Department for
Energy Security
& Net Zero

Assessing the deployment potential of flexible capacity in Great Britain – an interim report

DESNZ research paper number: 2023/051

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Baringa Partners and AtkinsRéalis UK Ltd

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Executive summary

This study has been commissioned by the Department of Energy Security and Net Zero to better understand the capacity deployment potential for the key flexible technologies in the power sector out to 2035 in Great Britain, and an assessment of their deployment barriers. This interim report summarises the findings for the unabated gas part of the research on flexible technologies, covering existing and new combined cycle gas turbine plants (CCGTs), new open cycle gas turbine plants (OCGTs) and new gas engines.

Baringa Partners were selected to carry out this study, supported by AtkinsRéalis.

Context

The UK Government has committed to fully decarbonise the power system by 2035, subject to security of supply. Depending on the scale, pace, and flexibility of electrification of the economy, electricity generation capacity may need to increase as much as two-fold by 2035 to meet expected increases in demand. Over the same period, we expect to see retirements of existing coal, nuclear, biomass and gas plants, the pace and nature of the latter being a key part of the research question. This presents challenges for ensuring adequate supply of firm, dispatchable and flexible capacity, as there is uncertainty in the deployment potential for low carbon flexible generation. To determine the scale of the challenge, it is critical to assess potential deployment levels of existing and new flexible technologies to 2035, including barriers to their deployment and policy levers to remove these barriers.

Scope and approach

The purpose of the wider study is to assess the capacity deployment potential for flexible power generation technologies out to 2035, including unabated gas and low carbon flexible capacity. This will be a key component to understanding and mitigating the risks to security of supply whilst decarbonising the power sector. This interim report presents the findings for unabated gas . The in-scope technologies considered in the wider study include existing and new CCGTs, new OCGTs and gas engines, gas carbon capture and storage (CCS), hydrogen-to-power, batteries, pumped storage hydro, other long-duration storage, biomass and biomass CCS. An assessment of the implication on decarbonisation is not in scope for this study.

This study presents an assessment of: (1) Deployment barriers for a range of flexible generation technologies; (2) Deployment curves for these technologies under different scenarios, which includes ’business as usual’, upsides to their deployment through removal of barriers, and downside risks to their deployment; and (3) Qualitative analysis of potential implications on ensuring capacity adequacy.

The deployment barriers cover the full project development cycle for flexible generation technologies, which this study has classified into four major categories: (1) Site, planning, and grid; (2) Engineering, Procurement and Construction (EPC); (3) Business case; and (4) Finance.

The study began with an initial desk-based assessment, which was then tested with 19 industry stakeholders through interviews to gather market intelligence. This covered developers in each technology class that are in-scope for this study, the relevant contractors and generation equipment manufacturers. Feedback from stakeholders has been combined with expertise and research from the Baringa and AtkinsRéalis teams to produce the final assessment.

The wider study aims to answer the following questions:

- What are the key barriers to deployment of capacity?
- What are the implications and impacts of these barriers on capacity deployment?
- What are the potential deployment profiles for the range of technologies under the current policy framework?
- What is the implication on security of supply?
- How could the barriers be removed by policy levers?
- What are the potential deployment profiles under optimistic assumptions with barriers being effectively addressed by policy intervention?

Deployment capacity for in-scope technologies is projected under the **Baseline** scenario. This is based on continuation of current policy (i.e., excluding policy under development), and a central view of development volumes and timelines based on judgement by Baringa and AtkinsRéalis. We have also developed the **Upside Enabled by Policy** scenario to represent an upside to the Baseline. We consider this to be a maximum realistic deployment potential for each technology where further policies are effective in addressing identified barriers. A **Downside Risk** scenario, representing a downside to the Baseline scenario, is presented for some technologies to highlight the uncertainty in achieving the Baseline scenario deployment levels.

Please note that the deployment assessment for unabated gas was conducted in summer 2023 and does not reflect Capacity Market pre-qualification evidence published in November 2023.

Main findings

- The interim report found that significant barriers exist in the deployment of both existing (in terms of lifetime extensions) and new build unabated gas capacity.
- Under the baseline scenario, compared to today’s level of 27GW, 15GW of existing CCGT capacity could retire, therefore leaving 12GW remaining on the system by 2035.
- Feedback from stakeholder engagement revealed that lifetime extension of existing CCGT plants, while technically feasible for many plants, is not guaranteed under current market conditions due to the level of investment capex required, lack of clarity on the future role of gas, risks around future revenue levels and adverse policy sentiment which makes investment decisions challenging.
- The investment appetite for new unabated gas is limited with a thin visible pipeline for new assets, particular for new CCGTs. New capacity for CCGTs, OCGTs and gas engines is limited to around 9GW in the baseline scenario by 2035. This includes 4GW

of assets which have secured CM contracts and are due to be operational by delivery year 2026/27. Feedback from stakeholders cited uncertainty around future decarbonisation pathway, planning consent and market risks among the main barriers for deployment of new gas capacity.

- Removing barriers to enable life-extension of existing CCGTs could contribute to ensuring capacity adequacy by enabling more plants to continue operating, particularly in the period around 2030. In the Upside scenario, further lifetime extension results in 24GW of installed CCGTs remaining online in 2030 (compared to 27GW now and 19GW in the baseline scenario). This could be enabled by lowering the Capacity Market refurbishment threshold for 3-year agreements for example, which is likely to have a direct impact on extended capacity deployment, subject to commercial investment decisions and technical state of aging plants.
- Under the Upside Enabled by Policy scenario, the total deployment potential for *new* unabated gas capacity (new CCGTs, OCGTs and gas engines) is 14GW by 2035[1] compared to 9GW in the Baseline. For new gas peakers, increasing the CM price cap and a clarification on the future role of gas peakers could help ease business case barriers. For new CCGTs, feedback from stakeholders suggests that effective levers to increase new build capacity beyond the baseline scenario (4GW including Eggborough) may be limited[2].
- The full report will present findings on the deployment potential out to 2035 and barriers assessment for a wider set of technologies, including low carbon flexible technologies that are in-scope of the study.

Barriers assessment

Gas generation (CCGTs in particular) is the primary flexible technology on the system currently. Figure 1 below presents our high-level RAG assessment on deployment barriers.

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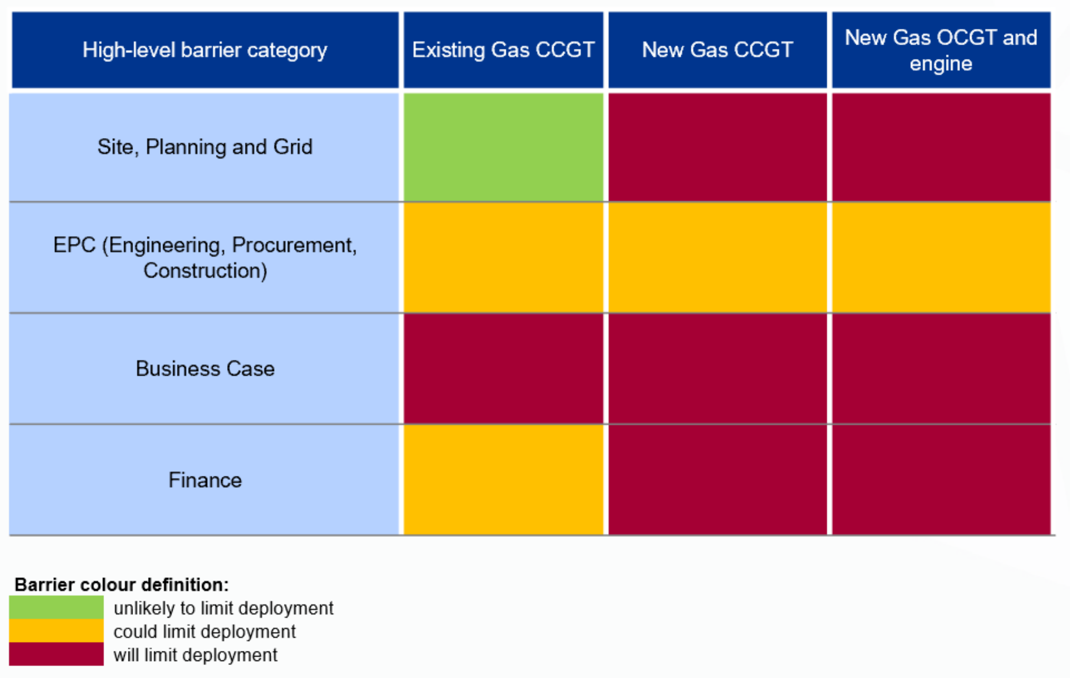
[1] This also includes c.4GW of assets which have secured CM contracts for delivery year 2026/27

[2] A detailed assessment on gas conversion potential is out-of-scope of the study. These levers may have a potential to increase the capacity deployment for CCGTs which is not considered in the Upside scenario in the report.

Figure 1: RAG assessment of technology deployment barriers



High-level barrier category	Existing Gas CCGT	New Gas CCGT	New Gas OCGT and engine
Site, Planning and Grid	🟩	🟥	🟥
EPC (Engineering, Procurement, Construction)	🟨	🟨	🟨
Business Case	🟥	🟥	🟥
Finance	🟨	🟥	🟥

Barrier colour definition:
🟩 unlikely to limit deployment
🟨 could limit deployment
🟥 will limit deployment

The business case for existing CCGT assets, i.e. economics of investing in lifetime extension, is the key barrier which could limit their continued deployment. Low expected profit margins, emission policy uncertainty and policy sentiment on unabated gas, market design uncertainty, and a lack of clear decarbonisation pathway to allow their continued operation beyond 2035 contribute to the business case barrier. The stakeholder engagement found that there are multiple existing CCGT assets facing life-extension decisions, with some potentially time-critical, near-term decisions which could affect closure of assets from as early as 2028. Timing of intervention is therefore critical due to several years of lead-time for life-extension plant overhauls. The identified barriers are not simple to remove, but the business case for life-extension could be improved by increasing revenue certainty, by enabling access to longer capacity agreements for typical life-extension capex levels.

For new gas CCGTs, there are critical barriers to their deployment in multiple categories, and further investment is very challenging. There is a very limited pipeline of new projects, beyond which the industry does not see much development potential given the 2035 decarbonisation objective. The main barrier to development of new projects is a lack of decarbonisation pathways for new projects, e.g. carbon capture retrofits. This impacts planning and financing, as projects struggle to receive backing if they are considered incompatible with decarbonisation objectives, and business case because long-term unabated operation carries significant stranded asset risk.

Engagement with stakeholders suggests that there is no appetite to develop further unabated CCGT projects beyond those included in the Baseline scenario. The complexity and limited potential impact of barrier removal, along with remaining barriers, suggest that it will be very difficult for policy intervention to incentivise further projects to come forward, absent a significant loosening of decarbonisation ambitions.

The study notes that the challenges around decarbonisation pathway for unabated gas plant are complex to resolve. A detailed assessment on the deployment potential for new gas plants which are then converted to low carbon is out-of-scope of the study, and as such is not considered in the Upside scenario.

