Value for money assessment of the low-carbon dispatchable CfD for Drax Power Station

Impact on energy affordability, security of supply and decarbonisation objectives

Drax

February 2025

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The purpose of this document

- Drax has commissioned Baringa to perform a value for money analysis (hereafter referred to as ‘VfM’) of support for the four biomass generation units at Drax Power Station in Selby, Yorkshire.
- This analysis is based on the heads of terms of the ‘low-carbon dispatchable CfD’ agreed between the Department of Energy Security & Net Zero (DESNZ) and Drax plc in relation to the four biomass units at Drax Power Station, which will apply from April 2027 (when the current CfD and Renewables Obligation (RO) support arrangements end) to March 2031.
- Value for money has been assessed across four different components: electricity system costs, carbon emissions, security of supply, and the option value of negative emissions through conversion to biomass with carbon capture & storage (BECCS).
- All monetary values in this report are presented in real 2023 prices, unless indicated otherwise.

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Low-carbon dispatchable CfD support to Drax Power Station is expected to reduce system costs and emissions and provide option value for future BECCS conversion

Consumer cost

Dispatchable CfD support to Drax is expected to result in a c.£1.6-3.1bn system cost saving[1] in a central scenario over the 4-year term

- Were there to be a single year with high gas prices (similar to those of 2022), total savings would increase to c.£2.5–£4 billion
- These savings are driven by two factors: **(1)** with Drax kept online, government can buy less capacity in the Capacity Market. **(2)** Drax generation lowers wholesale prices
- Taken together these savings more than offset the cost of CfD payments to Drax

Carbon savings

By displacing higher carbon thermal generation, Drax would save around 4 million tonnes of CO_2e over the 4-year term

- Drax generation will materially reduce gas generation (by 4.3%) and imports (by 4.9%), whilst having only a marginal impact on renewables generation (0.1%)
- This is expected to reduce total power sector emissions by around 5% over the four-year term, equivalent to taking an additional 1.5 million cars off the road
- If valued at the social cost of carbon, savings would be worth c.£960m (c.£240m p.a.). Taken together with system savings, this could provide £2.5-4bn in total societal benefits
- Drax's generation will also contribute to the Clean Power 2030 (CP2030) target

Security of supply

Drax will account for 5.4% of 'secure' capacity in 2030, with generation concentrated in periods of higher system need

- Today, the capacity of dispatchable technologies is equivalent to 87% of peak demand, but this will drop to 64% by 2030—with Drax accounting for 5.4% of that
- The majority (c.60%) of Drax's generation will be in the winter, with c.44% of its annual output between November and January—typically the highest demand months
- Drax will continue to be a significant provider of inertia and reactive power (having historically provided c.14% of all reactive power in the Northern zone) – services which are critical for system stability, efficient power transmission and the prevention of blackouts.

Maintains BECCS option

Dispatchable CfD support provides option value from potential future conversion to BECCS, which is projected to deliver savings of c.£15bn

- Converting 2 units at DPS to BECCS would remove c.8 $MtCO_2e$ per year, roughly equivalent to emissions from all Heathrow departing flights for a year
- Previous Baringa analysis[2] has shown that BECCS at Drax could reduce the cost of meeting carbon targets by c.£15bn (central case)
- The closure of DPS and associated supply chains and logistics could make deploying BECCS at scale significantly slower, more challenging and expensive

*Notes: **1)** This number sums the Baringa Reference Case generation cost with the range of uncertain outcomes from the Capacity Market **2)** Please note that assumptions in this report differ from previous Baringa analysis, available here: https://www.drax.com/wp-content/uploads/2024/01/Baringa_Report_2024_Drax_Power_Station.pdf. All numbers here are undiscounted and are provided in real 2023 terms*

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Proposed support arrangements are compared with a 'No Drax' scenario

Context

- Without support from the low-carbon dispatchable CfD, it is assumed that the four Drax biomass units would be decommissioned after March 2027 when existing support arrangements expire, as their costs would outweigh projected revenue.
- Dispatchable CfD support is assumed to keep all four units operational until March 2031, and to keep open the option of converting one or more units to power-BECCS.

Structure of low-carbon dispatchable CfD support arrangements

- The analysis considered dispatchable CfD support with key parameters as follows:
    - **Structure:** a single, two-way CfD covering all four biomass units
    - **Term:** April 2027 – March 2031
    - **Load factor cap**: CfD payments cover a load factor of up to 27% across all four Drax units each year, equivalent to c.6 TWh of annual generation
    - **Seasonal generation profile:** seasonal load factor caps of c.16% in summer vs c.38% in winter
    - **Strike Price:** 113 £/MWh, real 2012

Approach

- We used our pan-European electricity market model to assess the expected wholesale market price and carbon emissions with and without Drax generation, under four core Baringa 'cases'.
- We then separately calculated the level of top-up payments to Drax and other CfD generators, the impact on Capacity Market clearing prices, and the societal value of emissions savings.

