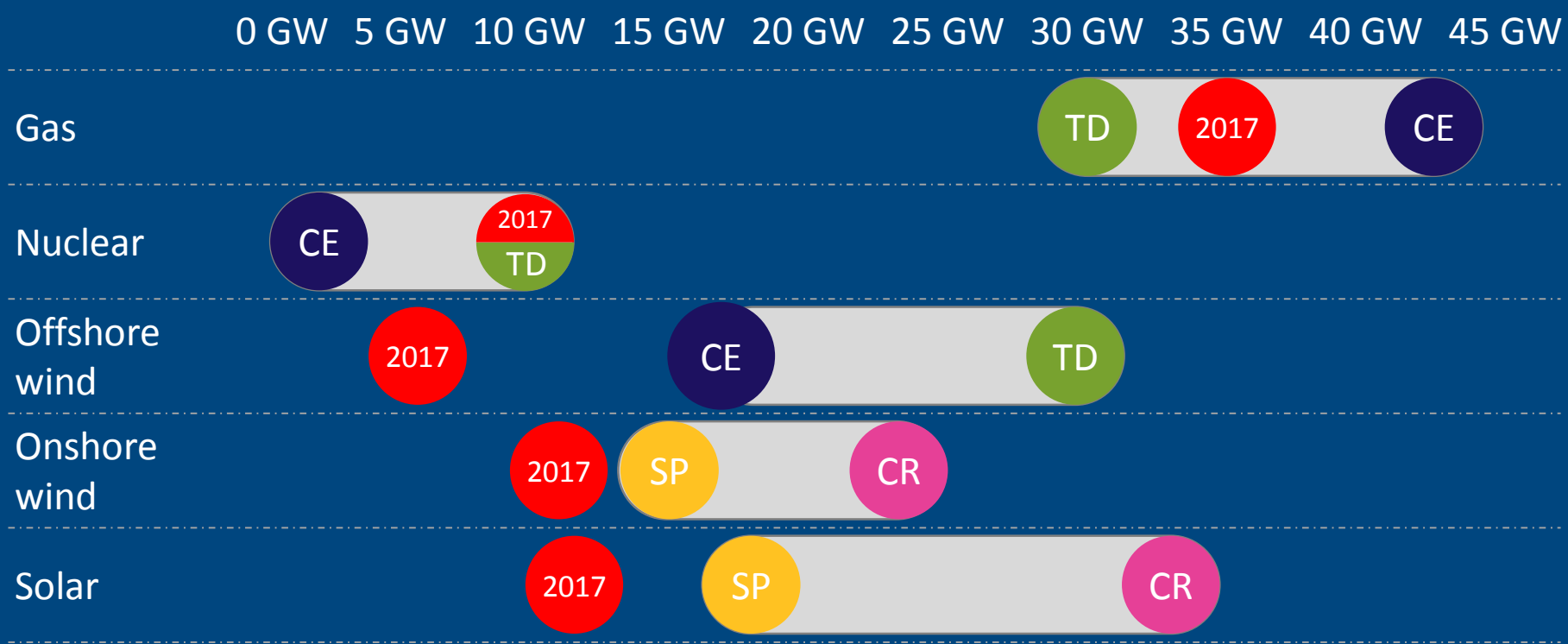

Electricity supply: flows drive need for network flexibility

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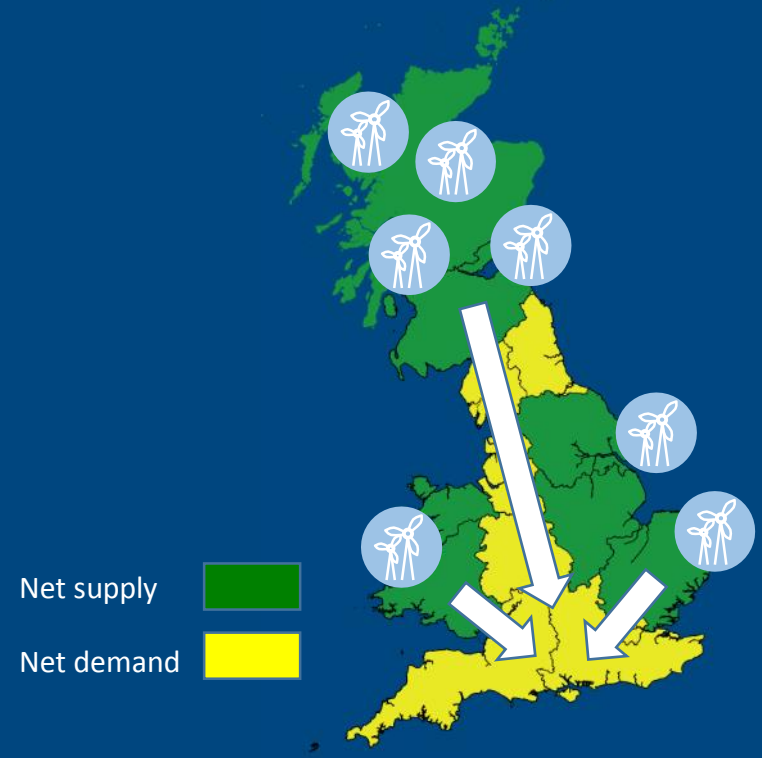
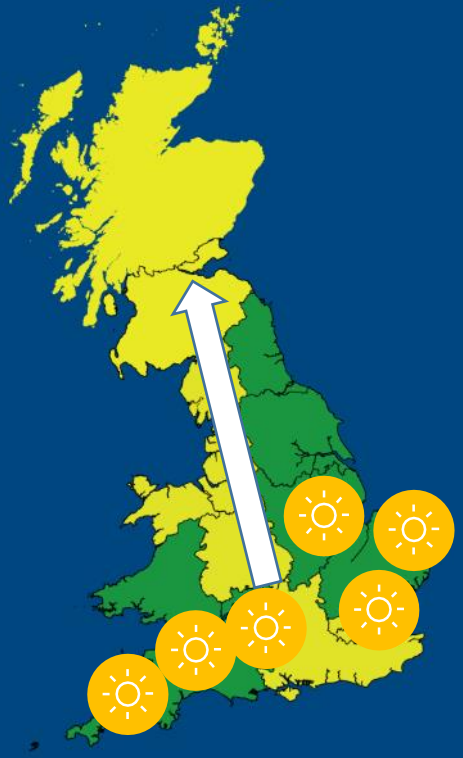
Winter 2030 in Community Renewables