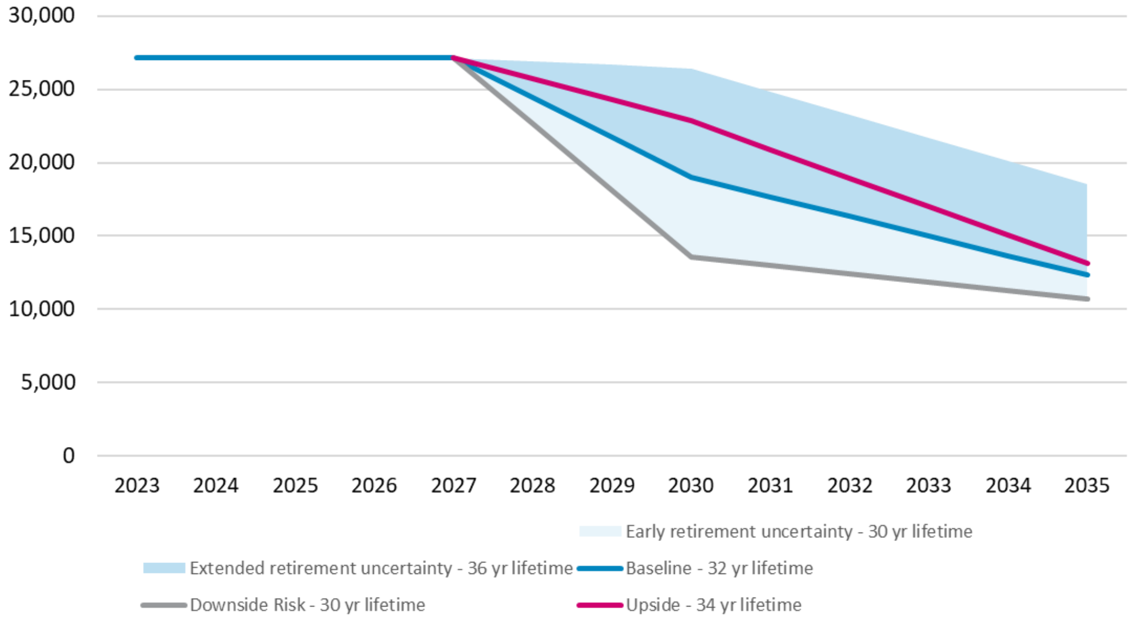
New OCGTs and gas engines face a similar set of barriers to new CCGTs but are considered to be lower risk investment options due to the smaller capex requirement and higher share of required revenues covered by capacity payments. Increasing the Capacity Market price cap and a clarification on the future role of gas peakers could help ease business case barriers.

Deployment potential assessment

Existing CCGTs

Existing CCGTs form the largest share of flexible generation capacity in the current market and as such their retirement is one of the most important considerations in capacity adequacy challenges.

Figure 2: Existing gas CCGT capacity (MW)



In the **Baseline** scenario, there is nearly 15 GW of existing CCGTs retiring by 2035 with more than 8GW retiring by 2030 – down from 27GW now, to 19GW in 2030 and with 12GW expected to remain by 2035. This assumes that assets within the existing gas fleet will retire at an average lifetime of 32 years. This is a high level assumption reflecting a range of mixed stakeholder feedback on the challenges operating CCGTs beyond 35-40 years. Some stakeholders were optimistic that some existing CCGTs could be operated to and beyond 40 years, if required, while others stated that continued operation would become infeasible due to the declining condition of multiple major components as asset age increases. The Baseline scenario uses a 32-year assumption which effectively assumes an average of 7-years' life extension beyond the typical 25-year design life for a CCGT, across the fleet. This average encompasses a range of potential plant closure decisions: (1) retiring before 30-years without investment when facing a major overhaul requirement; (2) many could potentially make a one-time 5-year life extension investment, retiring at around 30-years or slightly beyond given good plant condition; and (3) a small portion of plants could make two 5-year extensions or a one-time major 10-year extension decision, operating to 35-40 years, with a potential but low likelihood beyond 40 years

Figure 2 presents a range of uncertainty on either side of the Baseline 32-year age capacity profile. The coloured range shows potential outcomes with an average 30-36 years age for plant closure. This represents the uncertainty related to the fleets' condition and asset owners' decision making. Retirement dates of plants are based on Baringa data which record the commissioning dates of individual plants, with the decrease in overall existing CCGT capacity smoothed in a linear manner to represent the trend in capacity without highlighting the retirement of specific plants.

The lower end of the range (30-year average lifetime across the fleet) represents our assessment on the **Downside Risk scenario**, where we assume that retirement could happen anytime beyond a 25-year designed lifetime of gas plants. This could happen as a result of ESG (Environmental, Social and Governance) pressures from investors, poor asset condition, and tight capacity margins (for example as a result of low output from renewables or nuclear) using up equivalent operating hours (EOH) more quickly leading to earlier maintenance requirement.

The **Upside scenario** illustrates a case where policy interventions are successful in enabling further life extensions. This assumes an additional 2 years of average lifetime across the fleet *compared to the Baseline scenario* (34-year average lifetime). This is based on an expectation that policy could incentivise additional life-extension for some, but not all assets in the fleet due to the range of asset condition and business case barriers. The upside scenario also assumes that removal of key barriers could signal positive intent for the role of existing assets, bringing mothballed assets such as Calon back into the market.

Whilst the 34-year average lifetime across the existing CCGT fleet is assumed in the Upside scenario, the full indicative range of 32-36 years is a judgement based on feedback from stakeholders and comes with a degree of uncertainty. If most of the fleet have been maintained in a very good condition with proper investment historically, and they operate less frequently as reserve capacity in the future, there is a possibility, though not high, that prolonged lifetime could average around 36 years.

New CCGTs, OCGTs and gas engines

Figure 3 presents the deployment assessment for new gas capacities. The deployment potential for new gas contributes 8-9 GW across CCGTs, OCGTs and gas engines by 2035 under the Baseline scenario. This includes plants that have secured CM agreements in T-4 auctions for delivery years 2024/2025 to 2026/2027 (c.4GW), and our assessment on expected further deployment through the CM (see Figure 4).

For new CCGTs, the Baseline scenario assumes a total of 4GW of new capacity by 2028, which includes Eggborough (1.7GW) which has secured 15-year CM agreement. Beyond that, the Baseline scenario assumes further capacity from C. Gen and VPI Damhead Creek 2 which are two known projects with potential to be developed (total of 2.3GW). These plants are assumed not to proceed in the Downside Risk scenario.

The Baseline scenario for new OCGTs assumes no further capacity beyond projects with capacity market agreements (4 plants totalling 1.2GW) due to identified deployment barriers and feedback from stakeholders. This is noted as an uncertainty and some further deployment of OCGTs could emerge.

Figure 3: New Gas capacity including CCGTs, OCGTs and gas engines (MW)

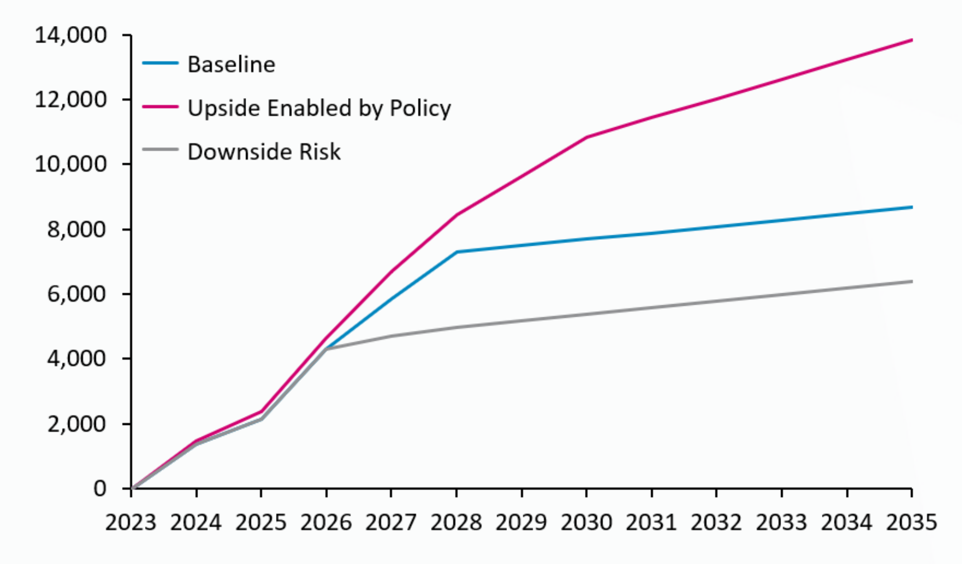
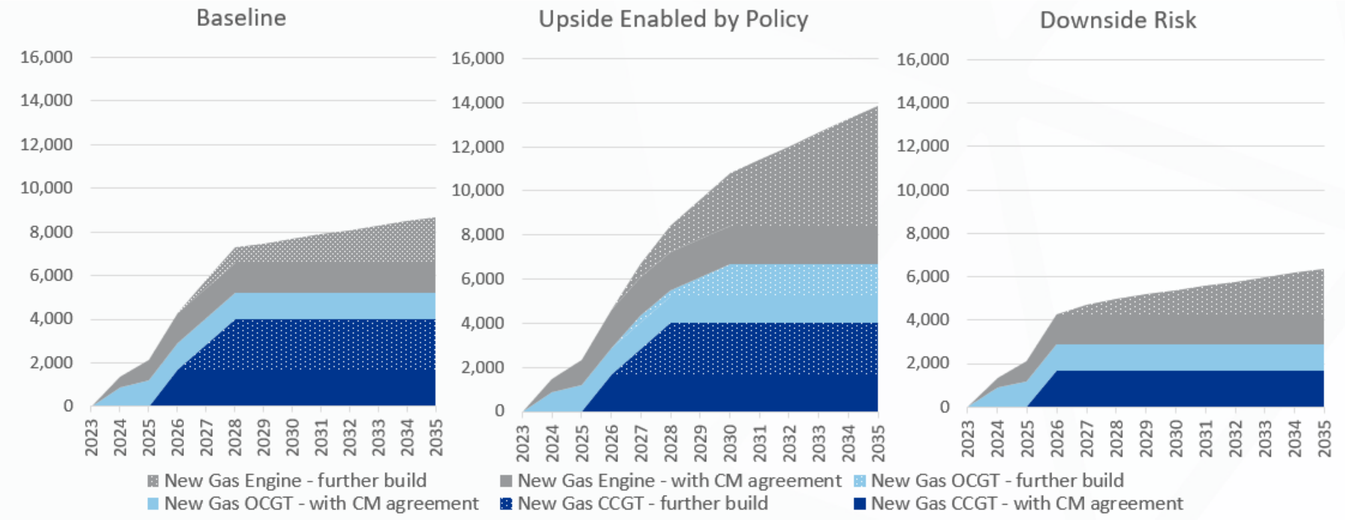


Figure 4: New Gas capacity technology breakdown (MW)



For gas engines, the Baseline scenario includes capacity with capacity agreements (1.4GW) with a further decreasing annual rate of future deployment from 400 MW in 2027 to 200 MW per year from 2029 which is reflective of stakeholder feedback on the challenges of developing new sites (planning and grid connection barriers) and reduced investor appetite for unabated gas (financing barriers). The continued deployment of gas engines, albeit at a slower rate, is considered reasonable because (1) high CM clearing prices with 15-year agreements would cover the majority of required revenues; and (2) the decarbonisation pathway for gas engine sites is potentially simpler than larger gas turbines with more manageable upgrade costs for hydrogen blending options, for example.

