Drax Power Station

Role of biomass and BECCS generation in GB electricity system

Drax

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Drax Biomass and BECCS technology plays a vital role in the UK energy system

1. Drax is the **largest single provider of secure supply** in GB's electricity system today

- **Drax Biomass units provide 2.6 GW of secure capacity** and represent 4% of GB's dispatchable capacity
- At times with the tightest margins over the last year (Jan 22-23) , **Drax Biomass has consistently provided 5-11% of total generation** and up to 70% renewable generation.

2. **Security of supply will become more complex** in the late 2020s as the capacity mix shifts to support decarbonisation, and would be made even more challenging without Drax biomass units

- We expect a **net loss of 4.5-6.3GW of secure capacity** between now and 2027 as nuclear, coal, and older gas plants retire, a 4 GW increase in peak demand, and a 25 GW increase in intermittent renewable capacity – so dispatchable capacity will fall from 93% to 85% of peak demand
- Loss of Drax (and other) biomass units would **further reduce dispatchable capacity to 80% of peak demand**, increasing reliance on generation from intermittent renewables and imported gas during times of system stress. Availability of interconnector capacity at times of peak demand is uncertain.

3. **No established technology can feasibly replace Drax's 2.6GW of biomass capacity by 2027** while ensuring security of supply without significantly increasing carbon emissions

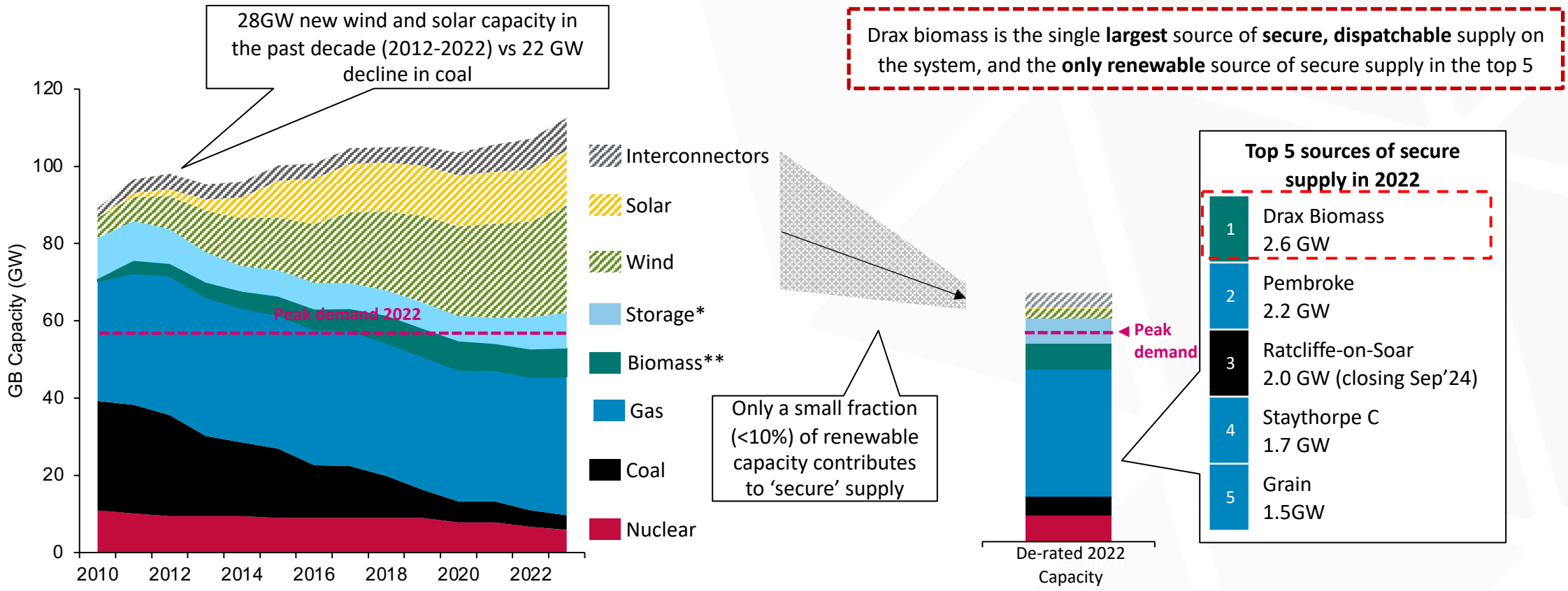
- Replacing Drax with gas generation would mean missing carbon targets and further increasing reliance on imported gas
- Meeting decarbonisation targets without negative emissions from Drax BECCS will be more expensive, more difficult, and more risky
  - It would require accelerating decarbonisation in challenging sectors such as heating, industry, road transport, and including more behaviour change
  - It is more cost effective and lower risk to keep existing biomass open than to build additional new build or retrofit gas CCS capacity

