

APGTF Workshop: Managing the Grid of the Future



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Overview: Future Grid Operation

Grid operation today

Future grid operation: what lies ahead?


Changes

Challenges

Solutions

National Grid

One of the world's largest 100% listed utilities focused on regulated transmission and distribution activities in electricity and gas in the United Kingdom and the United States



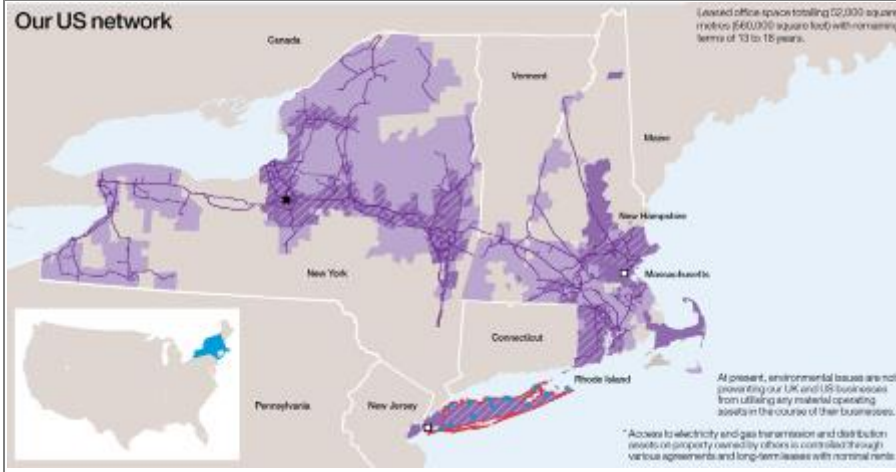
UK

65%

Based on operating profits

- GB gas & electricity system operator
- E&W electricity transmission owner
- GB gas transmission owner
- Gas distribution owner
- Interconnectors
- LNG storage
- Electricity Market Reform Delivery Body

Our US network



Canada

Vermont

Maine

New Hampshire

Massachusetts

Connecticut

Rhode Island

New Jersey

Pennsylvania

New York

Leased office space totalling 22,000 square metres (260,000 square feet) with remaining terms of 73 to 18 years.

All present, environmental issues are not preventing our UK and US businesses from utilising any material operating assets in the course of their businesses.

* Access to electricity and gas transmission and distribution assets on property owned by others is controlled through various agreements and long-term leases with nominal rents.