Summer 2030 in Community Renewables



Electricity supply: growth of flexibility in 2030

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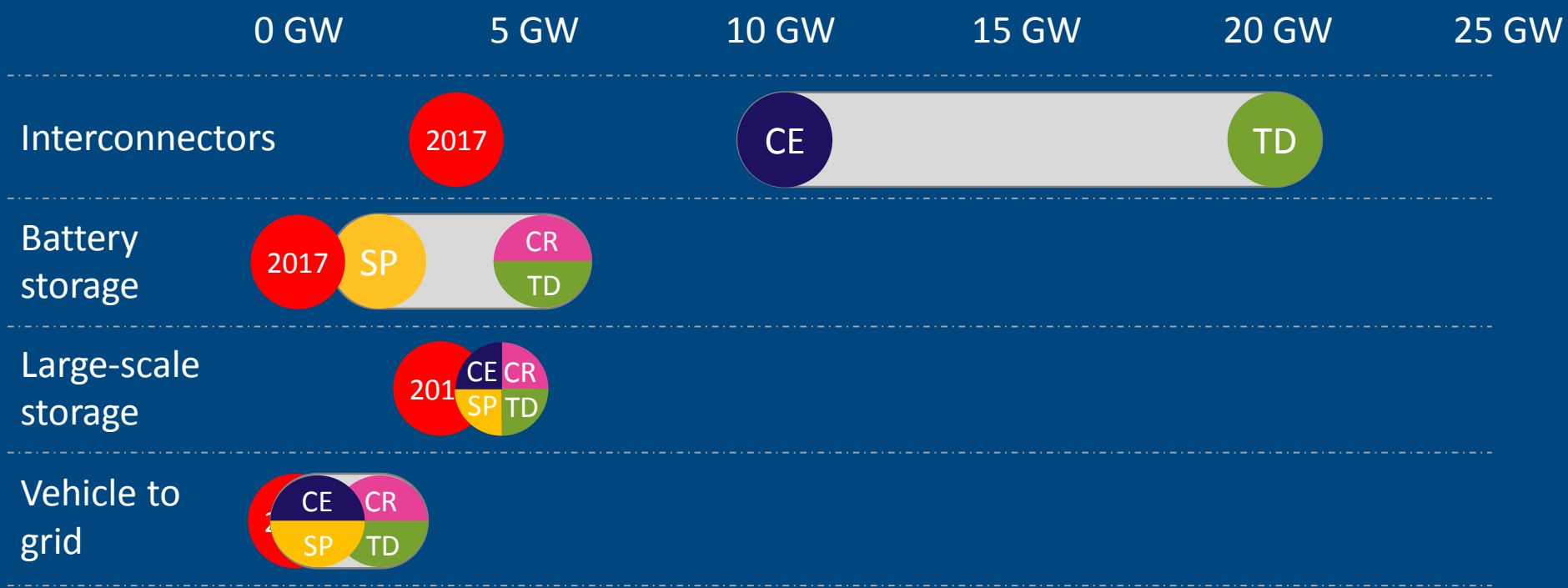

Electricity supply: growth of flexibility in 2050

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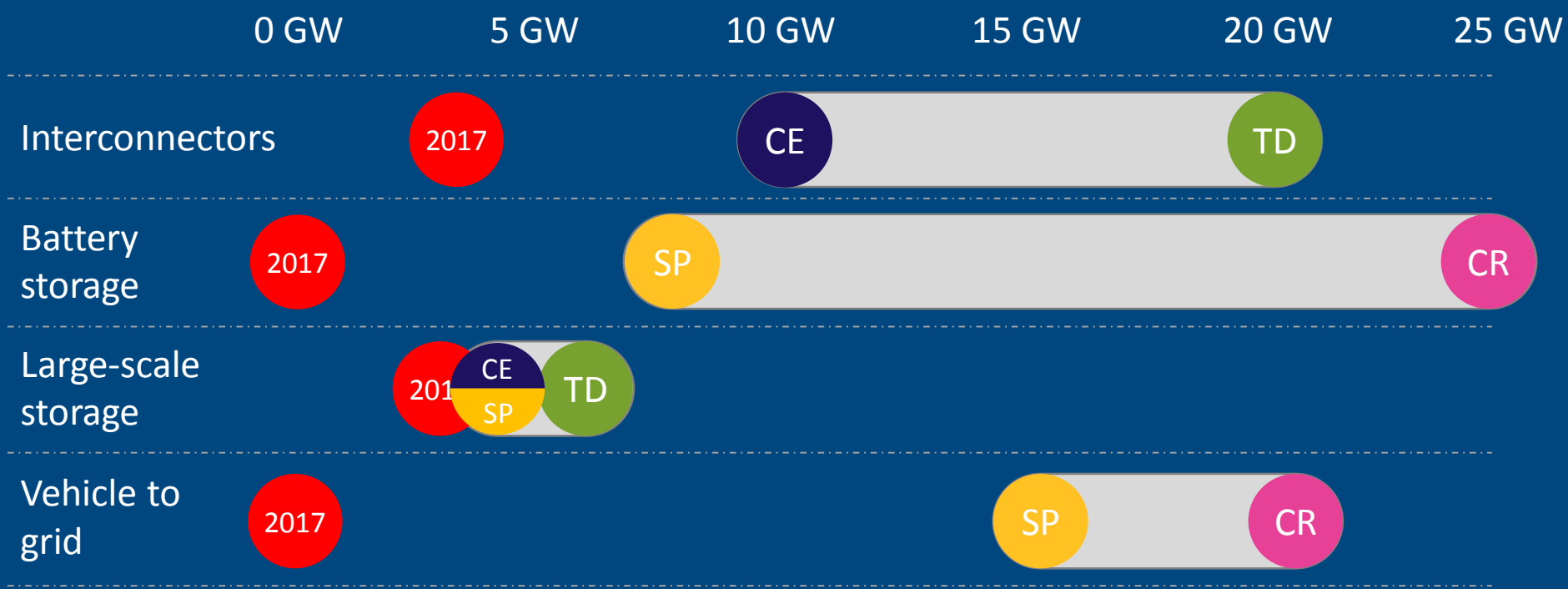