	Reference Case	Ref High Gas	Net Zero	Net Zero High
Demand	Central	Central	↑	↑
Gas Prices	Central	↑↑[1]	↓	↑
Carbon prices	Central	Central	↑	↑↑
Wind/Solar Output	Central	Central	↑	↑

Notes: 1) Calculated using an average of outturn gas prices in 2022, reshaped to the Reference case projected shape (high in winter and low in summer), and applied only in FY28-29

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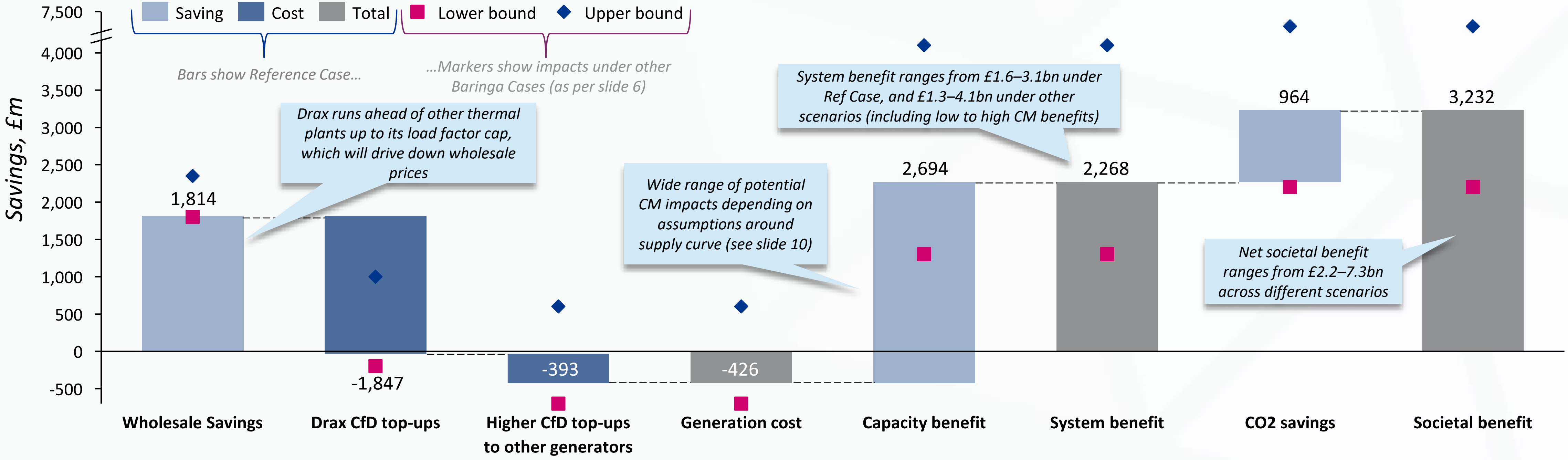
Central case yields £3.2bn in net societal benefits across the time horizon, with a range of £2.2 to £7.3bn across different scenarios

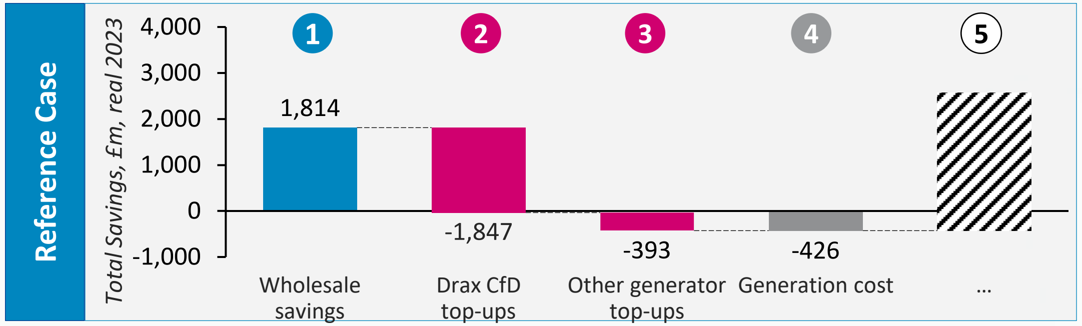
Breakdown of societal costs/benefits over 4 years accounting for electricity system, Capacity Market and carbon impacts (£m, real 2023)[1]