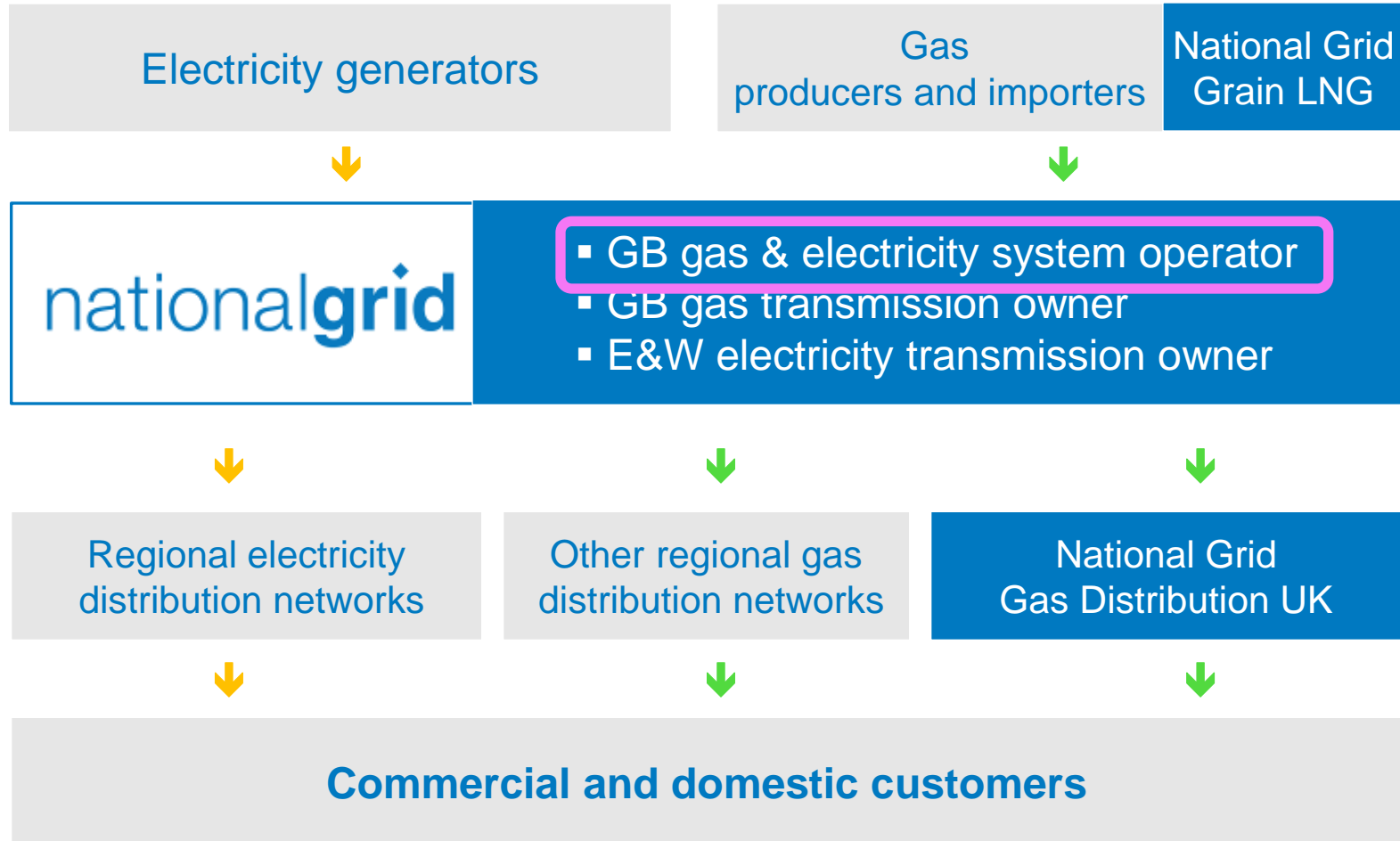
US

35%

Based on operating profits

- Electricity transmission owner
- Electricity distribution
- Gas distribution owner
- Canadian interconnector
- Gas storage
- Electricity generation