39mcm within day linepack change 2017/18

Shale: Preston New Road fracking

Norway record supply 36bcm

Gas supply

Gas supply: common themes in 2050

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UKCS depletion	Decarbonised gas	Decentralised supply
38 bcm	<1%	<1 %
0 bcm	6%	15%
0 bcm	39%	14%
1 bcm	0 %	7%
0 bcm	11%	3%

Gas supply: energy volumes provided in 2050

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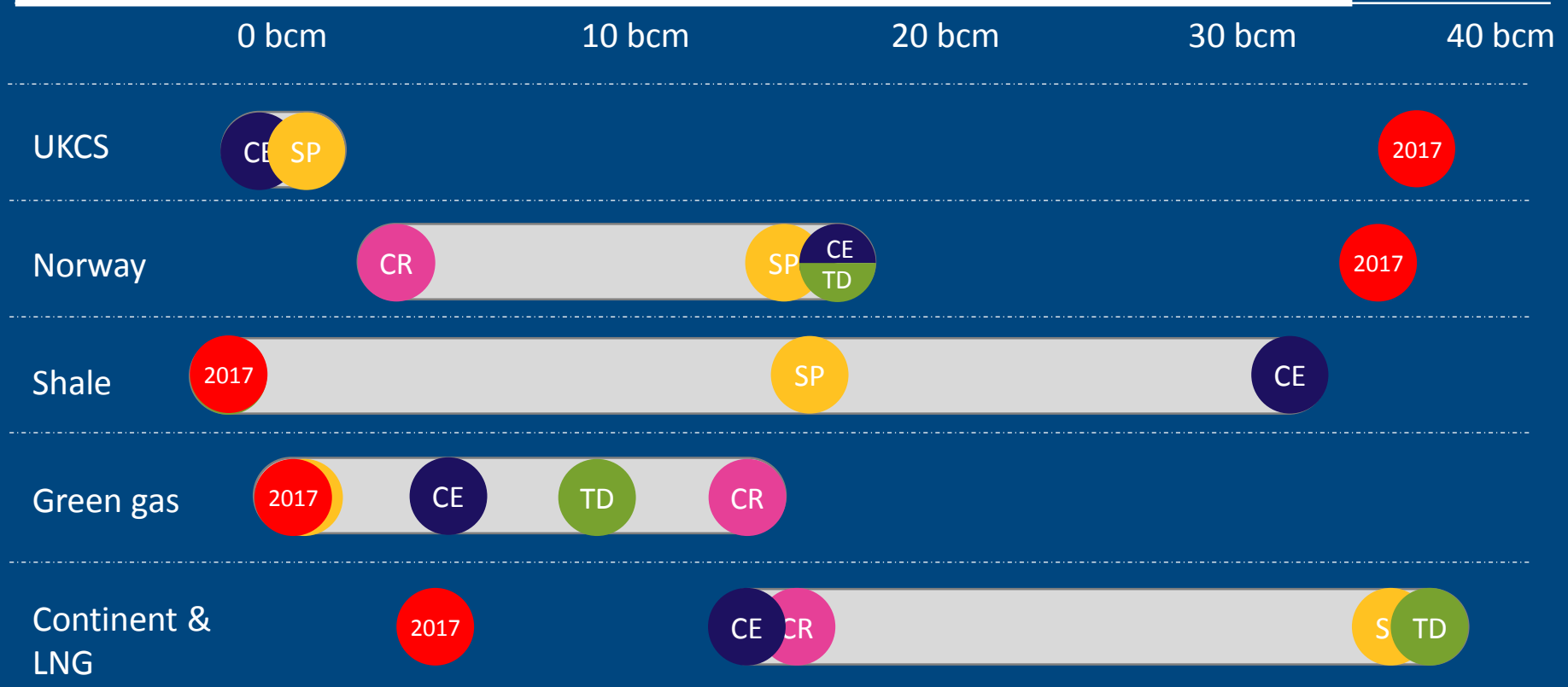

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Gas supply: flows drive need for flexibility

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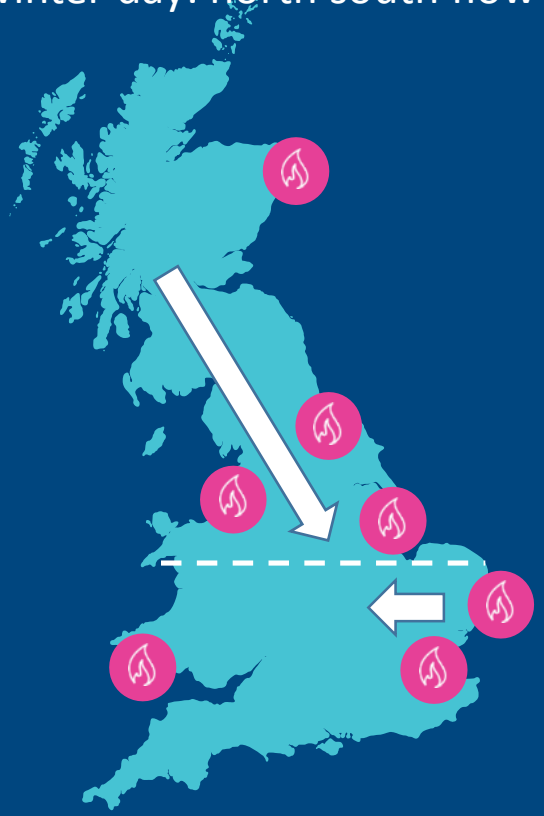
Typical winter day: north south flow



