

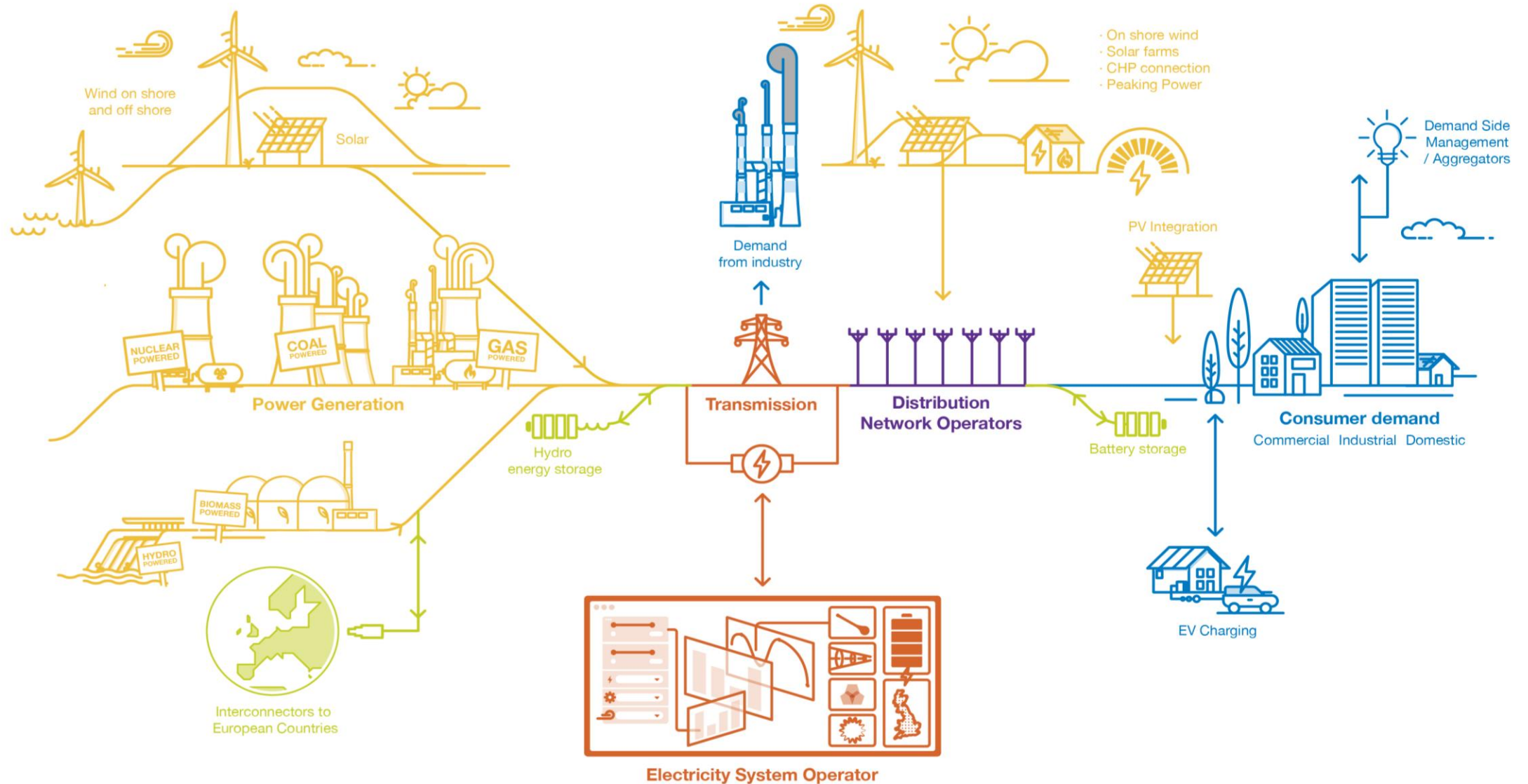
EPRI - IEA Workshop

Challenges in Decarbonisation; Building a Resilient Net-Zero Future

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Where we fit in the GB system