In the Downside scenario, all further new CCGT projects apart from Eggborough are considered as uncertain and therefore excluded in this scenario. No Downside scenario is presented for OCGTs and gas engines as the baseline is considered to be reasonably conservative. Potential downside risks would include non-delivery of capacity with CM agreements and a lower rate of deployment in further gas engine capacity if future CM clearing prices are low.

In the Upside scenario, we assess that removing barriers could lead to a deployment potential of around 14GW by 2035 for *new* gas assets (around 4GW of which already have CM contracts secured). The additional capacity, beyond the total of 9GW assumed in the Baseline, comes from OCGTs and gas engines. Incentivising additional new gas capacity would likely to be more effective in the earlier years, as the project pipeline would wind down as 2035 approaches and may require revenue guarantees given uncertainty around unabated operating hours.

Introduction

Project description and objectives

The UK Government has committed to decarbonising the power system by 2035, subject to security of supply. Peak electricity demand is projected to grow significantly to 2035 due to electrification of the economy. Large volumes of new build flexible capacity are required to complement the expanding volumes of renewables, to replace retiring high-carbon capacity, and to meet the growing electricity demand. As a result, uncertainties in the deployment of new flexible technologies risks there being a ‘capacity gap’ before 2035. That is, flexible capacity deployment may not be sufficient to meet the required peak electricity demand which could result in tight electricity margins, or the need to procure large volumes of high-carbon generating capacity.

This interim report presents the research findings for unabated gas. The wider study aims to answer the following questions listed below:

- What are the key barriers to deployment of capacity?
- What are the implications and impacts of these barriers on capacity deployment?
- What are the potential deployment profiles for the range of technologies under the current policy framework?
- What is the implication on security of supply?
- How could the barriers be removed by policy levers?
- What are the potential deployment profiles under optimistic assumptions with barriers being effectively addressed by policy intervention?

By answering these questions, this report provides a body of evidence to inform DESNZ’s policy development, especially in the coming years related to the Review of Electricity Market Arrangements (REMA), across several areas:

- *Capacity adequacy:* Measures to ensure that future market arrangements are appropriate and address the potential capacity adequacy gap.
- *Flexibility:* Flexibility is intricately linked to capacity adequacy as the deployment of low carbon flexible capacity is fundamental to ensure security of supply in a mass low carbon system. There is a linked question on who ‘decides’ what gets built (and the role of the market in this) given the complexity of the challenge and the need for system-wide thinking. Coordination across generation and networks, transmission and distribution connected resources, and across energy vectors is also an important consideration.
- *Operability:* A future electricity system will continue to require capacity with certain characteristics that can enable an operable system. The nature of operability requirements will also evolve. In a future electricity system with mass low-carbon power,

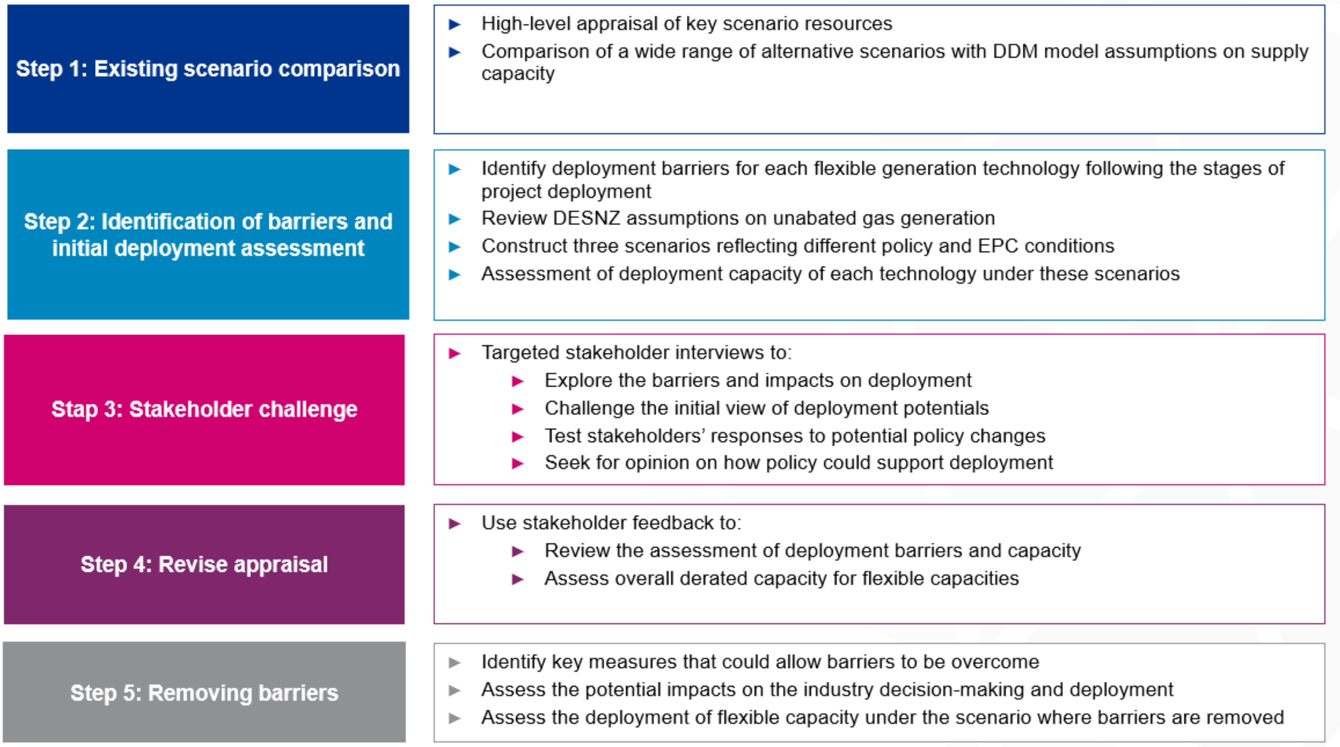
security of supply challenges will be driven by sustained periods of low renewables output as well as capacity driven challenges with meeting peak demand.

Approach

Research steps

The work was conducted in five key steps to provide an independent and critical assessment of deployment challenges to 2035. Figure 5 describes the details for each step.

Figure 5: Description of key steps



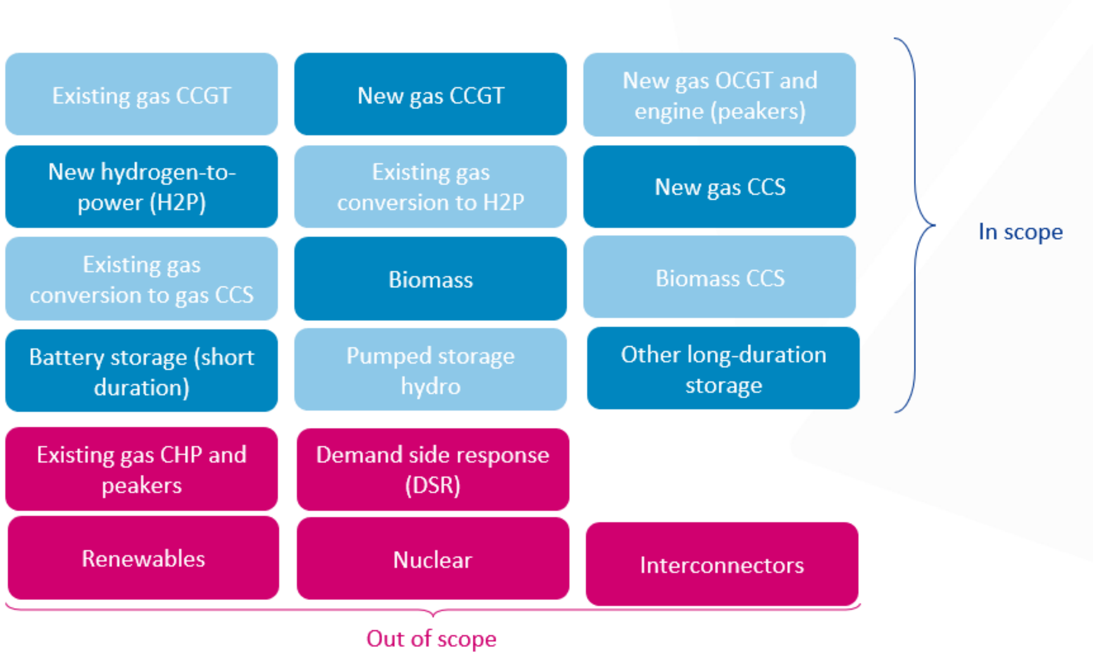
Step 1: Existing scenario comparison	► High-level appraisal of key scenario resources ► Comparison of a wide range of alternative scenarios with DDM model assumptions on supply capacity
Step 2: Identification of barriers and initial deployment assessment	► Identify deployment barriers for each flexible generation technology following the stages of project deployment ► Review DESNZ assumptions on unabated gas generation ► Construct three scenarios reflecting different policy and EPC conditions ► Assessment of deployment capacity of each technology under these scenarios
Stap 3: Stakeholder challenge	► Targeted stakeholder interviews to: ► Explore the barriers and impacts on deployment ► Challenge the initial view of deployment potentials ► Test stakeholders' responses to potential policy changes ► Seek for opinion on how policy could support deployment
Step 4: Revise appraisal	► Use stakeholder feedback to: ► Review the assessment of deployment barriers and capacity ► Assess overall derated capacity for flexible capacities
Step 5: Removing barriers	► Identify key measures that could allow barriers to be overcome ► Assess the potential impacts on the industry decision-making and deployment ► Assess the deployment of flexible capacity under the scenario where barriers are removed

The assessment was based on a combination of sources including desktop research on pipelines, data from the Transmission Entry Capacity (TEC) register and Renewable Energy Planning Database (REPD), Baringa's own GB power market scenarios, industry expert judgement, and nineteen stakeholder interviews which included developers of different technology classes, Original Equipment Manufacturers (OEMs), and Engineering, Procurement and Construction (EPC) companies.

Technology coverage for the full study

Figure 6 presents the technologies that the project covered. All renewable technologies (i.e., onshore wind, offshore wind, and solar), nuclear, and interconnectors are not in the scope of this study. As the study focuses on flexible power generation technologies, demand-side-response (DSR) is also out of the scope.

Figure 6: Technology coverage



Barrier classification

We have classified the barriers into four main categories aligning with the stages of project development. Table 1 describes what were seen as the key potential barriers in each category.