Typical winter day: balanced flow

FES is just the beginning…

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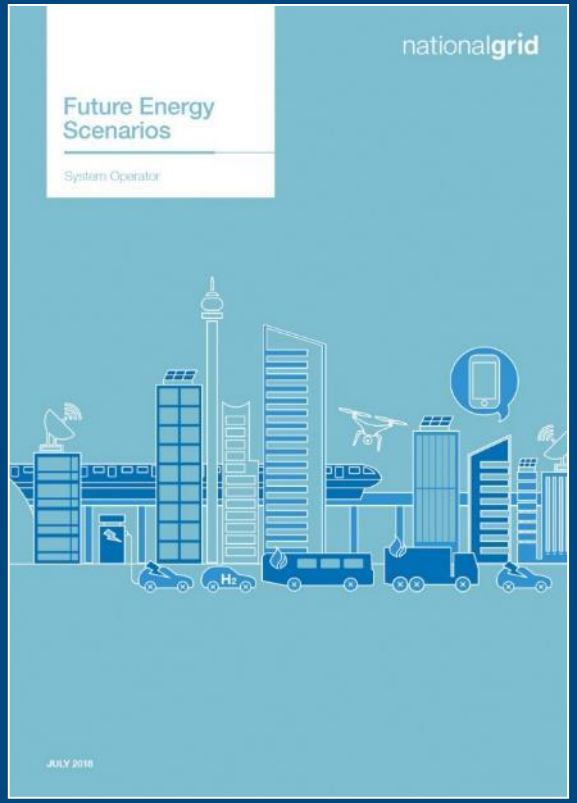

Network Options Assessment

Winter Review and Consultation

Gas Ten Year Statement

Summer Outlook Report

Winter Outlook Report

Gas Future Operability Planning

System Needs and Product Strategy

Electricity Ten Year Statement

System Operability Framework

Future Energy Scenarios 2018

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Thank you

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Electric Dreams

Baroness Bryony Worthington
Executive Director, Environmental Defense Fund Europe

World Energy Scenarios
Implications for UK energy strategy

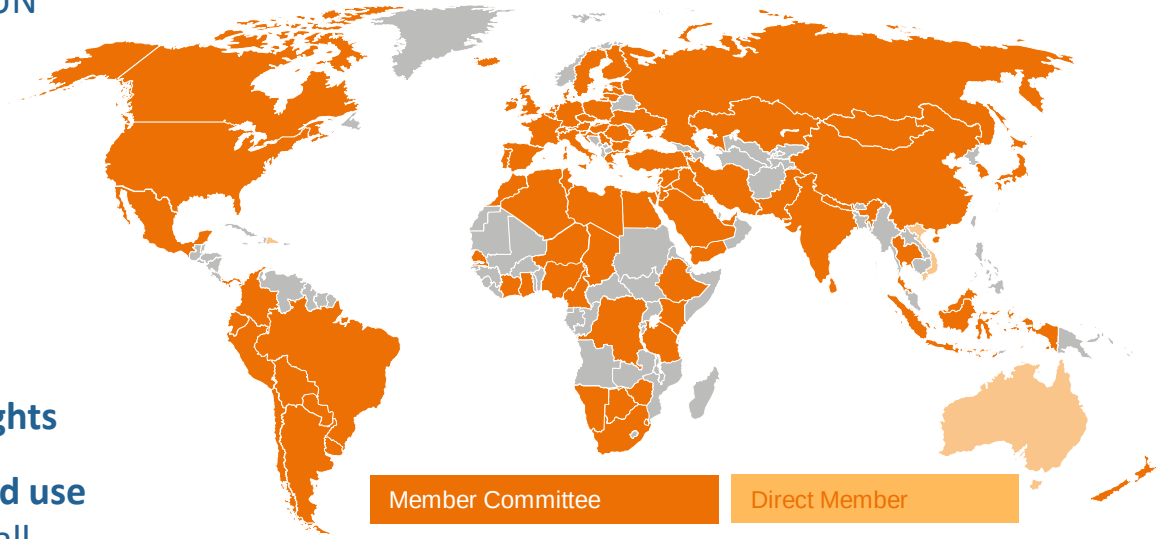
National Grid

Future Energy Scenarios Launch

Ged Davis | 12 July 2018 | London

About the World Energy Council

- A truly **global** energy organisation – UN accredited, established in 1923
- Engaging energy leaders and shapers across **the whole energy system and beyond**
- **Technology-and resource-neutral**
- At the heart of energy transition – **interactive tools and actionable insights**
- Promoting the **sustainable supply and use of energy** for the greatest benefit of all people



Pre-determined elements of the Grand Transition 2015-2060

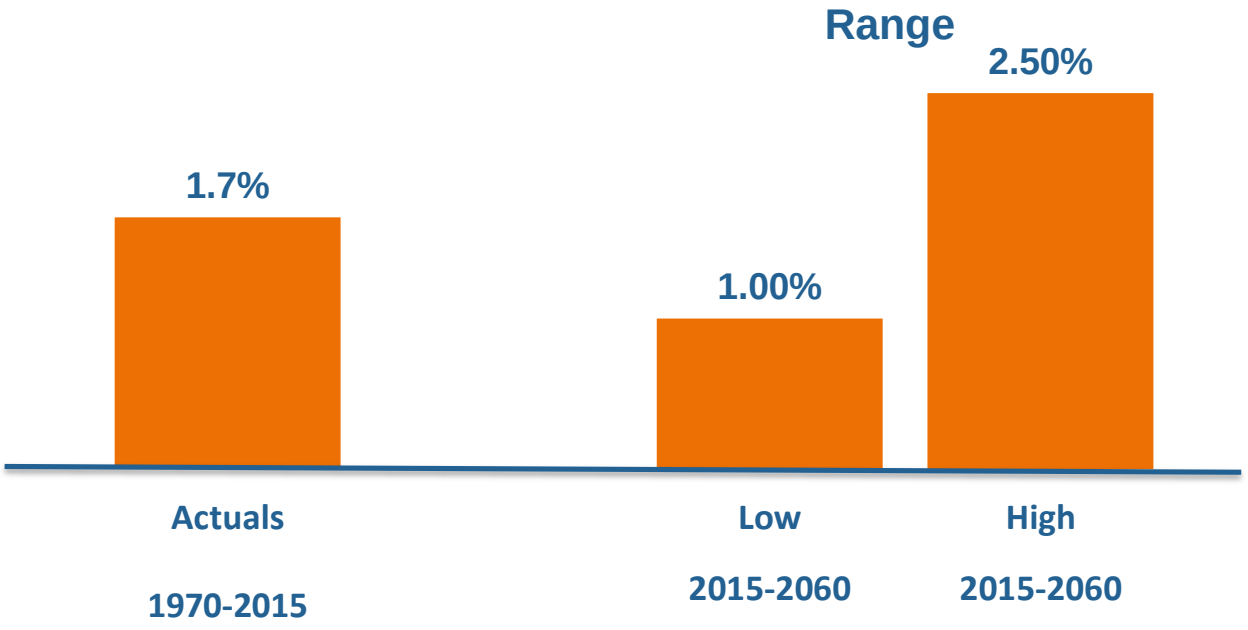
Population / Workforce	▪ Global population will grow 1.4x (0.7% p.a.)
New Technologies	▪ AI, robotics, 3D printing, predictive analytics, GPS, sensors/actuators, machine learning, IoT, fin-tech, including blockchain; nanotech, quantum computing and bio-tech ▪ Pervasive digitalisation; combinatorial impacts of new technologies ▪ Productivity paradox
Planetary Boundaries	▪ Multiple challenges not just climate change but biodiversity, deforestation, plastics, air pollution, water stress ▪ 1,000 Gt CO_2 carbon budget to 2100 for the 2°C target
Shifts in Power	▪ From OECD to non-OECD, especially Asia ▪ 2030: India is most populous country ▪ 2035-45: China is the world's largest economy