Drax Biomass is the largest single source of dispatchable capacity today

Gas, coal, and biomass are currently the key contributors towards security of supply in Great Britain

Significant growth of installed capacity of renewables

…but gas, coal and biomass continue to provide the majority of 'secure' supply

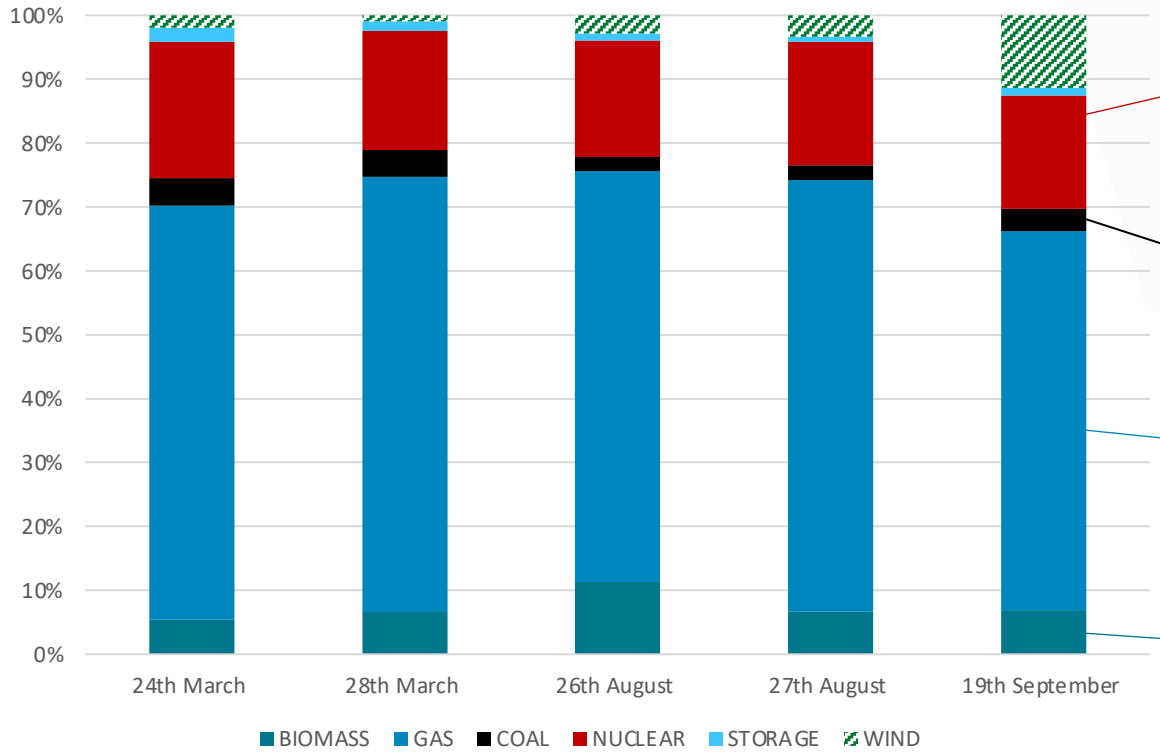


Notes: * Storage includes pumped storage, batteries and hydro. ** Biomass includes energy-from-waste Solid colour indicates dispatchable generation, dashed colour indicates non-dispatchable generation. 'Secure' capacity is capacity de-rated using National Grid ESO de-rating factors. Sources: DUKES, National Grid ESO, Baringa analysis

Drax has been a key contributor to security of supply at times of low renewable output

A system with higher renewable capacity brings system operability and flexibility challenges. Generation from dispatchable sources is key to meeting demand at times of low renewable output.