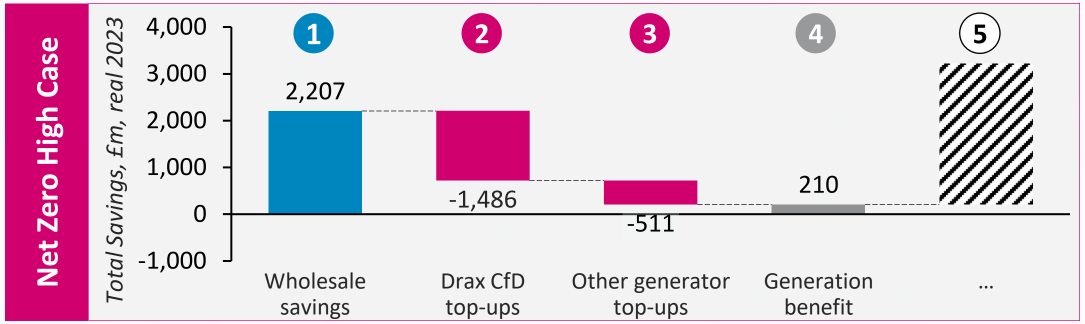


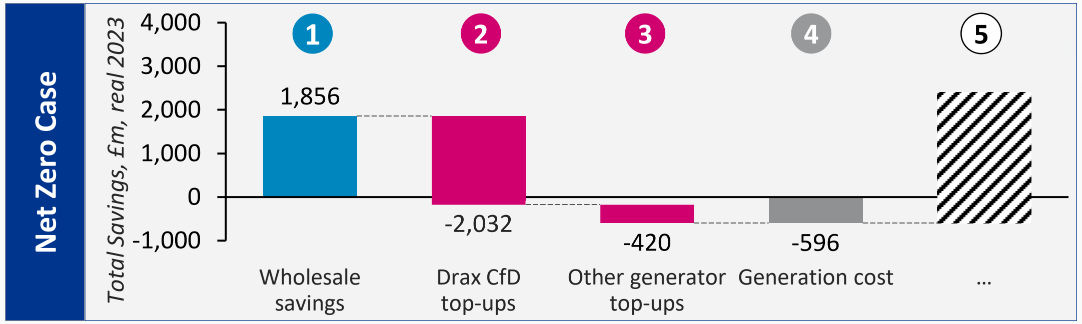
1	2	3	4	5	6	7	8
Total cost of wholesale generation, calculated as the product of load and the load-weighted wholesale price	Total cost of top-up payments to Drax calculated as strike price minus seasonal reference price multiplied by generation	Calculated as delta in top-up payments between No Drax scenario & the with Drax scenario	Sum of preceding components (wholesale cost + CfD top-ups)	Savings made in the CM by not having to procure additional thermal assets in order to cover the capacity gap	Generation cost + capacity benefit	Societal value of carbon calculated by multiplying the difference between the appraisal value and the market price of carbon	Net total (system benefit + CO_2 savings)

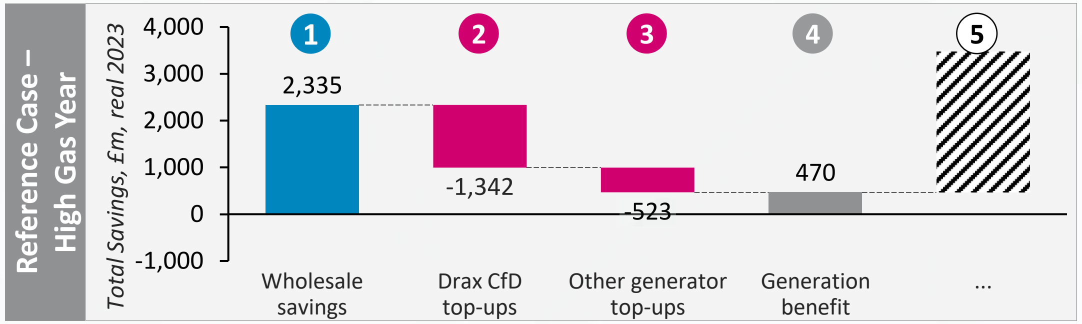
Notes: 1) All numbers here are undiscounted and are provided in real 2023 terms. Please note that totals may not sum exactly due to rounding.

The impact on generation costs varies from a net cost to a net benefit, depending on commodity prices and the pace of decarbonisation









Saving | Cost | Total

1 **Wholesale savings:**
Drax will run ahead of other thermal generation plants up to the load factor cap, optimising its generation profile to dispatch during higher price periods, thus prioritising periods of highest system need. This will reduce wholesale prices during these periods, resulting in lower generation costs compared to a counterfactual scenario without Drax.

2 **Drax CfD top-ups**
The new agreed strike price is anticipated to result in average annual top-up payments to Drax of c.£460 million per year (Ref Case), a c.50% decrease from the historical average.

3 **Top-ups to other generators:**
By lowering wholesale prices, there will be increased top-up payments for other CfD generators, as the gap between the reduced market price and their strike price widens.

4 **Generation cost/benefit**
Under the Reference Case and Net Zero Case there is a net increase in generation costs, because CfD payments to Drax and other generators outweigh the wholesale price reduction. However, under the Net Zero High case and the High Gas Year Case (in which commodity prices are higher) there is a net saving, because Drax displaces more expensive gas generation and interconnector imports.

5 **Other savings**
Other savings associated with the Capacity Market and appraisal value of carbon are examined in next sections