Grand Transition—Critical Uncertainties

- **Pace of innovation and productivity**
- Development of international governance and geo-political change
- Priority given to sustainability and climate change
- Selected ‘tools for action’—the balance between the use of markets and state directed policy

Productivity Prospects

Global Productivity Growth % p.a.



Source: Total Economy Database and World Energy Council

Grand Transition—Critical Uncertainties

- Pace of innovation and productivity
- **Development of international governance and geo-political change**
- **Priority given to sustainability and climate change**
- **Selected 'tools for action'—the balance between the use of markets and state directed policy**

Selected “Tools for Action”—States and Markets

States (governments)	Markets (businesses)
Taxes and subsidies	Competition (efficiency)
Public research, development, demonstration and deployment	Private research, development, demonstration and deployment
Regulation	Innovation
Education	Training
National and sector planning	Corporate vision and planning
Public investment	Private investment
State companies (monopoly)	Private corporations
Public-private enterprises	

Which set of tools will be dominant?

It doesn't matter whether the cat is black or white, as long as it catches mice.

Deng Xiaoping

Three Scenarios

WORLD ENERGY COUNCIL

Modern Jazz

Market-driven approach to achieving individual access and affordability of energy through economic growth

- Market mechanisms
- Technology innovation
- Energy access for all

Unfinished Symphony

Government-driven approach to achieving sustainability through internationally coordinated politics and practices

- Strong policy
- Long-term planning
- Unified climate action

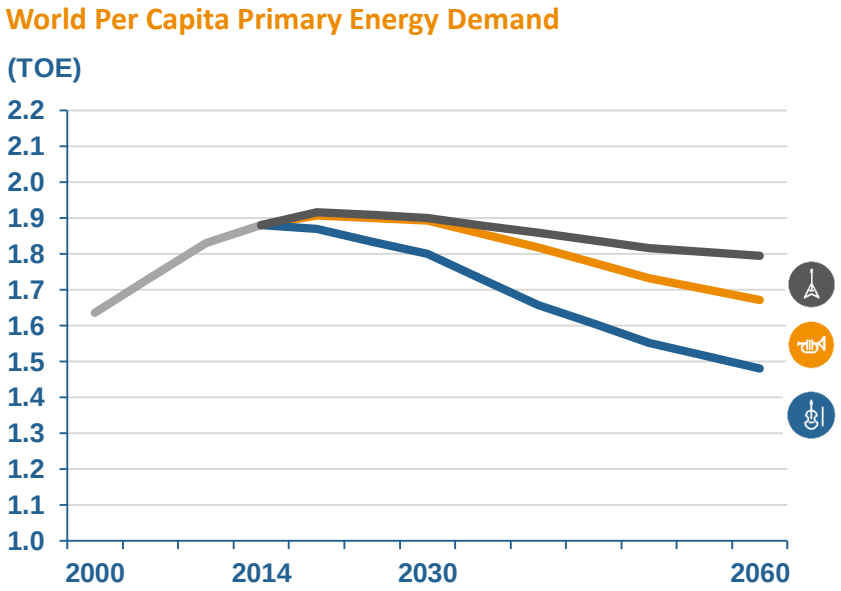
Hard Rock

Fragmented approach driven by desire for energy security in a world with low global cooperation

- Fragmented policies
- Local content
- Best-fit local solutions

The World's primary energy demand growth…

… will slow and per capita energy demand will peak before 2030 due to unprecedented efficiencies created by new technologies and more stringent energy policies.

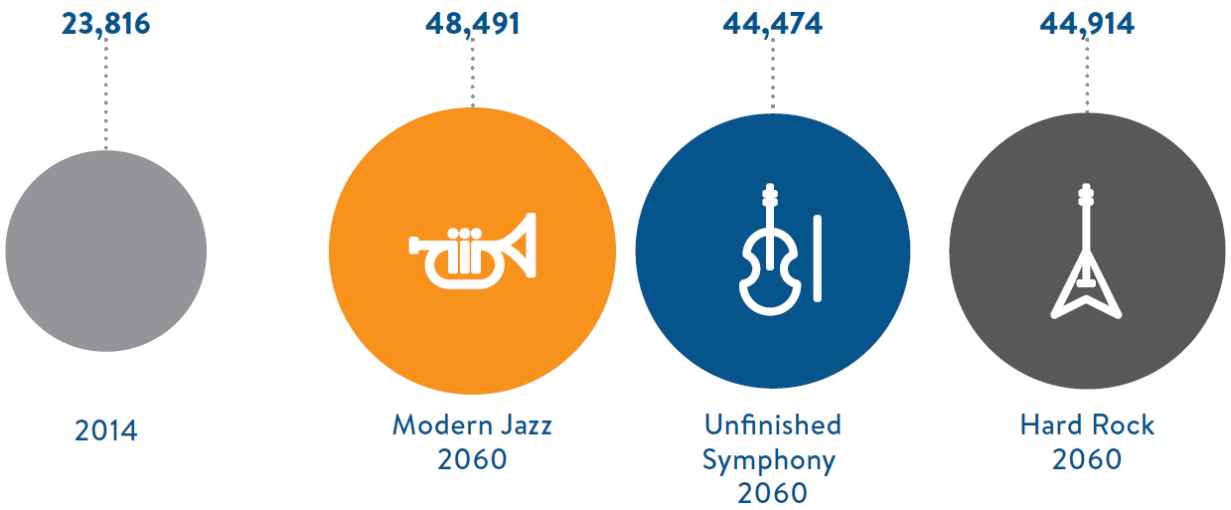


Source: World Energy Council, Paul Scherrer Institute and Accenture Strategy

The World's demand for electricity…

… will double to 2060. Meeting this demand with cleaner energy sources will require substantial infrastructure investments and systems integration to deliver benefits to all consumers.