UK RIIO regulated activities



Operating the Gas & Electricity Grids

Resolving market imbalance

Managing flows across the networks

Balancing supply and demand in real-time

Reacting to unforeseen system events

**Safe, reliable and cost efficient
for energy consumers**

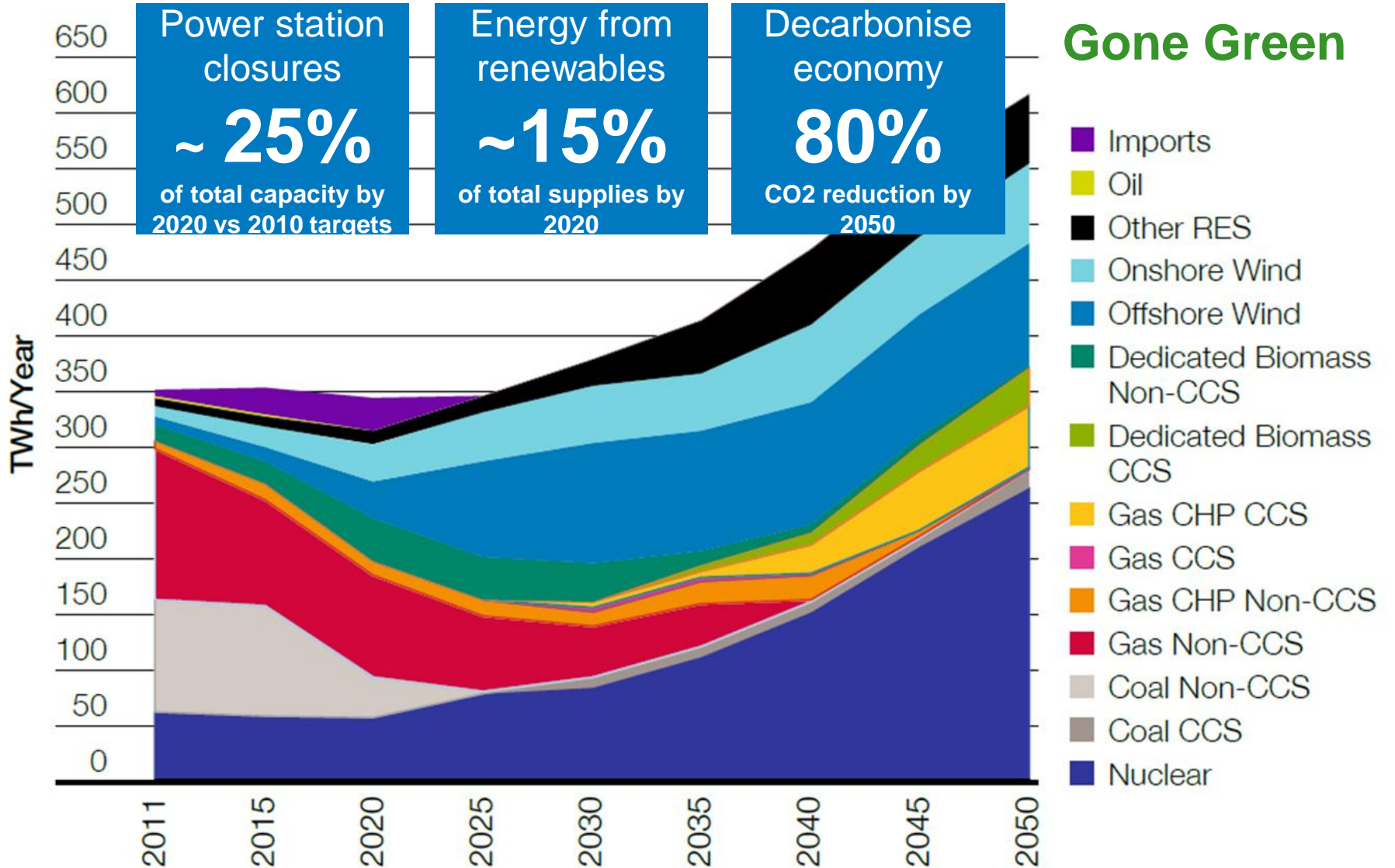
Change: Future Energy Scenarios

Power station closures
~ **25%**
of total capacity by 2020 vs 2010 targets

Energy from renewables
~ **15%**
of total supplies by 2020

Decarbonise economy
80%
CO2 reduction by 2050

Gone Green



Changes and Challenges

- **Changing supply**
 - **Challenge: remote energy sources**
 - **Challenge: variability & predictability**
 - **Challenge: maximising renewable output**
- **Changing demand patterns**
 - **Challenge: electrifying heat & transport**