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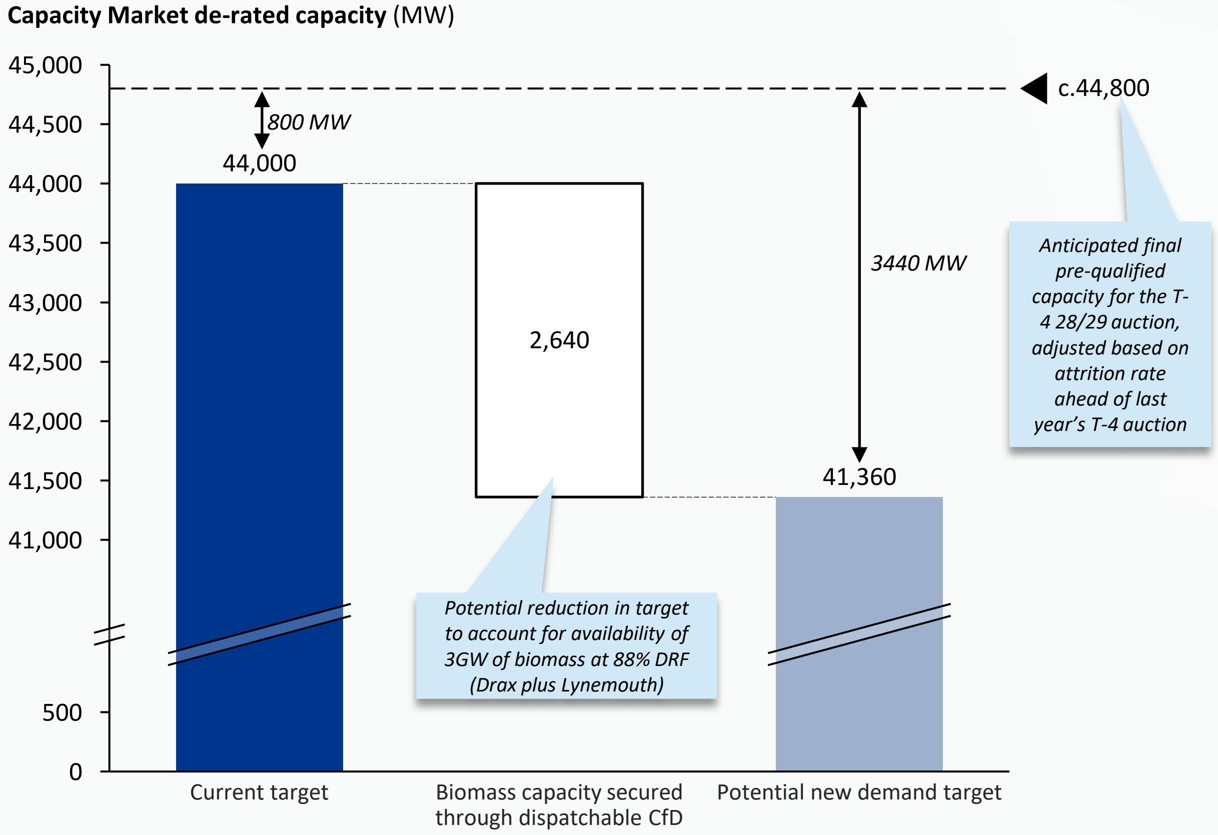
The dispatchable CfD could allow the Government to reduce the Capacity Market target for 2028/29 by c.2.6GW, leading to a lower clearing price

New CM demand target post-biomass CfD support (MW)



Total savings derived from having Drax on the system vary significantly between scenarios

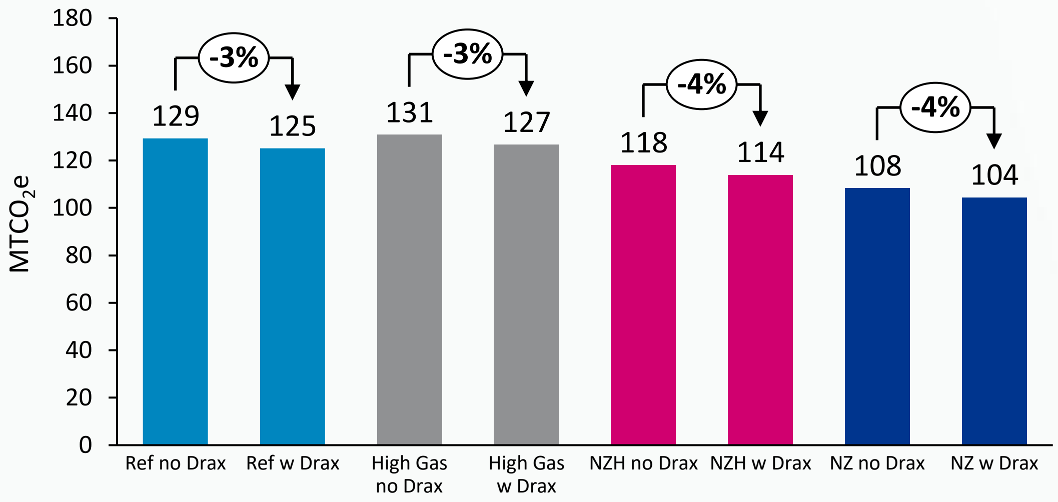
- **New demand target:** By securing biomass capacity through the dispatchable CfD, the government could reduce the CM target for T-4 2028/29 by c.2,640 MW (de-rated capacity of Drax and Lynemouth), which would result in the auction clearing lower down the supply curve.
- **Reduced Capacity Market clearing price:** This could reduce the clearing price by c.16-26 £/kW, resulting in a reduction in annual capacity payments of c.£640-1030m (real 2023) for a demand target of c.41GW. (We have assumed a similar impact for the T-4 2029/30 and 2030/31 CM auctions, but no impact on T-4 2027/28 since this auction has already taken place.)
- **Additional demand uncertainty:** There could also be adjustments to the demand target to reflect EDF's planned nuclear life extensions at Heysham 2 and Torness or the termination of Eggborough CCGT's capacity agreement. A reduced target from nuclear extensions could dampen the effect of dispatchable CfD support, while an increased target—driven by Eggborough's non-delivery and no nuclear adjustment—could amplify its impact on the Capacity Market.

Note that we have not accounted for a different capacity mix in the with / without Drax scenarios in our generation cost analysis on the previous slides. This means that it is possible this overstates the benefits of dispatchable CfD support, since additional non-gas capacity might also reduce wholesale prices. However, we expect that any such impact would be marginal, since a significant fraction of the additional capacity procured is likely to be gas peakers or CCGT refurbishment.