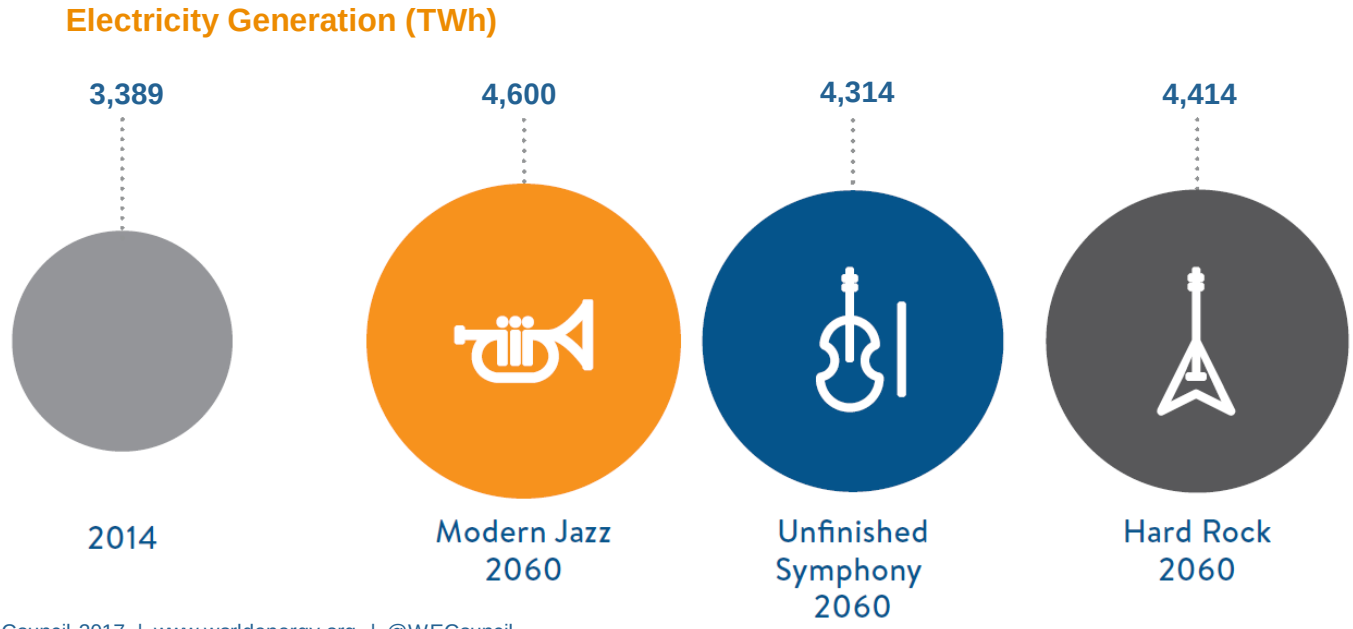
Electricity Generation in the World (TWh)



Source: World Energy Council, Paul Scherrer Institute and Accenture Strategy

Demand for electricity in Europe…

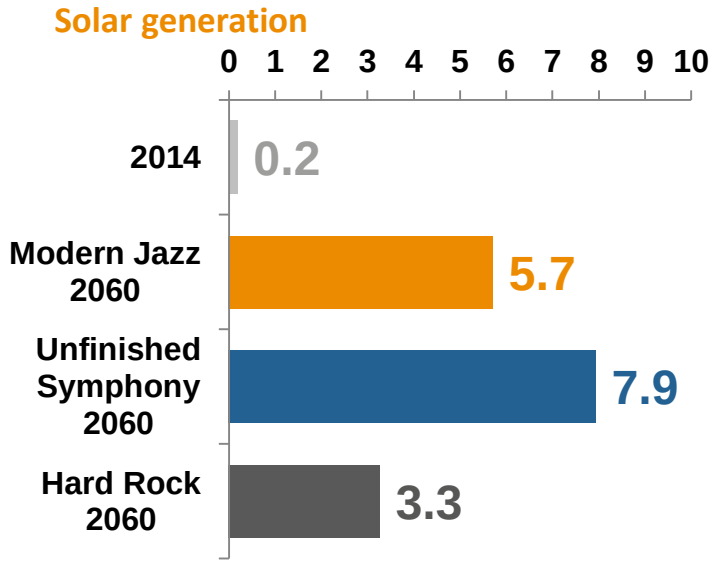
… will rise 27-36% to 2060. The significant increase of renewables with a share of nearly 46% in the electricity system will require substantial infrastructure investments and systems integration to deliver benefits to all consumers.

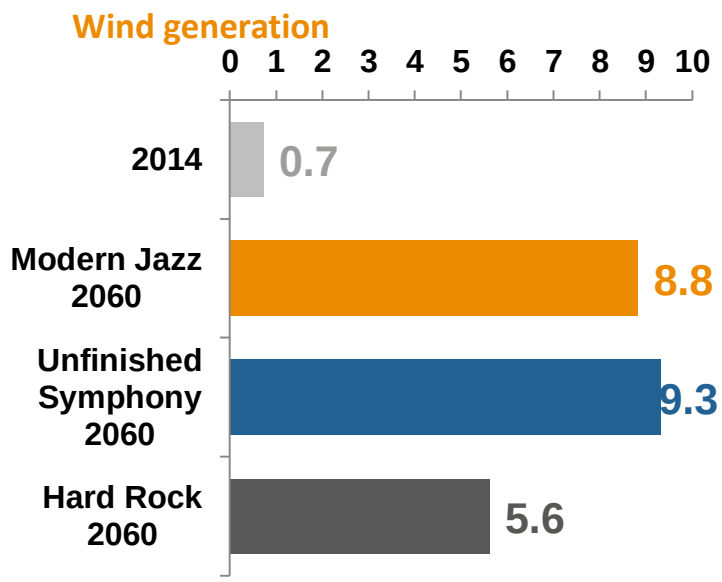


The phenomenal rise of World solar and wind energy…

…will continue at an unprecedented rate creating new opportunities and challenges for energy systems.