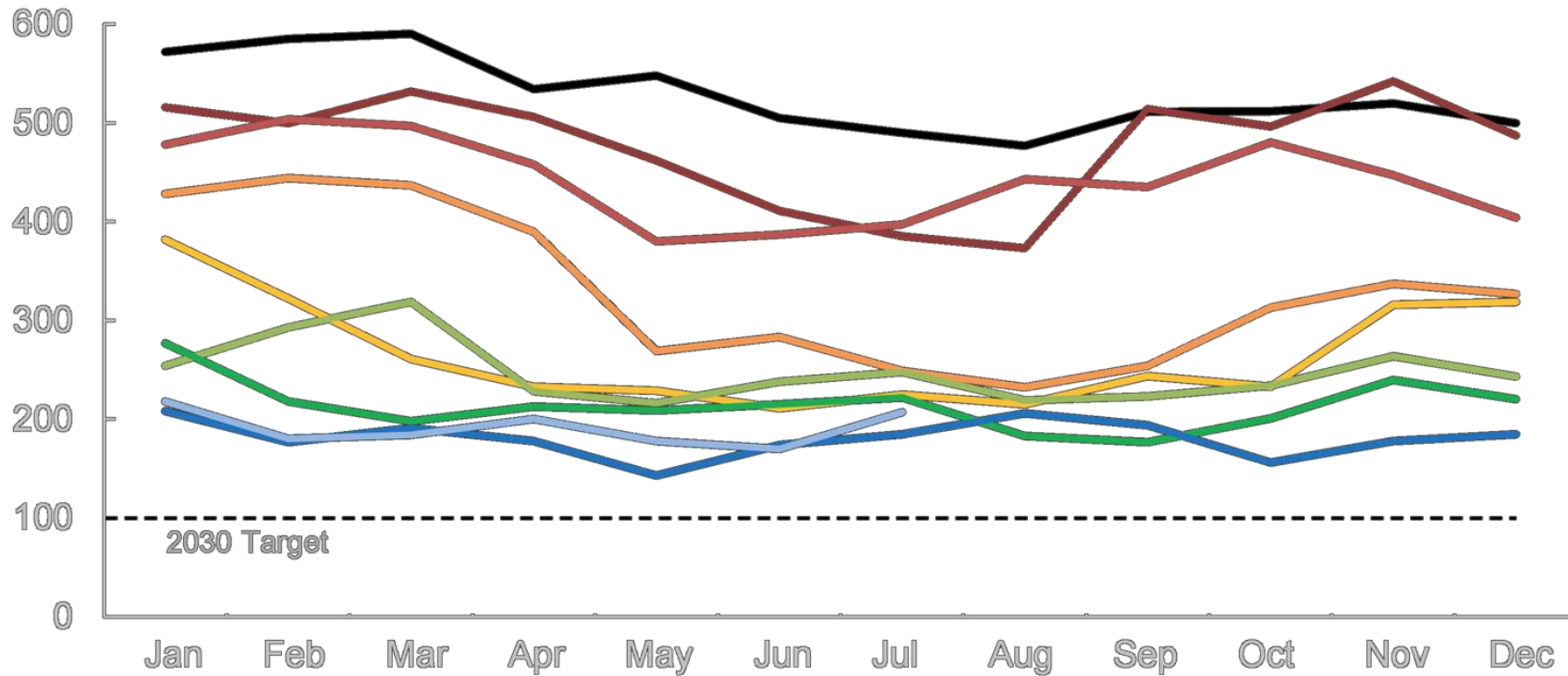


GB Decarbonisation Progress

We have been on this journey for over a decade, with a 65% decrease in emissions from 2013 to 2020

Carbon Intensity
(gCO₂/kWh)

—2013 —2014 —2015 —2016 —2017 —2018 —2019 —2020 —2021



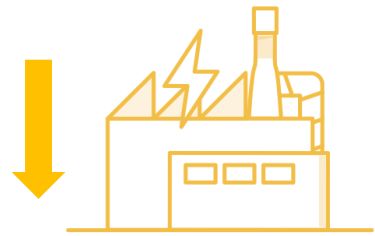
2013	529 gCO ₂ /kWh
2014	477 gCO ₂ /kWh
2015	443 gCO ₂ /kWh
2016	330 gCO ₂ /kWh
2017	266 gCO ₂ /kWh
2018	248 gCO ₂ /kWh
2019	215 gCO ₂ /kWh
2020	181 gCO ₂ /kWh
*2021	192 gCO ₂ /kWh