Table 1: Barrier categorisation

Barrier category	Detailed barriers
Site, Planning, and Grid	• Land ownership and access rights • Grid connection • DNO zonal connection and constraints • Planning permission • Gas (and/or hydrogen) connection • CO2 pipeline connection
EPC (Engineering, Procurement, Construction)	• Raw material tightness • OEM capacity • Other supply chain bottlenecks • Technology maturity • Labour for installation • Plant construction • Grid connection commissioning • Fuel (e.g. hydrogen) supply • Other infrastructure development
Business Case	• Commercial value – Energy market and non-EM revenue streams • Capital and operational costs • Policy – support schemes and business models • Policy – market participation arrangement • Policy – limitations on operation/emissions
Finance	• Return expectations • Macroeconomic environment • Debt/equity finance availability/cost • ESG regulation and corporate ESG strategy

Scenario definition

Three scenarios are defined for assessing the plausible deployment capacity for each technology.

- “Baseline” scenario estimates the expected capacity deployment profile for individual technologies under currently implemented policies, with technology deployment following central timelines which consider realistic delays and constraints caused by barriers.

- “Upside Enabled by Policy” scenario provides a technically feasible outcome with an increase in capacity deployment levels driven by removal of identified barriers through policy intervention (both under development and future policy).
- “Downside Risk” scenario is used to highlight the material risks to the Baseline scenario, resulting from uncertainty (e.g. CM auction outcome, business case dependency on other technologies).

Deployment assessment

Description and approach

This section introduces the structure of the technology-specific assessment which is covered in detail later.

For each technology, a brief description of the status of current capacity and the upcoming project pipeline where applicable is provided.

Assessment of deployment barriers is then presented, with a Red-Amber-Green (RAG) status (Table 2) determined for each category and a detailed discussion of the barriers provided. This reflects the current situation under existing policy and is aligned with the “Baseline” scenario. For each barrier, we then present a further assessment (explanation in

Table 3) of the extent that it can be addressed by policy. The key barriers which have a major impact in driving deployment are also identified.

Table 2: Description of RAG in barrier impact

Barrier impact RAG	Impact on capacity deployment
Red	**Will** limit deployment
Amber	**Could** limit deployment
Green	**Unlikely to** limit deployment

Table 3: Description of policy potential in addressing barriers

Potential to be addressable by policy?	Description
Y	Could be addressed
N	Not addressable
?	Impact hard to determine
-	Not applicable / Not a barrier

Following this assessment of barriers, a description of the Baseline capacity deployment scenario is set out. This is our estimated central view under Business As Usual policy and market conditions.

We then present how barriers could be removed through policy levers, and address the following questions:

- What are the key barriers which need to be addressed?
- How complex would the policy intervention be?
- What type of intervention is it likely to be?
- What could the potential impact be?

Assuming that policy interventions are introduced to remove barriers, we project the maximum realistic potential deployment for each technology in the Upside Enabled by Policy scenario. The deployment of some technologies is subject to market uncertainties and the impacts from other technologies which are out of the scope of this study, across all scenarios. For example, the deployment of batteries will be influenced by future wind capacity in the system. To highlight potential downside impact, we also project the Downside Risk scenario for specific technologies where appropriate.

Existing Gas CCGTs

Capacity basis description

CCGTs (combined cycle gas turbines) are a core capacity class in GB with around 27GW of installed capacity, accounting for around a quarter of total installed capacity in 2023 and providing a large share of dispatchable power generation in the current market[3]. Many of the plants are close to or beyond the end of their initial design life so there is uncertainty around the timing of retirements over the period to 2035.

For the discussion in this section, the capacity represents existing CCGTs while those with CHPs are excluded from the aggregated capacity. The existing capacity of CHPs is approximately 4 GW, and the capacity of OCGTs and engines is around 5 GW. We have not assessed these categories in detail in this study. We assess new OCGTs and gas engines separately.

Barrier assessment

Extending the lifetime for aging existing CCGTs has a challenging business case, while barriers in other barrier categories are more manageable, as set out in Table 4 below.

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[3] Source: Baringa Reference Case, DUKES 2023

Table 4: Deployment barriers for existing gas CCGTs

Category	Assessment	Detailed barriers	Addressable by policy
Site, Planning, Grid	🟩	There are no significant barriers for existing sites to continue operating. Permits are in place but may need updating.	
EPC	🟨	Several potential barriers with variable impact across different units	
		• Shortage of Original Equipment Manufacturers (OEMs): Maintenance and life-extension relies on only a few OEMs who may be ramping down existing manufacturing capacity and testing capability	N
		• Obsolete plants: Potential for some older plant configurations to become obsolete with additional complexity and cost to replace parts	N
		• Contractor shortage: Limited pool of contractors, aging workforce with recruitment challenges and competition from other engineering areas, e.g., renewables	?
		• Volume of maintenance: Volume of plant nearing major maintenance requirements could present a challenge	N
		• Condition of old plant: Beyond typical design life of 25 years, deterioration is increasingly likely to lead to high-cost component replacement or infeasible repairs	N
Business case	🟥	The business case for life-extension is challenging due to multiple sources of uncertainty	
		• Single-year CM: Single year capacity agreements provide limited bankable revenues to enable life-extension decisions	Y
		• Low expected margins: Market revenues and margins are expected to reduce due to deployment of renewables, storage, and other low marginal cost generation	N
		• Market design uncertainty: Ongoing reform such as REMA and CM reform creates significant uncertainty	Y
		• Emissions policy uncertainty: Uncertain carbon costs and proposed emissions restrictions (with potential application to existing generators) creates uncertainty	Y
		• Policy sentiment: Role of unabated CCGTs in power market, especially beyond 2035, is unclear with sentiment reported by stakeholders as 'anti gas'	Y

	🟥	• Decarbonisation pathway: Existing CCGTs do not have a clear decarbonisation pathway to allow their continued operation beyond 2035	Y
Finance	🟨	Financing conditions are challenging with investor appetite decreasing	
		• Availability of capital: Very limited pool of capital for continued investment in unabated gas and there is growing pressure for publicly listed companies to divest their interest in fossil fuels	N
		• Moderate investment size: Investment size required for life-extension is material (40-100 £m) but not prohibitive for a certain pool of investors	N
		• High return requirement: High hurdle rates may apply due to the uncertainty of future margins and long-term role	N

Key barriers

Among all the above barriers, (1) condition of old plant; (2) single-year CM; (3) market design uncertainty; and (4) policy sentiment are considered as the key barriers.

Life-extension decision making

There are multiple existing CCGT assets facing life-extension decisions with some potentially time-critical near-term decisions which could affect closure of assets from as early as 2028. The stakeholder engagement, conducted in summer 2023, confirmed that 10 £/kW/yr is a reasonable assumption for CCGT life-extension spread across 5 years for a 5-year lifetime extension and upgrade costs, with a typical one-off major maintenance capex event of 50 £/kW. However, some suggestions have been raised that market arrangements could be adjusted to better facilitate life-extension investment decisions.

The cost estimate of 10 £/kW/yr is subject to variability across different plants due to factors including varying plant configurations, age of plant and availability of components. The cost is also subject to change over time due to factors including macro-economics and availability of contractors. This assumption was considered to be reasonable when tested with stakeholders at the time of the analysis (summer 2023), however, there are indications that costs have increased since then.

There are a range of challenges associated with life-extension investment decisions:

- There is significant uncertainty in the level of future merchant energy margins (Wholesale + Balancing Mechanism - BM) with potential for policy intervention to limit profitability (e.g. IOLC, REMA).
- Future CM value is also considered to be highly uncertain due to market factors and proposed CM reform.

- While T-4 capacity agreements provide a form of bankable revenue for existing generators, the single year duration limits the extent to which these agreements can support longer-term investment decisions.
- ESG expectations from investors mean some owners are facing pressure to keep investment in unabated generation to a minimum, while others have high hurdle rates.
- The pathway to decarbonisation for all existing generators is uncertain with some having no viable options.
- General market and policy sentiment suggests decline for existing gas generation.

The result is that stakeholders report difficulties in committing to life-extension capex and have an expectation that future decisions will become even more challenging.

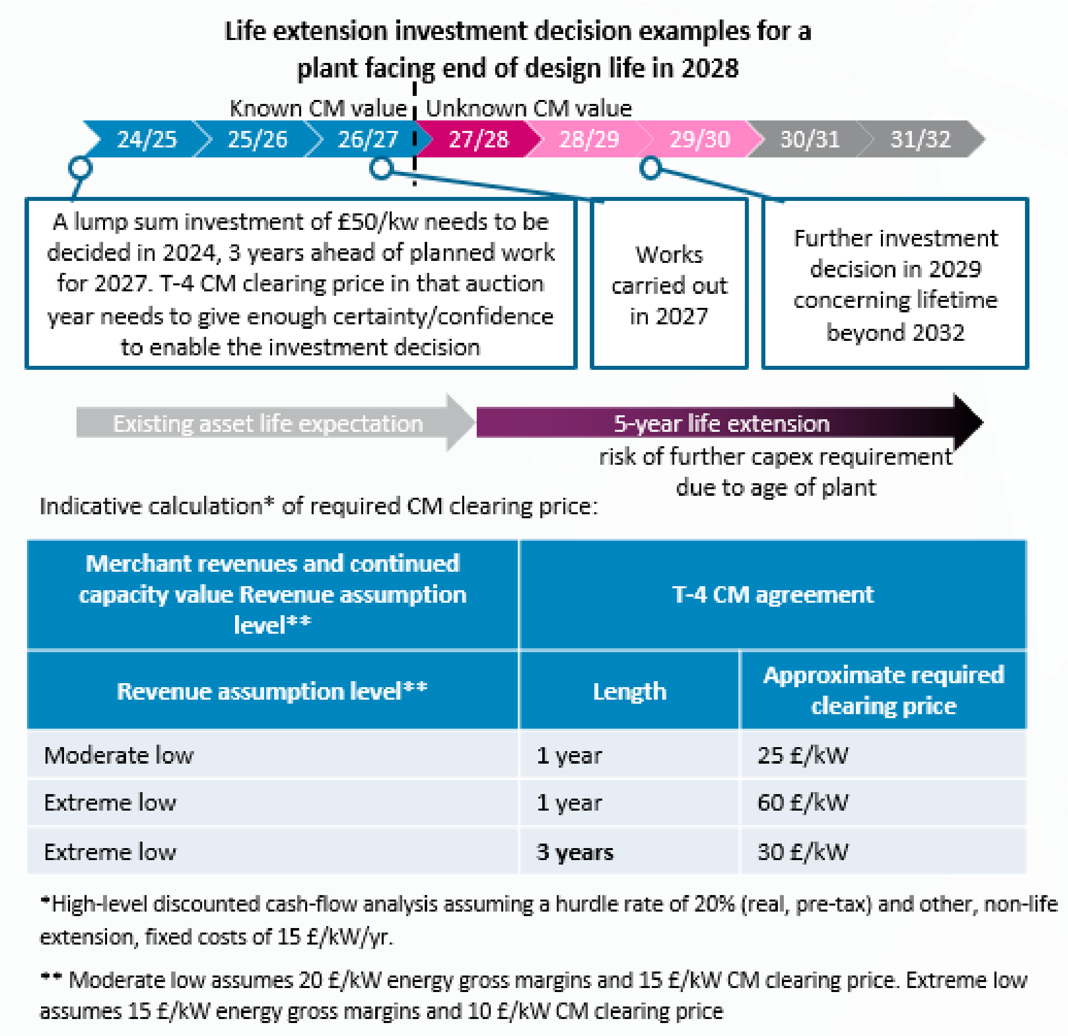
To illustrate the dynamics of life-extension decisions, we have considered a hypothetical scenario where a plant faces an end of design life in 2028. The lead-time for major maintenance events of this type and the requirement to commit to provision of capacity for T-4 suggests that the life-extension decision would need to be made in 2024 alongside the plant’s bid into the T-4 auction for 2027/28. We have estimated the hypothetical required Capacity Market clearing price for the 2027/28 auction to make the investment viable, based on a high-level, real terms discounted cash-flow analysis with different input assumptions on:

- the level of future merchant margins and CM revenues, and
- the length of the initial Capacity Market agreement

Figure 7 below illustrates the investment decision involved and the associated timeline.