Electricity Generation by Source (000’ TWh)

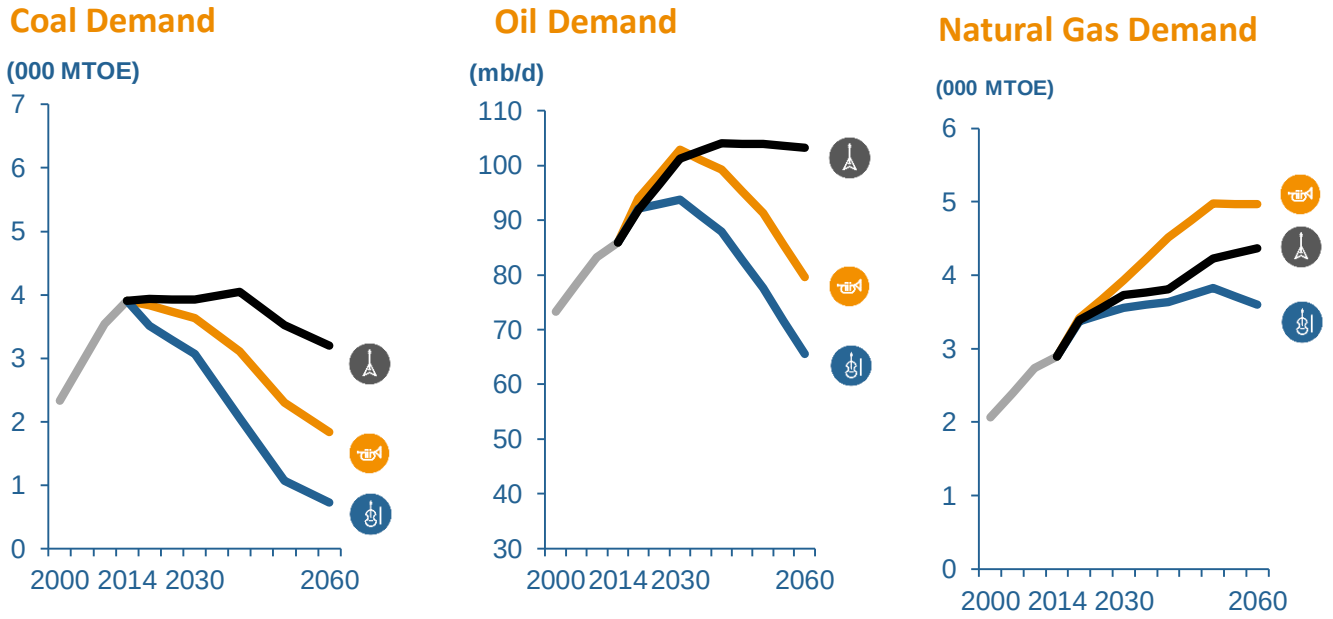




Source: World Energy Council, Paul Scherrer Institute, Accenture Strategy

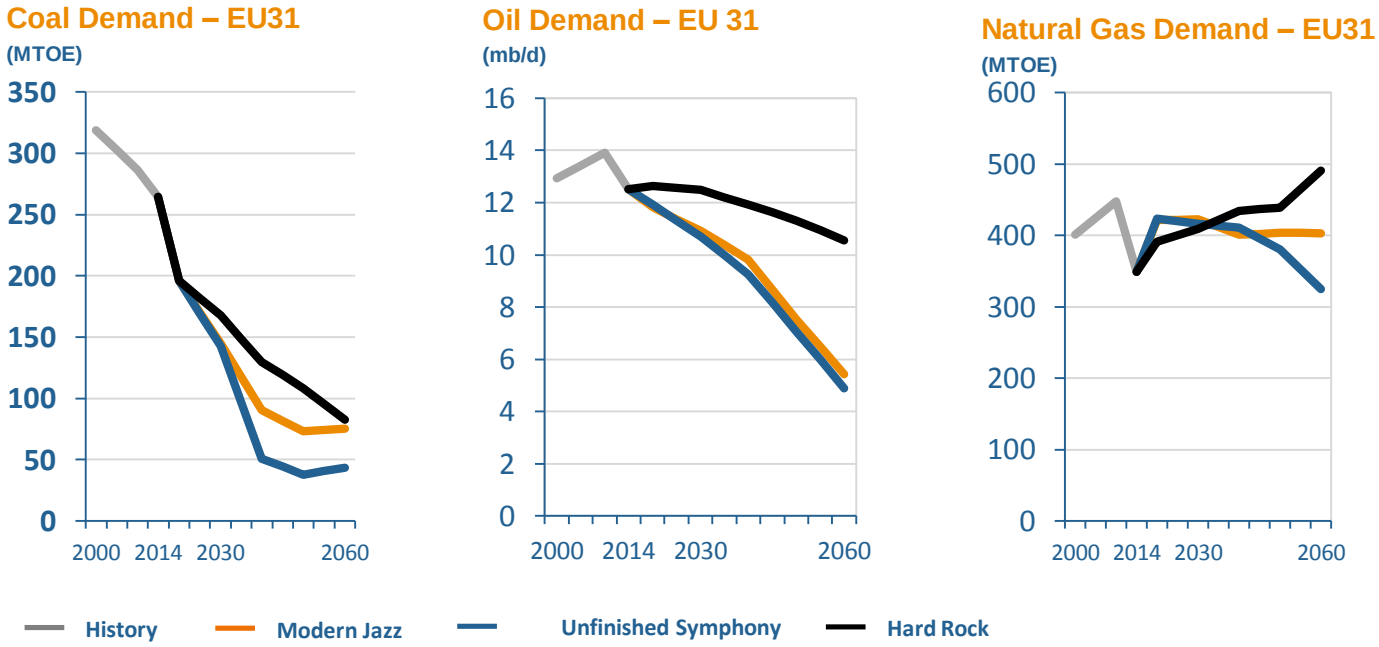
World demand peaks for coal and oil…

… having the potential to take the world from “Stranded Assets” to “Stranded Resources”