Changing supply: remote energy sources

Building the network to transport energy from new locations

New Generation increasingly located on coast

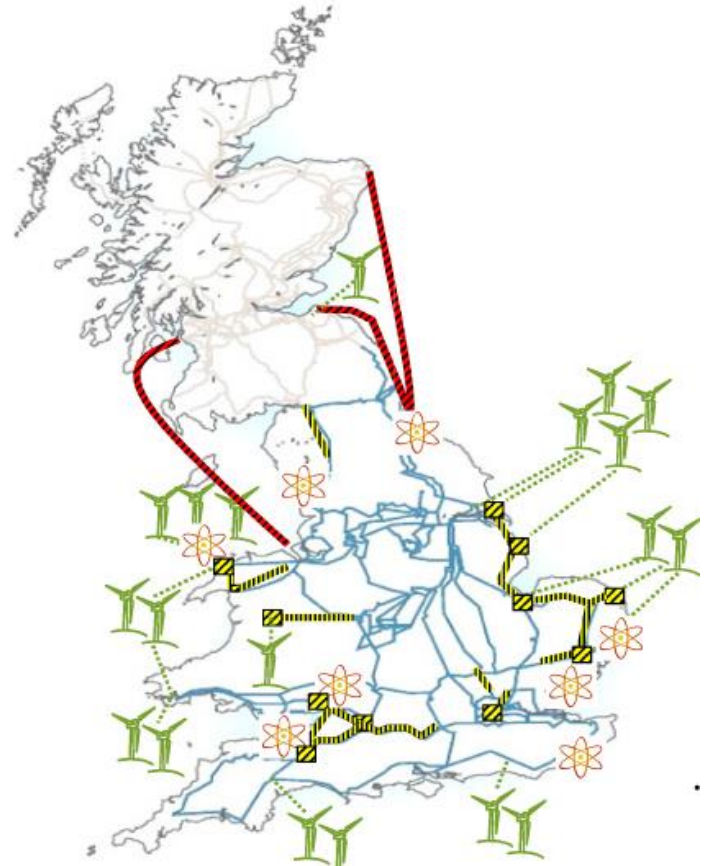
Wind power from Scotland

Wind power from the North & Irish Sea

Wind power from Wales

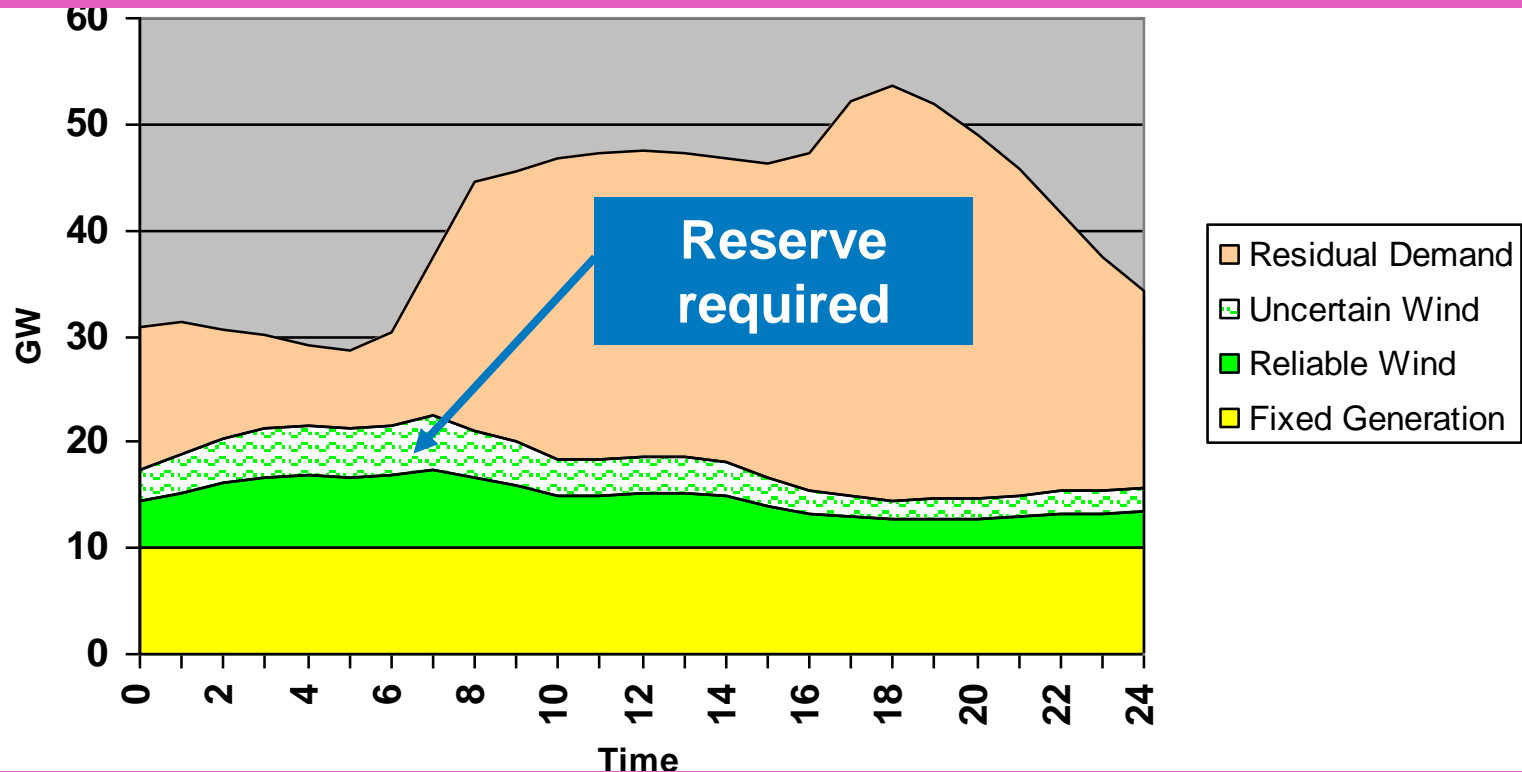
Nuclear power

Access to Cooling Water



Changing supply: variability & unpredictability

Where do we get the reserve to cover the uncertainty?