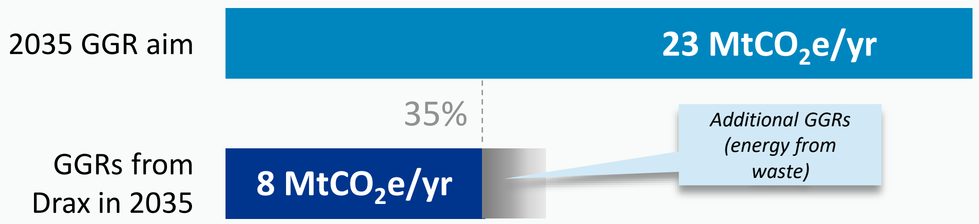
Notes: 1) All numbers here are undiscounted and are provided in real 2023 terms

The dispatchable CfD would deliver significant carbon savings compared to a counterfactual without Drax

Total carbon savings with and without Drax, all cases



Contribution of BECCS at Drax to 2035 GGR ambition



The low-carbon dispatchable CfD supports carbon savings and maintains the option of converting to BECCS

During dispatchable CfD period

- **Carbon savings:** the low-carbon dispatchable CfD would deliver carbon savings of more than 1 million tonnes CO_2e per year (4 MtCO_2e over the course of the four-year term). This equates to 3-4% of the total power sector emissions across the entire period. The fact that Drax can generate flexibly means that it can selectively dispatch during higher price periods, displacing higher-emission thermal assets.
- The carbon reductions delivered by the new low-carbon dispatchable CfD are significant and equivalent to:

Taking **375,000 internal combustion engine cars off the road per year**; or

Reducing the total number of passengers on departing flights by **5.75 million** per year.

BECCS at Drax

- The low-carbon dispatchable CfD maintains the option of converting to BECCS, which is projected to deliver carbon removals of 4 MtCO_2e per unit p.a. from 2030 (8 MtCO2e once two units are converted in the early 2030s).
- BECCS at Drax is the only credible near-term option for large-scale carbon removals (apart from energy from waste which is much smaller-scale), helping to achieve the Government's 2035 Greenhouse Gas Removals ambition by contributing 35% toward 23 MtCO_2e engineered removals.

Notes: 1) Please note that all numbers here are undiscounted and are provided in real 2023 terms

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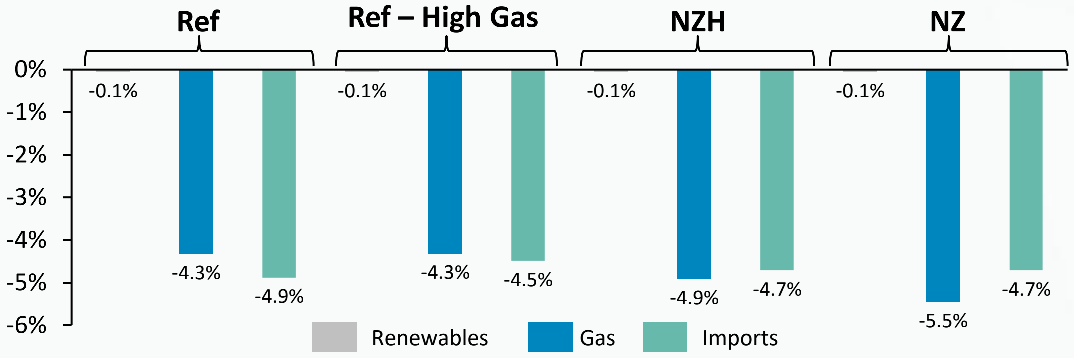
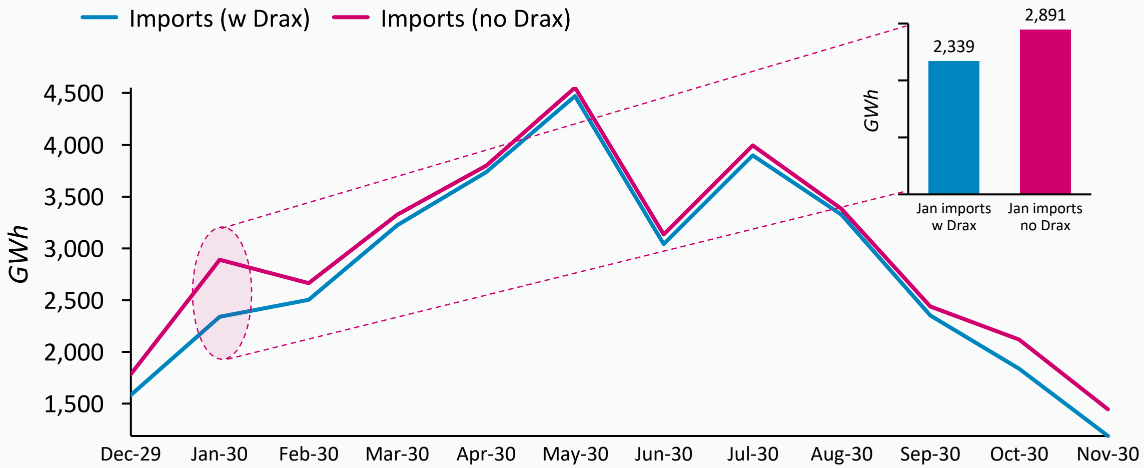
Drax generation primarily displaces thermal generation & imports, with a small impact on renewable generation

% Displacement of generator types relative to No Drax scenario



Volume of imports being displaced by Drax during the year of greatest interconnector imports, GWh (Dec 2029 - Nov 2030)



Gas generation reduced by 4.3%, interconnector imports by 4.9%

- **Impact on gas and interconnectors:** in the Baringa Reference Case, Drax reduces gas generation by c.4.3% and interconnector imports by c.4.9% (equivalent to about 9600 GWh of generation and 6000 GWh of imports respectively). The reduction in renewable generation is significantly smaller by comparison – about 0.1% (equivalent to about 500 GWh). This reduction in high-emission generation contributes to the Clean Power 2030 target.