05 April 2021, Carbon Intensity was a record low of 39 gCO₂/kWh

By 2025 we are targeting a system with 0 gCO₂/kWh for some periods

Engineering Challenges to 2025

Decarbonisation of the GB power system has resulted in changes in four key areas:



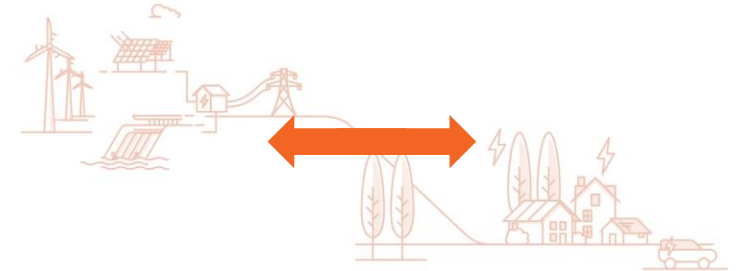
Less dispatchable generation



More variable sources of generation



More asynchronous generation



Generation moving to different areas.

Each of these changes brings about new engineering challenges which have to be resolved to operate a zero carbon network.

- We have a roadmap of new fast acting response products and complimentary reserve products to manage system **frequency** both pre and post **asynchronous generation**, **high variability from differing sources of generation** and larger loss sizes.
- We are buying competitively **stability** only services from new and existing technology types, through these pathfinder projects we are on track to track to procure all our inertia, short circuit level and other stability requirements from 2024 until 2027. These are required to replace the services services as **more asynchronous generation** connects. We will be launching a stability market in 2024 for enduring service procurement.
- We have been competitively buying commercial solutions to manage **voltage** requirements against network build options. This is as **more asynchronous generation** and **generation moving to different areas** increase the network need. We have a demand side party delivering the service in one area and are running a programme to procure services for about 1/3 of the national need.
- We are working to replace our **restoration** services from **less dispatchable generation** to new providers, mixing demand side capability and more more variable sources of generation
- We are progressing network reinforcements and new ways to alleviate **thermal** congestion on the network brought about as **generation connects further away from demands centres**.

Meeting the Challenges

Delivered

What is next

Future

Frequency

Dynamic Containment - We have over 900 MW of fast acting (sub 1 sec) response service to contain the frequency following a fault

This service will be followed by two pre-fault dynamic response services in 2022, **Dynamic Moderation** and **Dynamic Regulation** to ensure a stable pre-fault frequency with increased variability. These will be matched with complementary reserve services

We are looking at using control systems to manage multiple asset types to deliver an overall response capability

Stability

Stability Pathfinder Phase 1 is live now with synchronous compensators providing both inertia and short circuit level into the system, without providing active power

We are running two further Stability Pathfinders to procure the same inertia and short circuit levels from new technologies such as grid forming stability services at required locations across GB

We aim to have a stability market to allow short term procurement of stability only services

Voltage

Voltage pathfinders have competed commercial solutions against TO build options. The solution includes a large demand side user who absorbs reactive power

We are expanding our voltage pathfinder across more of GB in 2021 in larger zones.

We are aiming to have a full reactive market to allow short term procurement of reactive only services

Thermal

Regional Development Programmes are being used to maximise participation from distributed energy resources in managing local constraints

Constraint Management Pathfinder is exploring ways to allow different technologies to compete in helping to reduce congestion post fault. We are looking at how new technologies such as storage can help manage congestion.

More coordination of networks both onshore and offshore to reduce overall system congestion

Restoration

Trialling hybrid solutions of mixed technology types to deliver restoration capability.

Distributed ReStart is running to explore how to procure restoration services from solar, wind, hydro within distribution networks

Developing the learning from the Distributed ReStart innovation project into a nationwide restoration capability to meet new **Restoration Standard**