In Jan 22 - Jan 23, for the five periods with the lowest wind and tightest margin, biomass has consistently provided 5-11% of total generation and, at times, more than 70% of the total renewable generation



Nuclear

- **Current Capacity: 5.9GW**
- **2.1GW** due to retire by **2026 (**Hartlepool, Heysham 1) with **2.4GW** by **2028** or earlier (Heysham 2, Torness)
- Sizewell B (1.2GW) may be the only nuclear capacity in 2027, as Hinkley Point C (3.26GW) has high risk of delay beyond current stated 2027 date

Coal

- 100% of coal generation provided by Ratcliffe on Soar units (1 unit due to close in March 2023 and remaining 3 units by Sept 2024)
- All unabated coal due to decommission by October 2024 in line with UK net zero targets

Gas

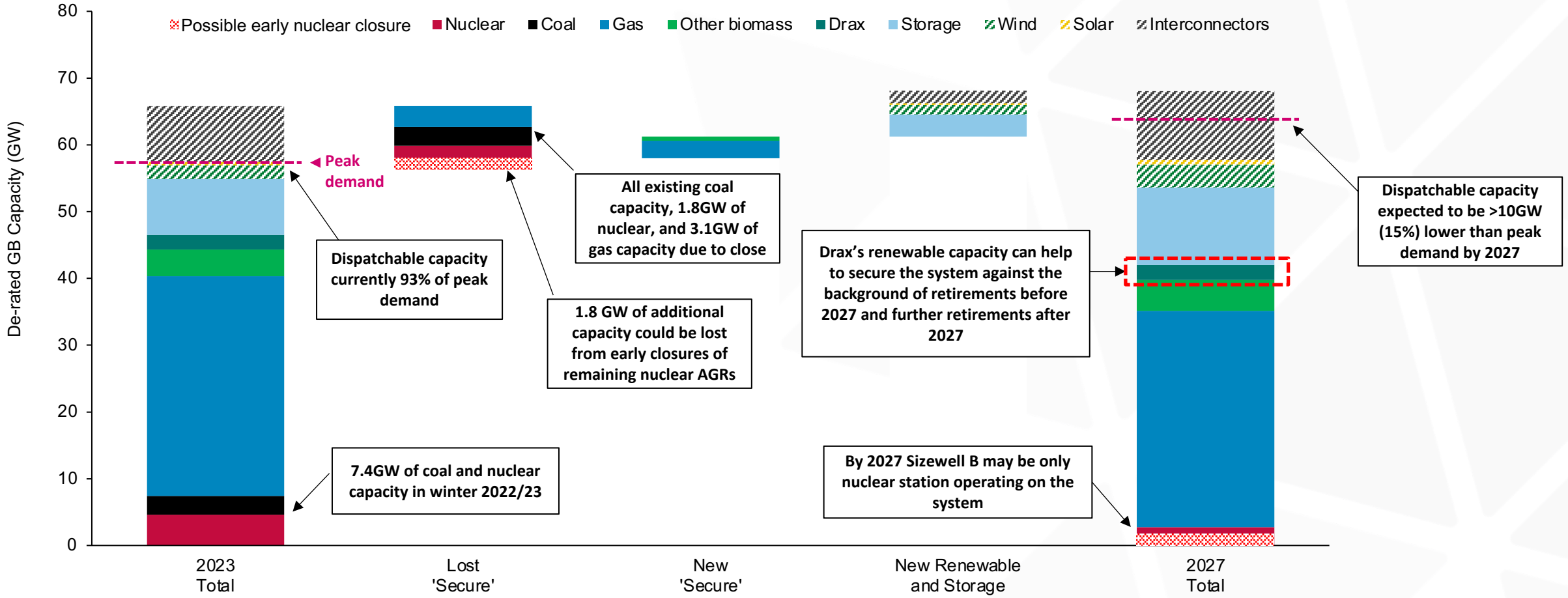
- A number of older and less efficient assets in the gas CCGT fleet are expected to retire in the coming years.
- Retirements are partially offset by new CCGT deployment and the first gas CCUS capacity coming online in the late 2020s.