- **Generation profile optimisation:** Under the new deal, Drax only receives CfD support up to a c.27% load factor[1] (equivalent to c.6 TWh of generation), meaning that it must optimise its dispatch profile to generate during periods of higher prices. Consequently, it is projected that Drax will generally run during higher carbon, higher price periods, displacing thermal generation.

- **Interconnector imports:** Drax's generation reduces reliance on electricity imports, in particular during the coldest winter months. For example, in January 2030 Drax is projected to reduce imports by 552 GWh in a single month – equivalent to c.20% of entire imports. This provides a buffer against high seasonal demand and price volatility, and improves security of supply in the event of system tightness.

Note: 1) Drax can operate above a 27% load factor, but generation above this would not be supported under the CfD regime

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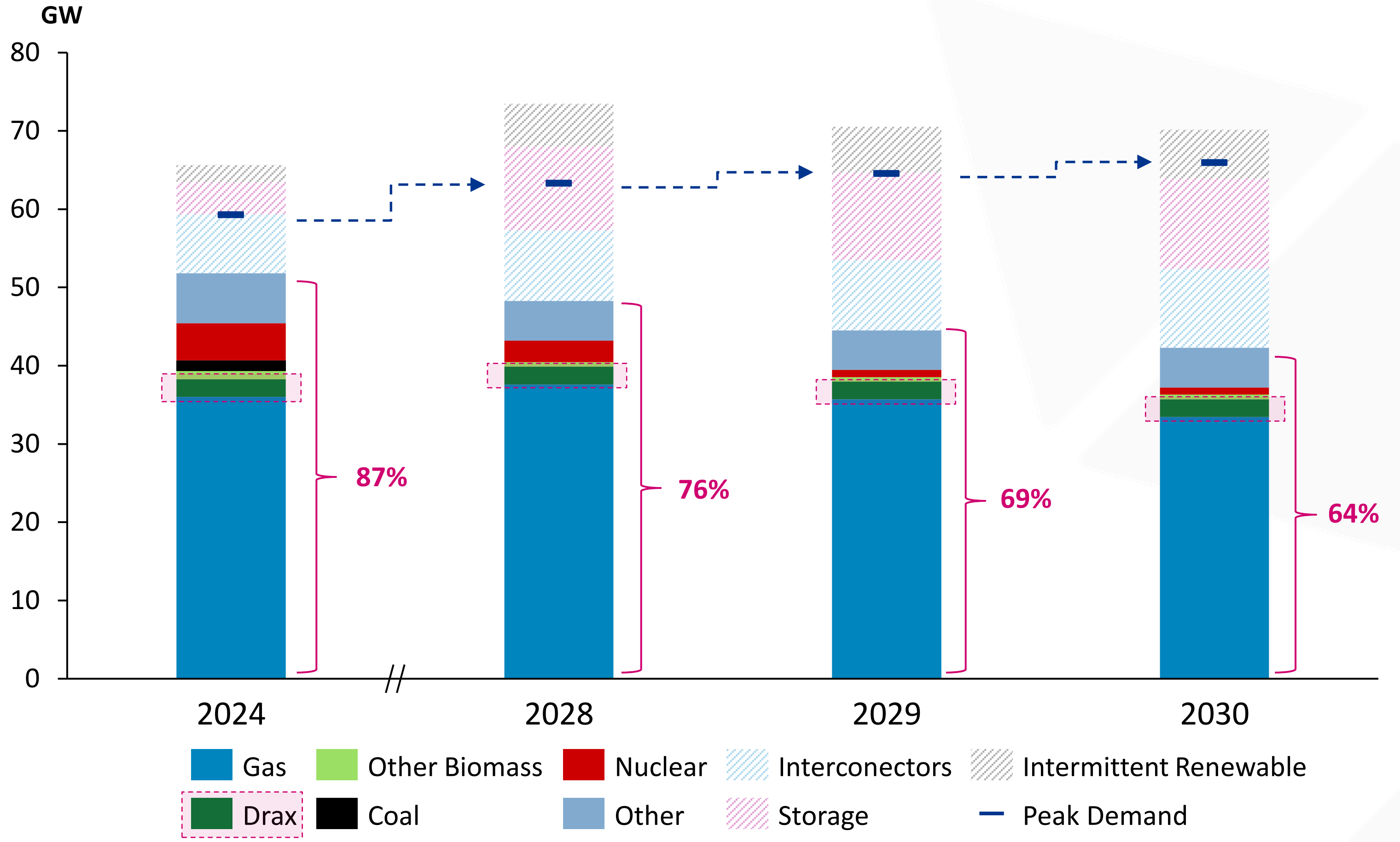
As GB relies more on intermittent renewables, storage, and interconnector imports for peak demand, retaining secure capacity like Drax becomes increasingly important

De-rated capacity mix and peak demand projections, Ref Case view (GW)



Secure capacity drops by c.23% 2024-30

- Over the next 6 years GB will increasingly rely on intermittent renewables, storage and imports to meet peak demand
- 'Secure' technologies, such as gas, nuclear and biomass, are **more readily available in times of electricity system tightness**
- Drax currently provide 4.4% of secure capacity; this will **increase to 5.4% in 2030**
- Whilst at the same time, 'secure' capacity will drop from 87% to 64% of peak demand; **this would drop by a further 3.5pp to 60.5% if Drax Power Station were to retire**
- This is driven by a net **decrease in 'secure' de-rated generation**, as well as an **increase in peak demand of 6.6 GW**
- Drax also provides resilience through its biomass stocks – the energy stored in Drax's supply chain could generate electricity **equivalent to 2.5 days of UK demand**

Generation mix is based on Baringa projections, including any publicly announced closure dates for specific assets. Capacity is de-rated using NGESO's de-rating factors for that year (2029 and 2030 use 2028 de-rating factors)
'Secure' technologies include: gas, biomass, coal, nuclear and other (biowaste, oil, hydro run-of-river). Intermittent renewables include: solar, wind and marine.