Several relevant stakeholders reported that investment decisions typically assume or consider a relatively low level of merchant energy margins, far lower than historically achieved levels, due to an expectation of competition from other forms of generation in coming years. This has been illustrated with ‘Moderate Low’ assumed merchant energy margins at 20 £/kW/yr and ‘Extreme Low’ at 15 £/kW/yr; which compares to historical energy margins typically upwards of 30 £/kW/yr. We have also varied future CM clearing prices assumed in years following the initial T-4 agreement, alongside the merchant revenues, with ‘Moderate Low’ at 15 £/kW/yr and ‘Extreme Low’ at 10 £/kW/yr. Based on stakeholder engagement, we understand that conservative assumptions are typically made.

Figure 7: Existing gas CCGT life extension decision illustration[4]



A lump sum investment of £50/kw needs to be decided in 2024, 3 years ahead of planned work for 2027. T-4 CM clearing price in that auction year needs to give enough certainty/confidence to enable the investment decision

Works carried out in 2027

Further investment decision in 2029 concerning lifetime beyond 2032

Indicative calculation* of required CM clearing price:

Merchant revenues and continued capacity value Revenue assumption level**	T-4 CM agreement	
Revenue assumption level**	**Length**	**Approximate required clearing price**
Moderate low	1 year	25 £/kW
Extreme low	1 year	60 £/kW
Extreme low	**3 years**	30 £/kW

*High-level discounted cash-flow analysis assuming a hurdle rate of 20% (real, pre-tax) and other, non-life extension, fixed costs of 15 £/kW/yr.

** Moderate low assumes 20 £/kW energy gross margins and 15 £/kW CM clearing price. Extreme low assumes 15 £/kW energy gross margins and 10 £/kW CM clearing price

The other variable considered is the length of the initial capacity agreement. Existing generators are eligible for single-year capacity agreements, but three-year agreements are available to refurbishing plants with a capex threshold of 125 £/kW. Lowering this threshold to a level allowing typical life extension capex to qualify would provide additional revenue certainty to support life-extension investment decisions.

The example above illustrates that when Moderate Low revenue levels are considered across the 5-year life-extension period, the required CM clearing price for the initial capacity agreement (in this example, the T-4 auction in 2024/25) is around 25 £/kW. However, if Extreme Low merchant revenues are assumed, the required CM clearing price increases substantially to 60 £/kW. This illustrates how life-extension decisions could become infeasible, or more marginal, if plant owners take a pessimistic view on future market revenues.

Consideration of a longer 3-year CM agreement, along with Extreme Low merchant revenues across the three years of the CM agreement results in a required clearing price of 30 £/kW.

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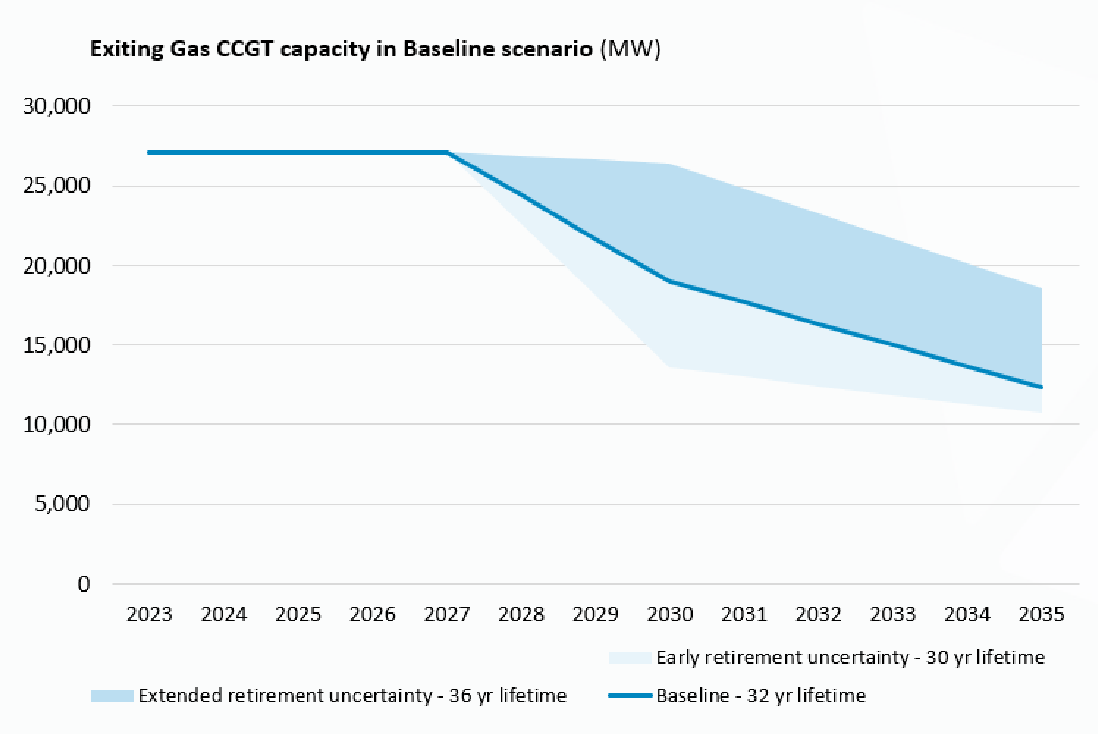
[4] Illustrative hurdle rate assumption based on stakeholder feedback of rates “in the high teens”

This illustrates how access to a longer-term CM agreement could facilitate life-extension decisions at lower CM clearing price levels.

Baseline scenario capacity assessment

Figure 8 presents the projected capacity for existing CCGTs. The condition of individual plant within the CCGT fleet will determine the possibility and cost of life-extension works. We have not carried out a plant-by-plant assessment (outside the scope of work). We have used the retirement of plant at a specified asset age as a proxy for the most likely capacity closure profile across the fleet for the Baseline scenario. Retirement dates are based on Baringa data which record the commissioning dates of individual plants. For plants that were commissioned before 1996, we assume that the earliest retirement happens in 2028 to reflect their contracted capacity status in T-4 2026/2027. To represent the trend in capacity without highlighting the retirement of specific plants, we smoothed the decrease of capacity in a linear manner.

Figure 8: Existing gas CCGT capacity in Baseline scenario



Stakeholders reported a range of views on the challenges of operating CCGTs beyond 35-40 years. Some stakeholders were optimistic that some existing CCGTs could be operated to and beyond 40 years, if required, while others stated that continued operation would become infeasible due to the declining condition of multiple major components as asset age increases.

The Baseline scenario uses a 32-year assumption which effectively assumes an average of 7-years' life extension beyond the typical 25-year design life for a CCGT. This could translate through a range of plant closure decisions: (1) some retire before 30-years, not investing when facing a major overhaul requirement; (2) many could potentially make a one-time 5-year life extension investment, retiring at around 30-years or slightly beyond given good plant condition;

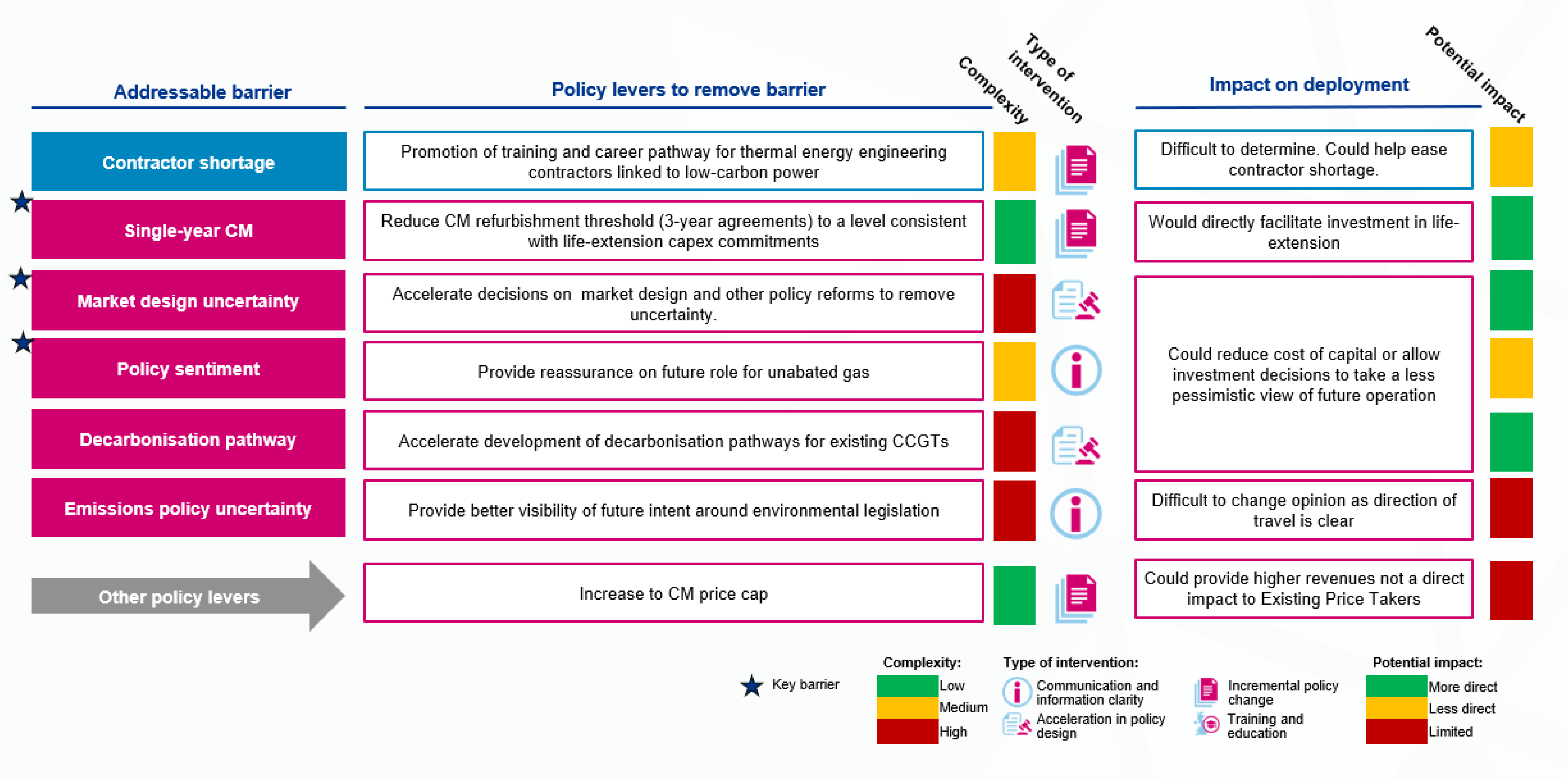
(3) a small portion could make two 5-year extensions or one-time major 10-year extension decision, operating to 35-40 years, with a potential but low likelihood beyond 40 years.