Biomass

- **Drax biomass** (2.6GW) provides the majority of **secure biomass** supply, with Lynemouth (400MW) and Wilton (30MW) providing additional capacity.
- With the conversion from two biomass units to BECCS units, this delivers **secure, renewable, and dispatchable capacity with negative emissions**.

Security of supply will become more challenging with closure of coal and nuclear

A loss of 7.8-9.6 GW of existing ‘secure’ capacity together with a 4GW increase in peak demand will make security of supply more challenging by 2027. Drax will represent 4% of remaining dispatchable capacity



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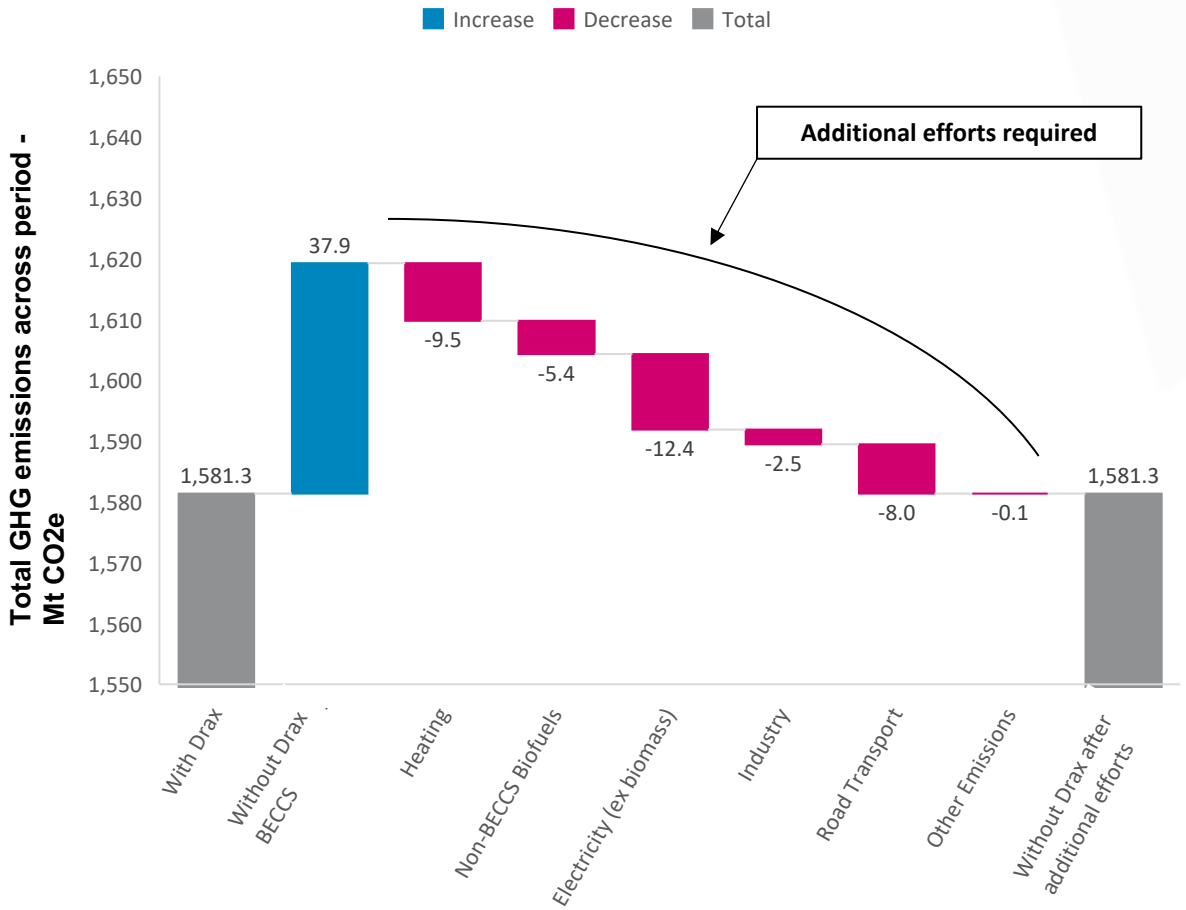
Without Drax BECCS, decarbonising will be harder, more expensive and more risky