Implications wind/solar using asynchronous generators

Voltage control

System Inertia

Fault levels

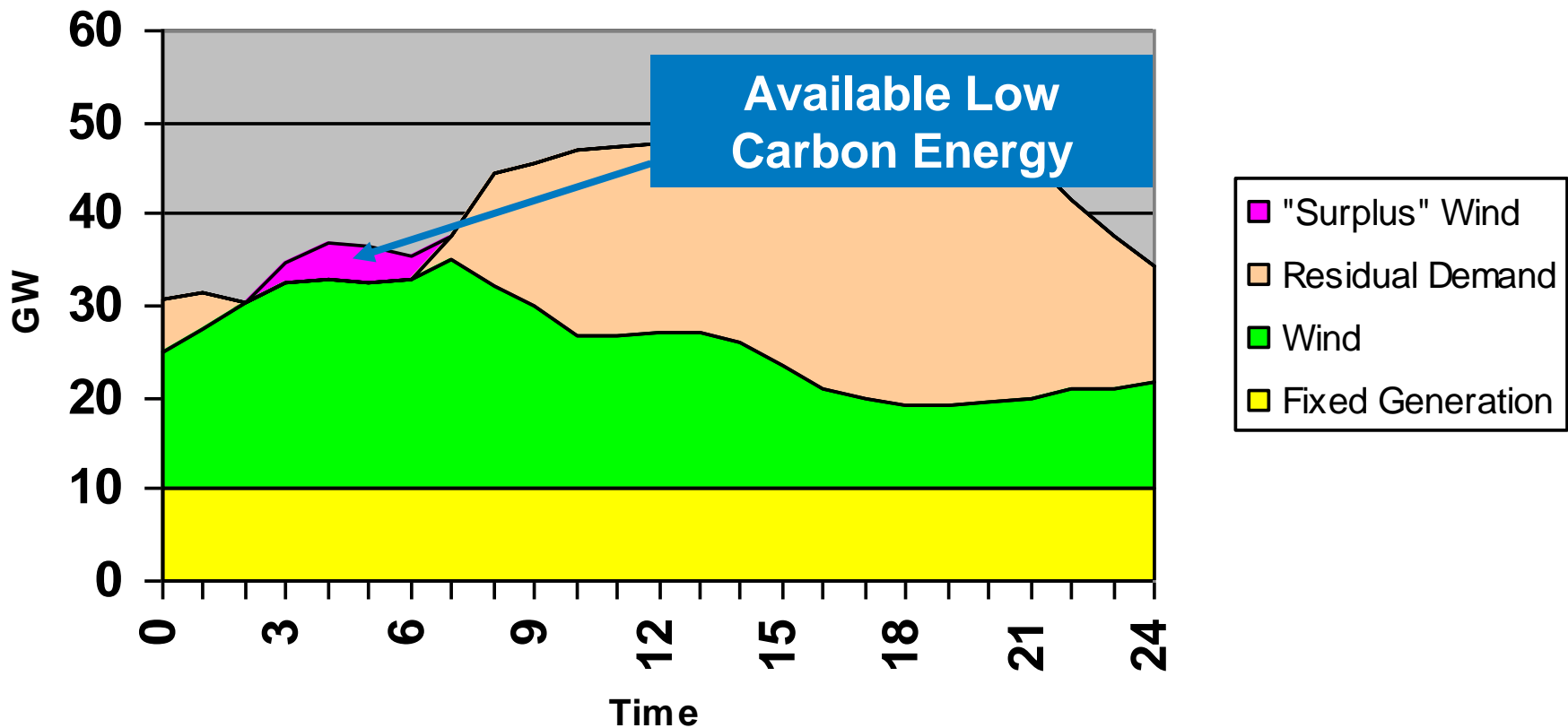
Frequency

Managing variability & unpredictability

- More accurate weather forecast
- Shorter notice to generate
- Lower minimum stable generation
- Faster ramp rates
- Flexing Inter-Connectors
- Storage
- Demand side response
 - Synchronous generation also provides: inertia, voltage control, frequency response and fault infeed