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We examined 3 key impacts: electricity costs, capacity costs and decarbonisation

Key Impacts

Generation costs

Generation cost: the cost impact to the wholesale market is calculated across several components:

1. **Wholesale cost:** the total cost of meeting customer electricity demand, calculated as the product of customer load and the load-weighted electricity price
2. **Drax CfD top-up payments:** the total cost of providing top-up payments to Drax, calculated by obtaining the difference between the strike price and the seasonal reference price, and multiplying by Drax's generation
3. **Top-up payments to other generators:** calculated as delta in top-up payments between No Drax scenario & the Drax scenario

Capacity Costs

Capacity Market benefit: the savings made in the Capacity Market by not having to procure additional capacity to cover the capacity gap:

1. **Difference in CM target:** If Drax and Lynemouth receive a CfD contract, the target could be reduced to c.41.5GW
2. **Reduction in clearing price:** this could reduce the clearing price by c.£13-26/kW; this would result in potential savings of between £640-1030m (real 2023 terms).
3. **Net position:** this saving is summed with the generation cost to give a system cost/benefit

Decarbon-isation

Societal cost: cost to the system of keeping Drax online, + the savings made in carbon emissions compared to a No Drax scenario:

1. **Total carbon emissions (MtCO2e)** compared to a No Drax scenario – calculated by subtracting the carbon emissions from the equivalent No Drax scenario
2. **Value of carbon emissions:** Difference in carbon emissions between the counterfactual No Drax and with Drax scenario, multiplied by HMG carbon appraisal value minus assumed UK ETS market carbon price
3. **Total system value with carbon savings:** system value minus total savings derived from the value of carbon emissions

How we examined these impacts

1 Power market modelling

Baringa uses a Plexos simulation engine, combined with the latest market intelligence to ensure its Pan European market model is as accurate as possible

This market model simulates the European energy network to produce a set of outputs (detailed on the right) which build up a comprehensive picture of energy trends across Europe (including generation schedules for all generators)

2 Off-model calculations

Using the outputs from our Plexos model, we can calculate several of the outputs detailed on the right, necessary to calculate electricity system costs (including generation cost and CfD top-up payments for Drax and other generators

3 Capacity Market calculations

We calculate the total de-rated capacity of opt-in and conditionally pre-qualified assets from the 2028/29 T-4 Capacity Market pre-qualification register, subtracting the capacity of assets which are unlikely to take a contract.

We then reduce assumed pre-qualified capacity based on attrition rate in last year's T-4 auction. We then subtract Drax and Lynemouth's capacity from the target volume and then calculate a new supply-demand curve using the new demand

4 Value of carbon impacts

Calculated by multiplying the difference between the appraisal value and the market price of carbon in our model – that gets us to our societal value of carbon.

Outputs

- Power prices
- Wholesale revenues
- Generation schedules
- Fuel usage
- Carbon emissions
- System curtailment
- Dispatch costs
- Interconnector imports and exports

- Wholesale cost
- Generation cost
- Drax CfD top-up payments
- CfD top-up payments to other generators

- New CM target
- New clearing price range
- Total CM savings by extending biomass
- Total capacity in pre-qualification register

- Societal value of carbon savings

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Baringa's market model provides a comprehensive overview of Pan-European market dynamics, allowing us to assess the effect Drax is likely to have on the entire system

Baringa Inputs

Baringa Case Inputs

- *Fuel and carbon prices*
- *Decarbonisation targets*
- *Demand (growth and shape)*
- *Forced outage Rate*
- *Planned outages*

Generator Dataset

- *Existing and committed plants*
- *Installed capacity*
- *Efficiencies*
- *Operating costs and constraints*
- *Hourly wind and solar profiles*

New Build Assumptions

- *Operating and maintenance costs*
- *Capacity build limits*
- *Other revenues*
- *Variable operating costs and efficiencies*
- *Capacity reserve margin requirements*

Our market experts track on policy updates and market news, which are then translated into model inputs.

Baringa market model

Operational Constraints drax

- *Unit parameters*
- *Min. up/downtime*
- *Hot product constraint*

Cost Inputs drax

- *Biomass fuel*

Support Scheme Constraints drax

- *Strike price*
- *Annual and seasonal volume caps*

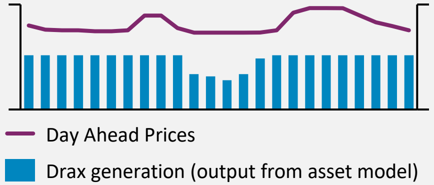
Drax-specific inputs are provided by the Drax commercial development team to ensure that the market model accommodates Drax's operational and support scheme constraints.