In Figure 8, we present a range of uncertainty on either side of the Baseline 32-year age capacity profile. The coloured range shows potential outcomes with an average 30-36 years age for plant closure. This represents the uncertainty related to the fleets' condition and asset owners' decision making.

Removing barriers

Potential policy levers to reduce barriers for extension of existing CCGTs are presented in Figure 9 below. A relatively less complex barrier to remove would be the single-year CM agreements (addressable by lowering the refurbishment threshold for 3-year agreements), which is likely to have a direct impact on extended capacity deployment. Other barriers would either be relatively more complex to remove or be less likely to have a direct impact. It is important to note though that the removal of barriers for gas and other technologies need to be considered in the round under a coherent policy vision to fully decarbonise the power system by 2035, subject to security of supply.

Figure 9: Barrier removal for existing gas CCGT



Addressable barrier	Policy levers to remove barrier	Complexity	Type of intervention	Impact on deployment	Potential impact
Contractor shortage	Promotion of training and career pathway for thermal energy engineering contractors linked to low-carbon power	🟨	📄	Difficult to determine. Could help ease contractor shortage.	🟨
★ Single-year CM	Reduce CM refurbishment threshold (3-year agreements) to a level consistent with life-extension capex commitments	🟩	📄	Would directly facilitate investment in life-extension	🟩
★ Market design uncertainty	Accelerate decisions on market design and other policy reforms to remove uncertainty.	🟥	⚖	Could reduce cost of capital or allow investment decisions to take a less pessimistic view of future operation	🟩
★ Policy sentiment	Provide reassurance on future role for unabated gas	🟨	ℹ		🟨
Decarbonisation pathway	Accelerate development of decarbonisation pathways for existing CCGTs	🟥	⚖		🟩
Emissions policy uncertainty	Provide better visibility of future intent around environmental legislation	🟥	ℹ	Difficult to change opinion as direction of travel is clear	🟥
Other policy levers	Increase to CM price cap	🟩	📄	Could provide higher revenues not a direct impact to Existing Price Takers	🟥

★ Key barrier

Complexity:
🟩 Low
🟨 Medium
🟥 High

Type of intervention:
ℹ Communication and information clarity
⚖ Acceleration in policy design
📄 Incremental policy change
🎯 Training and education

Potential impact:
🟩 More direct
🟨 Less direct
🟥 Limited

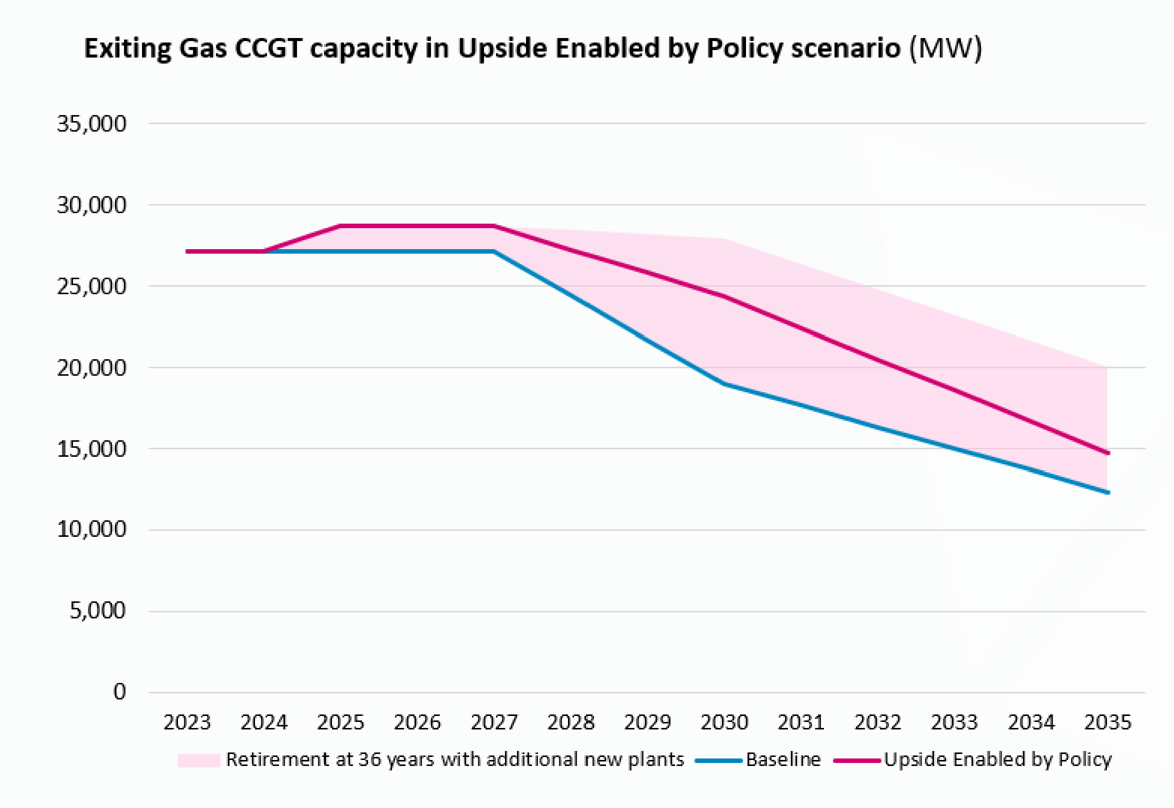
Upside Enabled by Policy

Figure 10 presents the capacity of existing CCGTs in the Upside Enabled by Policy scenario. This upside scenario for existing CCGTs includes two assumptions over the Baseline, namely: (1) The inclusion of the Calon CCGTs; and (2) An assumed incremental life-extension by an average of 2 years for all other existing CCGTs (34-year average lifetime)

The Calon CCGTs have been mothballed since Calon Energy was placed into administration. The two more modern Calon CCGTs (Severn and Sutton Bridge) are considered to have the potential to come back into the market in 2025, with a total capacity of 1.55 GW. While this return is uncertain, the removal of key barriers could signal positive intent for the role of these assets in the market.

The capacity curve for this scenario (see Figure 10) illustrates a likely upside when policy interventions are introduced to allow further life extension. The uncertainty range is highlighted with the shaded area. The overall capacity would be close to the scenario line but not necessarily follow the trend on a yearly basis due to the simplified retirement assumption. If most of the fleet have been maintained in a very good condition with proper investment historically, and they operate less frequently as reserve capacity in the future, there is a possibility, though not high, that many may have prolonged lifetime averaging around 36 years. The indicative range of 32-36 years is a judgement based on feedback from stakeholders and comes with a degree of uncertainty.

Figure 10: Existing gas CCGT capacity in Upside Enabled by Policy scenario



The extended average lifetime could be achieved through:

- A clearer policy signal on the role of unabated gas clarified for energy security which would allow operators to better justify continued investment in these assets.
- Extending CM agreements to 3 years, allowing revenue support for longer periods and reducing operators' exposure to the high merchant risk around the changing generation mix.

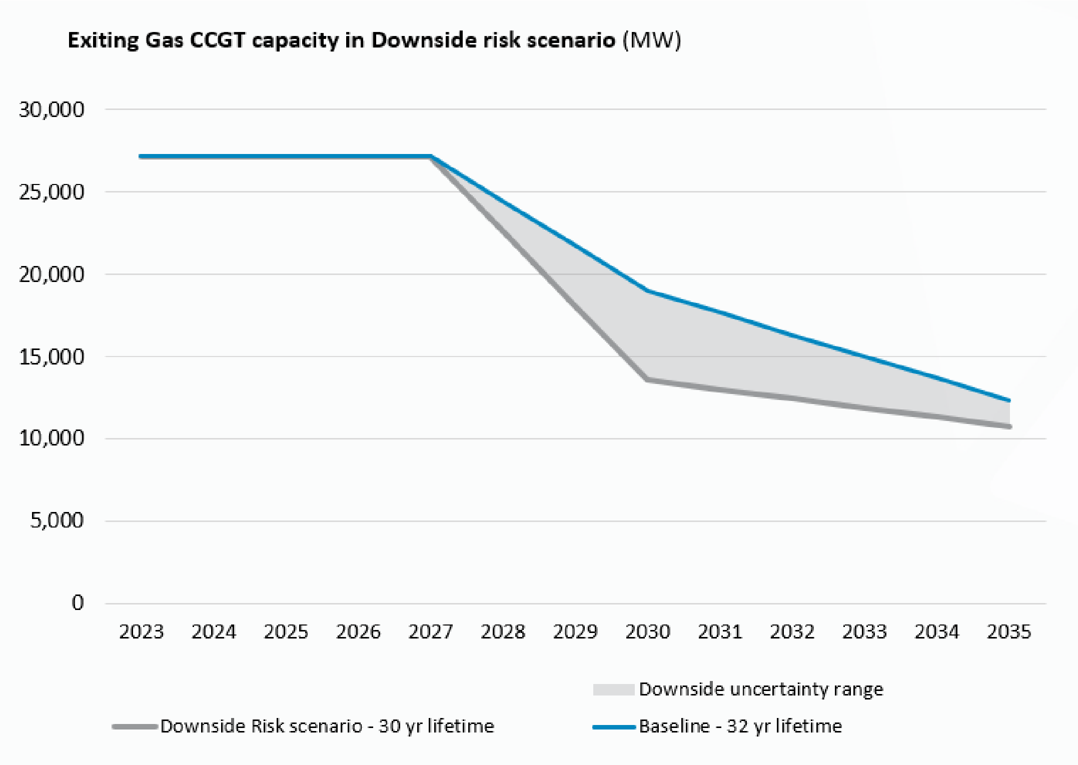
This could translate to more plant being able to invest in either additional rounds of major maintenance, or more capital to upgrade for efficiency improvement. Both would lead to an increase in average asset life.

However, aging plant conditions, overall ESG pressure, and growing decarbonisation sentiment persist as key barriers to continued operation and further investment. Therefore, we only assume a 2-year increase in average for the Upside Enabled by Policy scenario.

Downside Risk

While we assume that plants are fully capable of operating through their 25-year designed lifetime, retirement could happen anytime beyond that. For our Downside Risk scenario (see Figure 11), we assume an average 30-year lifetime, i.e., average extensions limited to 5 years as opposed to 7 years in our Baseline scenario.