In the absence of Drax-BECCS, the energy system needs to deploy more difficult and expensive decarbonisation options in heating, industry, and road transport or emissions targets will be missed

Comparison of Fifth Carbon Budget (2028-2032) Total Emissions with and without Drax BECCS



- **In the absence of Drax-BECCS, greater decarbonisation efforts are needed across other sectors of the economy.**
- During the period of the Fifth Carbon Budget, this would mean a 25% increase in the required reduction in domestic heating emissions.
  - This is approximately equivalent to fitting an extra 0.5m heat pumps on top of the circa 3m already expected – equivalent to a city the size of Birmingham.
- Road transport requires a further 5% in emissions reduction without Drax-BECCS.
  - This is equivalent to replacing an extra 700k vans with hybrid or electric variants, in addition to the 900k hybrid vans and over 10m electric cars already required by 2032.
- Without Drax, significant extra renewable capacity is also required.
  - An additional 10 GW of solar, requiring approximately 40,000 acres of land use, or 20,000 football pitches.
  - An extra 4 GW of wind, over and above the circa 60 GW that is already anticipated in the case where Drax is retained.
- Published analysis has indicated that these alternative options would add billions to the cost of transition

Comparing roles of biomass and gas CCS

- **Biomass and gas CCS are both options for low carbon dispatchable generation - but they have key differences:**
  - **Existing biomass has very low capex but comparatively high fuel cost**. This reverse is true for gas with CCS.
  - It is **more cost effective to keep existing biomass open than to build additional new build or retrofit gas CCS capacity**. Expected costs are £82-129/MWh for biomass compared to £116-144/MWh for gas with CCS
  - Gas with CCS presents **greater delivery risk and performance risk** (as it is new build) and increases reliance on imported gas
  - Gas with CCS has **potentially significantly higher greenhouse gas emissions** depending on capture rate and upstream emissions

	Drax Biomass	Gas CCS
Reference plant size (MW)	1250	1050
Capex (% of Gas CCGT)	N/A	250-350
SRMC (£/MWh)	82-129	45-74
Direct Emissions (gCO2/KWh)	0	20-40*
Supply Chain Emissions (gCO2/KWh)	110	130-210
Levelised cost (£/MWh) 40% load factor	82-129	116-144

Small changes in capture rate assumptions for gas CCS have important implications for emissions intensity for gas CCS.

Under most scenarios, retaining and running biomass units is cost effective compared to the gas CCS alternative, especially at 40% load factor expected for gas CCS.

* We assume a range of 90-95% capture efficiency for gas CCS technologies. ** Gas has up to twice the level of supply chain and indirect emissions, depending on fugitive emissions. All prices are real 2022.

Annex

Renewables, particularly wind, are highly variable and exposed to extended periods with low or no output

Given the online capacity for wind and solar is to increase by 25GW from 2023 to 2027, secure reliable and low carbon alternatives are needed on the system

- For security of supply, National Grid assumes wind will generate at a **minimum of 7-11% of its installed capacity*** at times of system stress
- In 2021, a relatively low wind year, there were **30 instances** where the GB wind fleet load factor was **below 11% for 24 hours** or longer.
- The **shortfall was made up by thermal generators**, particularly gas and biomass which ran at close to full output
- This **will not be possible in the future:** all coal will have closed and prolonged generation from unabated gas is not compatible with emissions reductions
- Retaining biomass capacity means **greater diversity of fuels** and reduces reliance on natural gas

*Annual Report on the Operation of the Capacity Market in 2019/20, published June 2021