Drax Inputs

Market Model Outputs

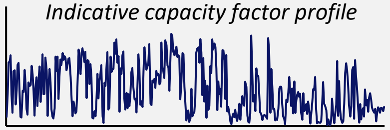
Dispatching profiles and wholesale Prices

Indicative generation profile



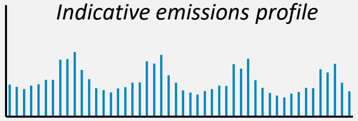
Renewable & gas generation and load factors

Indicative capacity factor profile



Pan-European emissions (Mt CO2e)

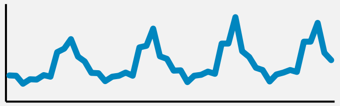
Indicative emissions profile



'Off-model' calculations

Wholesale costs

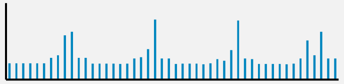
Wholesale Cost indicative profile



Wholesale cost on the system is calculated by multiplying customer load by the load weighted price

Drax CfD top-up payments

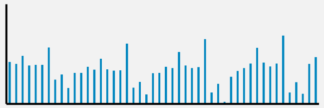
Indicative Drax top-up payment profile



Top-up payments are higher in winter months, aligning with Drax's optimised generation profile which will see the station generating more during high-price periods

Top-up payments to other generators

Indicative top-up payments to other generators



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Legend		
Exactly implemented	*Partially implemented*	*Not implemented*

Various operational unit constraints underpin if and how the individual units at DPS can dispatch, independent of price signals in the day-ahead market

Group	Constraint	Actual physical constraints	Implemented in Baringa's market model?
Technical Parameters	Drax unit parameters	Minimum Stable Load per Unit: ***300 MW*** Maximum Export Capacity per Unit: ***645 MW***	Market model includes operational range (between MEL and SEL) with corresponding efficiencies.
Technical Parameters	Minimum up/downtime	Minimum up/downtime: 6 hrs	Market model includes min up/down time provisions to allow units to reach temperature/cool down
Outages	Planned outages	Each unit has a major planned outage (c.90 days) every 4 years	We apply a 5% annual maintenance rate (c.18 days a year, or 72 days every four years)
Outages	Average forced outage rates	Annual Average Forced Outage Rate: ***8%***	Baringa's market model uses its own internal assumptions of a 15% forced outage rate.
Fuel	Fuel supply	Deliveries are assumed to be evenly phased across the year and volume is always available when needed when (although Drax is exposed to delivery risk)	Although fuel supply/biomass stocks is not directly modelled, the constraints implied by them are partially represented via minimum monthly load factors in summer and the shoulder months. This reflects supply chain and storage constraints.
Fuel	Biomass stocks	The model optimises generation so that biomass stocks remain above the minimum limit (300kt) and below maximum available useable storage (1mt)	
	Hot product constraints	Some of the fuel arrives at DPS 'hot', and therefore has to be burnt quickly to avoid fire risk; there one unit at Drax runs 7am-11pm for 15 days in June-Sept.	Market model forces Drax Unit 1 to run in months 6 to 9, for the first 15 days, 7am till 11pm
	Staggered starts	One unit to start every 3 hours	Not implemented

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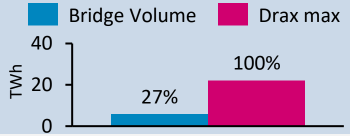
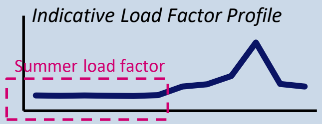
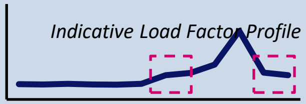
Our modelling implements key design features of the low-carbon dispatchable CfD to ensure realistic running patterns, but there are also some limitations

Design features and assumptions

Area	Constraint	Illustrative
Annual generation cap	27% average load factor across the entire period	
Summer maximum monthly load factor	16%	
Hot product constraint	1 Unit running 7am – 11pm, 15 days in June - September	
Logistics constraints	26% minimum load factor in October, February and March	
Term	FY 2027-31	Apr 27 ⟷ Mar 31

Limitations

Impact on BM or Ancillary Services	➢ Historically, Drax has contributed to multiple ancillary markets, including inertia, reactive power services and frequency response. ➢ Revenue from these could be significant, especially given the fact that Drax is located in a zone which procures the most ORPS ➢ Requirements to provide balancing/ancillary services have not been factored into our market model, which considers wholesale markets only.
Capacity mix adjustments	➢ Our modelling potentially represents an overestimate of system benefits, since it does not take into account the wholesale price impact of the additional secure capacity that would be procured in the absence of Drax. ➢ However, in practice this effect is likely to be limited, as in the absence of Drax additional thermal capacity (together with storage) would likely have been procured, and would like still have been the price setting plant in most periods
System operability	➢ Our market model may not accurately represent system operability limitations, e.g. flexibility and responsiveness of biomass generation to grid demands ➢ They may also include constraints on balancing supply and demand during variable renewable output ➢ Finally, grid or transmission constraints may not be perfectly represented (although the GB transmission network is carefully built up through our Plexos model).
Outage profiles	➢ Baringa's market model uses a 15% forced outage profile to reflect unpredictable interruptions of service - this flat outage profile may not accurately reflect Drax's projected outage profile ➢ Historically, Drax's outage profile has been around ~8%. This means that our modelling potentially overstates the number of outages. Although this doesn't directly affect Drax's generation (which is volume-constrained already), this may mean that we underestimate the optimisation value of Drax in our model.

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