Figure 11: Existing gas CCGT capacity in Downside Risk scenario



There are three key aspects of uncertainty which could lead to earlier retirement of gas CCGT plants, which include:

- *Company ESG agenda and ESG pressures from investors:* Given a global trend of decarbonisation, some companies and investors may decide to discontinue any business related to unabated gas. There is the risk that large publicly-listed companies will have to commit to divest gas assets to minimise their carbon footprint and advance their decarbonisation transition strategies.
- *Higher cost for plant less well-maintained historically:* Current fleet conditions could vary depending on how they were operated and maintained previously. Some may have been operating with high load factors and frequent starting without extensive maintenance. Some sites which are close to the coast may also suffer from greater corrosion.
- If other technologies, including renewables, nuclear, interconnectors and DSR do not deliver at the projected level, then existing CCGTs are the only available option to make up the shortfall and may burn up equivalent operating hours (EOH) more quickly, leading to earlier retirement. However, there is a limitation to how policy or any other intervention could effectively control that.

New Gas CCGTs

Capacity basis description

Table 5 shows that there are 13.4 GW of CCGT projects in the pipeline but only 3 GW of these are considered active[5].

Projects marked as Red are considered inactive. This is a judgement based on a combination of factors - changing developer strategies, alignment with decarbonisation pathways and planning/grid connection constraints – but there is uncertainty around it. This assessment is as of summer 2023 and does not reflect prequalification evidence published in November 2023.

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[5] Data source: TEC register, CM register, Baringa research, Stakeholder interviews

Table 5: New gas CCGT project pipeline and status

Project Name	Developer	Capacity (MW)	Comments	
Eggborough CCGTs (U1+U2)	EPUKi	1700	CM awarded T-4 2023	🟩
Damhead Creek 2 Unit 4 CCGT	VPI	900	CM prequalified T-4 2023 (No go at 63 £/kW)	🟨
Damhead Creek 2 Unit 5 CCGT	VPI	900	CM prequalified T-4 2023 (Not in auction)	🟨
North Killingholme	C.Gen	470	CM prequalified T-4 2023 (No go at cleared 63 £/kW price)	🟨
Kings Lynn B	EPUKi	1700	Consented (expired possibly). Prequalified CM T-4 2022. Not in CM T-4 2023	🟥
Gateway Energy Centre CCGT	Intergen	630	Consented. Not in CM 2023. High uncertainty in developer strategy	🟥
Tees CCPP	Sembcorp	1700	Consented. TEC 2025-30. Not in CM T-4 2023	🟥
Mablethorpe Storage	Statera	1500	TEC Register 2031. Project not listed on Statera website	🟥
Trafford Power	Carlton Power	2050	Prequalified CM T-4 2022. Not in CM T-4 2023. Possible mothballed development	🟥
Ferrybridge D	SSE	1820	Consented. TEC 2028-34. Not in CM T-4 2023. High uncertainty in developer strategy	🟥

Barrier assessment

There are critical barriers to the deployment of new gas CCGTs in multiple categories, and further investment is very challenging. There is a very limited pipeline of new projects, beyond which the industry doesn’t see much development potential.

Table 6: Barrier assessment of new gas CCGT deployment

Category	Assessment	Detailed barriers	Addressable by policy
Site, Planning, Grid	🟥	Very limited projects in pipeline and challenging to get planning approval	
		• Limited pipeline: Very limited pipeline of new projects being actively developed with grid connections and planning approvals	N
		• Limited sites: Limited appropriate sites with viable future decarbonisation pathway	N
		• Planning consent: Challenging to get planning approval for new unabated gas plants	Y
		• Connection time: Time required to get grid connection for new sites is long	Y
EPC	🟨	Potential bottleneck due to large volume of construction	
		• OEM capacity: OEMs shifting manufacturing focus to smaller flexible assets	N
		• Contractor shortage: Limited pool of contractors, aging workforce with recruitment challenges in competition from other engineering areas e.g., renewables	Y
Business case	🟥	Very challenging business case due to high levels of market and policy uncertainty, leading developers to require return in less than 10 years	
		• CM price cap: CM price to meet return requirements could be in excess of the current cap	Y
		• Policy sentiment: Participation of unabated CCGTs, especially beyond 2035, is unclear with sentiment reported by stakeholders as ‘anti gas’	Y
		• Market design uncertainty: Ongoing reform such as REMA and CM reform creates significant uncertainty	Y
		• Emissions policy uncertainty: Limits proposed to constrain new-build CCGT operation from 2034 with uncertainty in carbon costs and potential further restrictions	Y
		• Decarbonisation pathway: Conversion of new CCGTs to burn hydrogen is technically complex. Sites need to be close to a CCS cluster for potential retrofit.	Y
Finance	🟥	Financing conditions are very challenging as public companies are not able to invest due to ESG factors	
		• Availability of capital: Very limited pool of capital for continued investment in new unabated gas	N

	🟥	• ESG pressure: Public companies committed to decarbonisation will not invest in new unabated gas assets	N
		• High capital cost: Capital investment for CCGT is high requiring debt finance to fund construction or highly capitalised balance sheet developers	N
		• High return requirement: High hurdle rate is applied due to uncertainty of future margins and long-term role	N

Key barriers

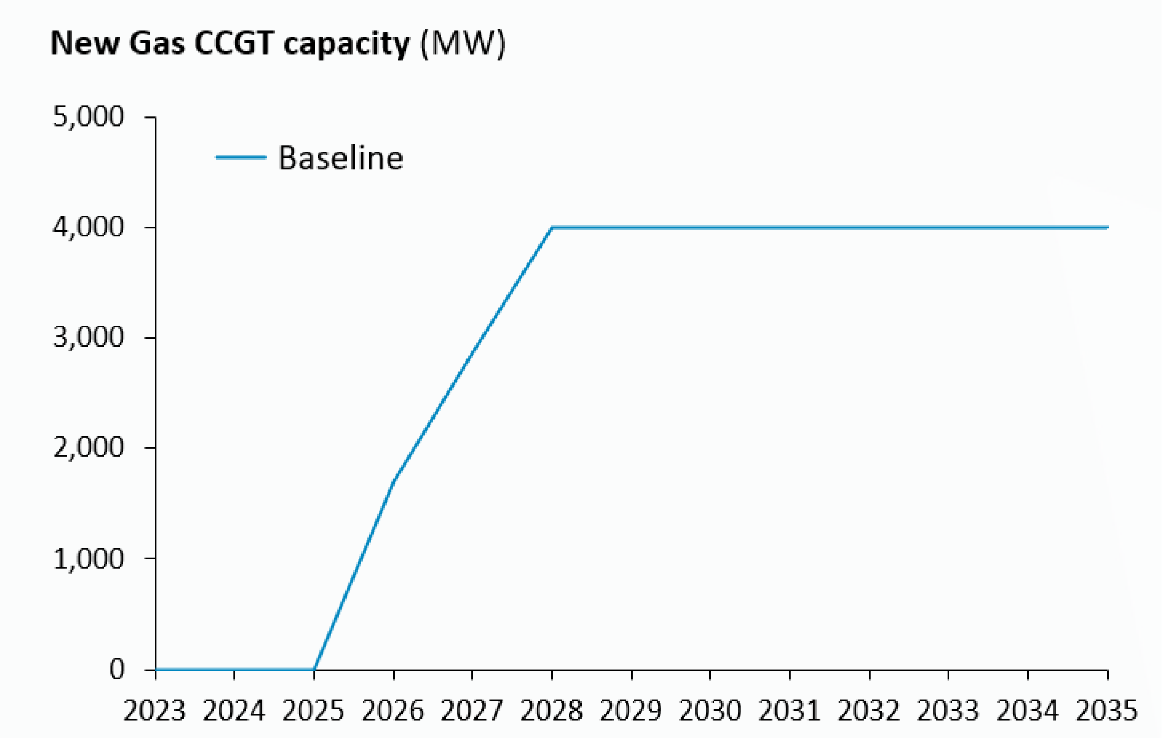
Among all the above barriers, (1) limited pipeline; (2) emission policy uncertainty; (3) decarbonisation pathway uncertainty; and (4) availability of capital are considered to be the key barriers.

Baseline scenario capacity assessment

Figure 12 shows the capacity in the Baseline scenario. For new CCGTs, the scenario includes Eggborough (1700 MW) which has a 15-year CM agreement from 2026-2027 and would start operating in 2026. This also assumes that initial commissioning is on an unabated basis. If the project is developed to be CCS ready, commissioning it as a potential abated asset would lead to a 1-year delay in the process.

Beyond that, the scenario assumes only C. Gen and VPI Damhead Creek 2 are the two projects with potential to be developed (total of 2300 MW). We assume deployment of these projects across 2027-28 on the basis that they could secure CM agreements in the next 1-2 years. The outcome of the CM auctions still remains uncertain. However, given the large scale and extensive preparation work required for CCGTs, we assume these amber-rated projects are more likely to be deployed in the Baseline scenario. This leads to a total 4 GW of new build gas capacity in 2028.

Figure 12: New gas CCGT capacity in Baseline scenario

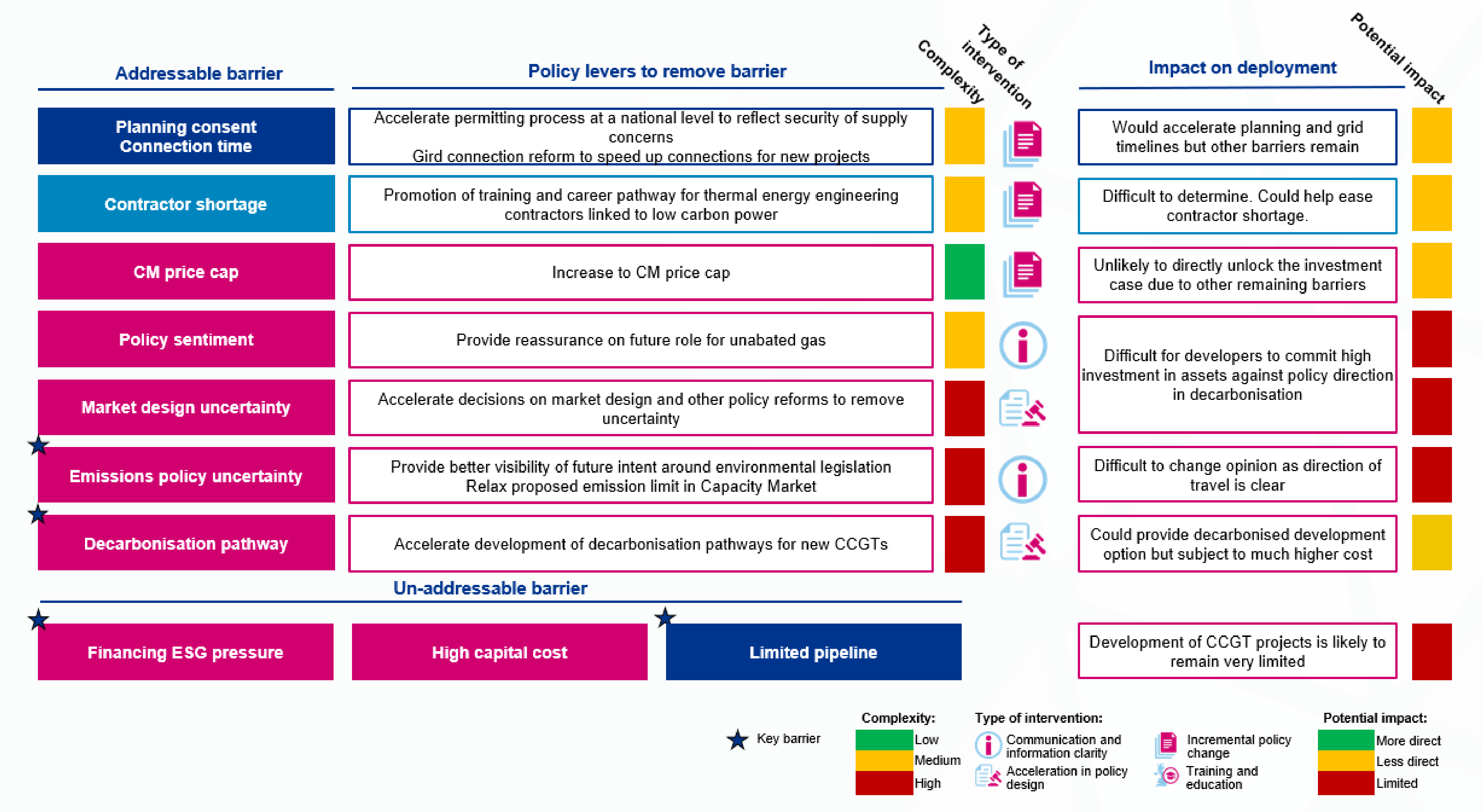


Engagement with stakeholders suggests that there is no appetite to develop further unabated CCGT projects. Planning consent, business case, and financing barriers combine to make the investment case very challenging for new CCGT projects.