Source: World Energy Council, Paul Scherrer Institute and Accenture Strategy

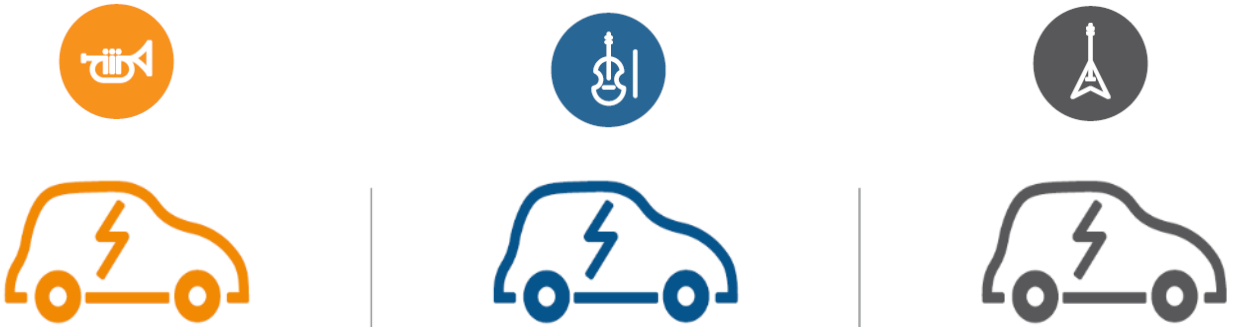
Demand has peaked for coal and oil in Europe



Transitioning global transport…

… forms one of the hardest obstacles to overcome in an effort to decarbonise future energy systems.

Electric Vehicles of Light-duty Vehicle Fleets in the World

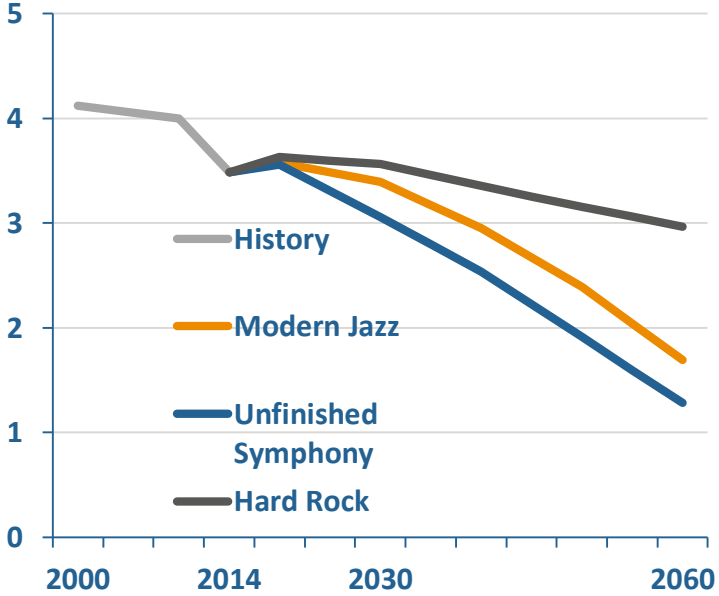


Source: World Energy Council, Paul Scherrer Institute and Accenture Strategy

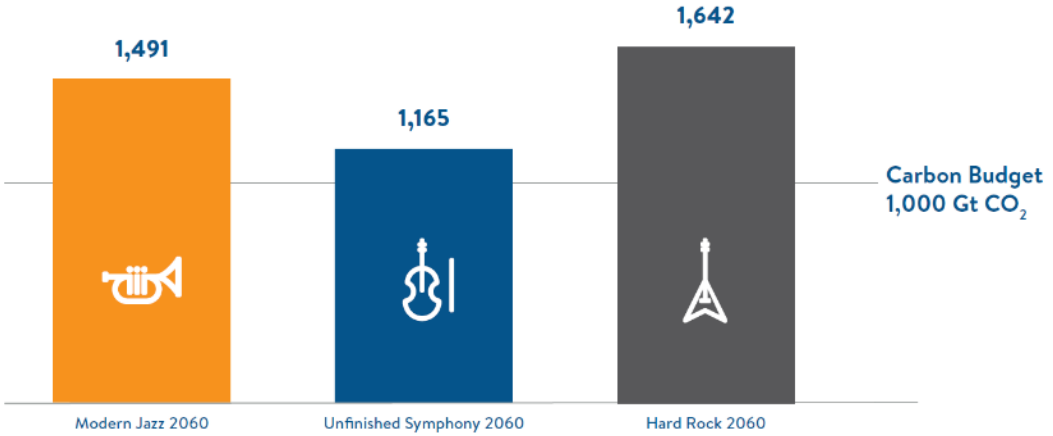
Limiting global warming…

…to no more than a 2°C increase will require an exceptional and enduring effort, far beyond already pledged commitments, and with very high carbon prices.

Annual Carbon Emissions – EU31 (Gt CO_2)



Cumulative Global Carbon Emissions 2015-2060 (Gt CO_2)



Source: World Energy Council, Paul Scherrer Institute, Accenture Strategy

Implications for UK energy strategy

Global/Regional*

- Grand Transition and outcome of critical uncertainties globally will shape UK energy options/strategy
- Global influences will matter more: e.g. sustainability and climate change, world oil markets, geopolitics, technology developments and global economy
- What happens in Europe matters to UK

*UK accounts for 1.4% of global energy consumption

Implications for UK energy strategy

UK

- Need higher energy investment levels going forward than historically
- Need to ensure a resilient energy system, capable of handling cyber threats and impact of extreme weather events on energy infrastructure
- Need to reassess strategy for energy security, and develop strategy for energy storage, EV fleet management, ‘Power to X’ and HGV transport
- Need upgraded tools; new data, simulation models and capacity for total cost analysis.

Thank you

Ged Davis
Executive Chair of Scenarios,
World Energy Council

Q&A panel

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Host: Roisin Quinn

Panel: Fintan Slye, Marcus Stewart, Baroness Worthington and Ged Davis