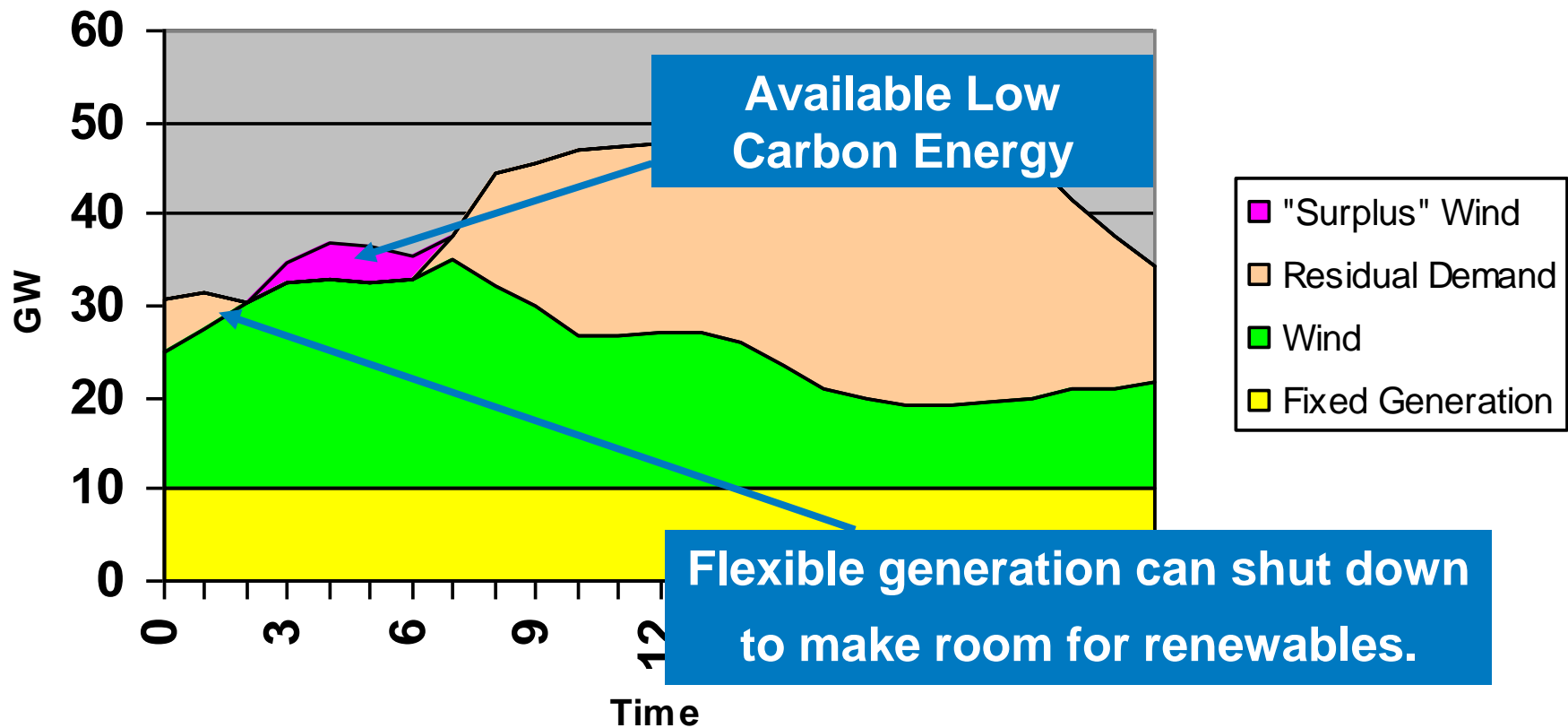
Changing supply: maximising renewable output

Need active demand to "harvest" available energy



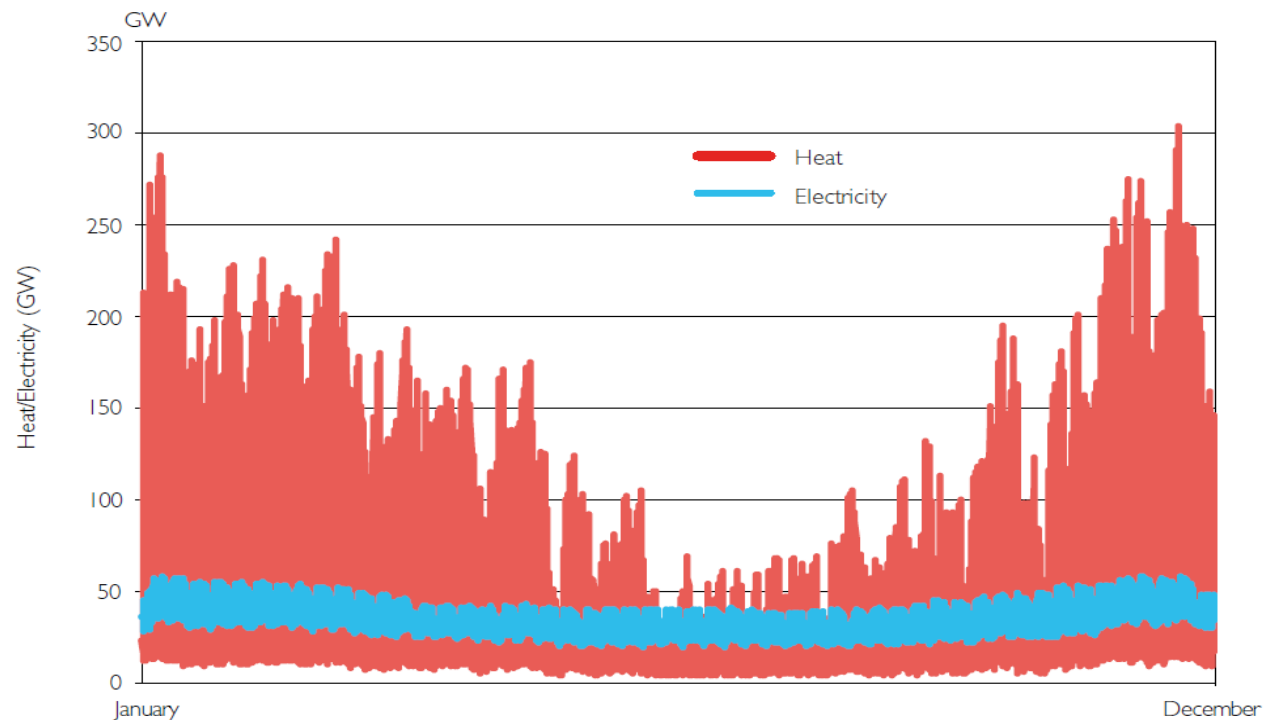
Changing supply: maximising renewable output

Need active demand to “harvest” available energy



Changing demand patterns: electrifying heat & transport

How do we meet peak winter demand?



Changing peak demand patterns

Meeting peak heat demand during winter months

Electrification of vehicles

Electrification of heating

Solutions: enhancing future grid operations

Considering these challenges, we are working closely with stakeholders to develop:

Policy

Market Rules

Tools

Information
Flows

Grid Assets

Identifying ***robust, cost effective solutions*** to meet the delivery of a secure, low carbon future for consumers.

Solutions: working closely with industry

Policy

Market Rules

European codes

Changing RoCoF settings

Access interconnector flexibility

Sub Group Co-Chair on Solar PVs

Tools

System balancing tools

Information Flows

Improved modelling & forecasting

Future Energy Scenarios

Grid Assets

Network investment to reduce locational issues

DECC, Ofgem, European TSOs, Industry groups, Met office, consumers, suppliers, generators, DNOs, communities and planning authorities.

Solutions: longer term

Policy

Market Rules

**Interconnector for flexibility;
frequency response**

Tools

**Demand
side
response /
Dual fuel
heating**

**Enhanced
generator
flexibility**

**Information
Flows**

**Greater
sharing of
information
within the
industry**

Grid Assets

**Network
flexibility
to deal with
varying
flows**

DECC, Ofgem, European TSOs, Industry groups, Met office, consumers, suppliers, generators, DNOs, communities and planning authorities.

Conclusion: Future Grid Operation

Decarbonisation is *changing* Energy supply and demand

This brings new *challenges* when *balancing* the electricity and gas grids

Working on *solutions* now and for the future to manage these challenges

Requires *engagement* and *co-operation* between industry, government and consumers

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