Removing barriers

Figure 13 shows the assessment on removing barriers for new CCGTs. Though there are levers to remove some of the barriers, the overall impact is likely be limited. Most measures are difficult to implement. Some could be related to a high budget requirement (e.g. accelerate decarbonisation pathway – CCS), while others around emissions are against the ambitious direction of travel for decarbonisation. There are also several key barriers that could not be addressed, in particular unlocking the business case for new CCGTs could be very challenging.

Figure 13: Barrier removal for new gas CCGT



Addressable barrier	Policy levers to remove barrier	Complexity	Type of intervention	Impact on deployment	Potential impact
Planning consent Connection time	Accelerate permitting process at a national level to reflect security of supply concerns Gird connection reform to speed up connections for new projects	🟨	📄	Would accelerate planning and grid timelines but other barriers remain	🟨
Contractor shortage	Promotion of training and career pathway for thermal energy engineering contractors linked to low carbon power	🟨	📄	Difficult to determine. Could help ease contractor shortage.	🟨
CM price cap	Increase to CM price cap	🟩	📄	Unlikely to directly unlock the investment case due to other remaining barriers	🟨
Policy sentiment	Provide reassurance on future role for unabated gas	🟨	ⓘ	Difficult for developers to commit high investment in assets against policy direction in decarbonisation	🟥
Market design uncertainty	Accelerate decisions on market design and other policy reforms to remove uncertainty	🟥	📝		🟥
★ Emissions policy uncertainty	Provide better visibility of future intent around environmental legislation Relax proposed emission limit in Capacity Market	🟥	ⓘ	Difficult to change opinion as direction of travel is clear	🟥
★ Decarbonisation pathway	Accelerate development of decarbonisation pathways for new CCGTs	🟥	📝	Could provide decarbonised development option but subject to much higher cost	🟨

Un-addressable barrier

			Impact on deployment	Potential impact
★ Financing ESG pressure	High capital cost	★ Limited pipeline	Development of CCGT projects is likely to remain very limited	🟥

★ Key barrier

Complexity:
- 🟩 Low
- 🟨 Medium
- 🟥 High

Type of intervention:
- ⓘ Communication and information clarity
- 📝 Acceleration in policy design
- 📄 Incremental policy change
- 🎓 Training and education

Potential impact:
- 🟩 More direct
- 🟨 Less direct
- 🟥 Limited

Upside Enabled by Policy

Engagement with stakeholders suggests that there is no appetite to develop further unabated CCGT projects beyond those included in the Baseline scenario.

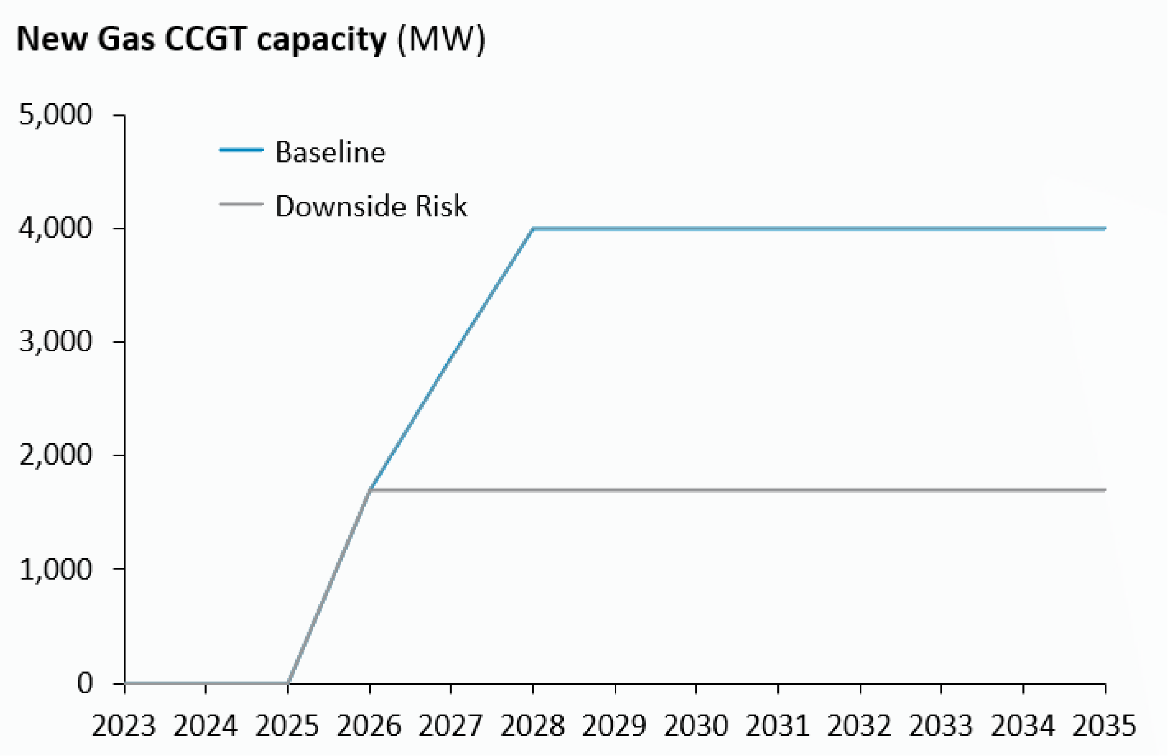
The complexity and limited potential impact of barrier removal, along with remaining unaddressable barriers, suggest that it will be very difficult for policy intervention to incentivise further projects to come forward. The capacity in the Upside Enabled by Policy scenario is therefore the same as in the Baseline.

A detailed assessment on the deployment potential for new gas plants which are then converted to low carbon is out-of-scope of the study, and has not been considered in full in the the Upside scenario, Downside Risk

Figure 14 shows the deployment capacity of new gas CCGT in the Downside Risk scenario. We consider projects with CM agreements (EPUKI's Eggborough project, 1700 MW) to be reasonably secure. However, all further projects are considered as uncertain and therefore excluded in this scenario.

There is a risk that developers could consider the business case and financing to be challenging enough to make a final investment decision impossible in the current environment.

Figure 14: New gas CCGT capacity in Downside Risk scenario



The CM price cap of 75 £/kW is a barrier for some stakeholders. The combined challenges in both business case and financing conditions mean that a higher capacity agreement strike price may help.

New Gas OCGTs and Engines

Capacity basis description

OCGTs (open cycle gas turbines) and gas engines provide dispatchable power generation in the GB market, with a total combined capacity of 4 to 5 GW being currently operational.

The pipeline (as shown in Table 7) of new OCGT projects is relatively light at a total of 1.2 GW with confirmed CM agreements and a further 1.7 GW of visible development pipeline[6]. Projects marked as red are considered less likely to proceed due to changing developer strategies.

New gas engines have been consistent across recent capacity auctions with around 600 MW in each of the past three rounds leading to a total pipeline of 1.7 GW (as shown in Table 8) awarded agreements in recent capacity auctions[6]. A further pipeline of 0.6 GW is visible via recent unsuccessful CM participation, though additional capacity could exist. Developers have reported reduced appetite to develop new projects due to a combination of grid, planning and business case barriers.

Table 7: New gas OCGT project pipeline and status

Project Name	Developer	Capacity (MW)	Comments	
Hirwaun Power	Drax	300	CM awarded T-4 2021. Build in progress	🟩
Millbrook Power	Drax	300	CM awarded T-4 2021. Build in progress	🟩
Progress Power	Drax	300	CM awarded T-4 2021. Build in progress	🟩
VPI Immingham B OCGT	VPI	300	CM awarded T-4 2022. TEC 2024	🟩
Eggborough OCGT	EPUKi	300	CM prequalified T-4 2023 (No go at 63 £/kW)	🟨
Corby 2	ESB	330	CM prequalified T-4 2023 (No go at 63 £/kW)	🟨
Abergelli Power Ltd	Drax	300	CM prequalified T-4 2023 (Not in auction)	🟨

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[6] Data source: TEC register, CM register, Baringa research, stakeholder interview

Gateway Energy Centre OCGT	Intergen	300	Consented. Not in CM 2023. Further progress depending on developer strategy	🟥
Medway 3	SSE	500	TEC register 2031	🟥

Table 8: New gas engine project pipeline and status

Project Name	Developer	Capacity (MW)	Comments	
Various projects (T-4 2021)	STOR power, Forsa, Conrad, various	576	CM awarded T-4 2021	🟩
Various projects (T-4 2022)	Statera, Forsa, VPI, Conrad, RWE, various	589	CM awarded T-4 2022	🟩
Thurrock 1	Statera	270	CM awarded T-4 2023	🟩
Various projects (T-4 2023 awarded)	Various	300	CM awarded T-4 2023	🟩
Thurrock 2	Statera	330	CM not prequalified T-4 2023	🟨
Various projects (T-4 2023 withdrawn)	Statera	200	CM prequalified T-4 2023 (Not in auction)	🟨
Various projects (T-4 2023 unsuccesful)	Conrad, Mercia, various	90	CM prequalified T-4 2023 (Not awarded)	🟨

Barrier assessment

New OCGTs and gas engines face a similar set of barriers to new CCGTs but the smaller capex requirement and lower requirement for market revenues decreases risk.

Table 9: Barrier assessment of new gas OCGT and engine deployment

Category	Assessment	Detailed barriers	Addressable by policy
Site, Planning, Grid	🟥	Very limited projects in pipeline and challenging to get planning approval	
		- Limited pipeline: Limited pipeline of new projects being actively developed with grid connections and planning approvals	N
		- Planning consent: Challenging to get planning approval for new unabated gas plants with a high likelihood of local objections	?
		- Connection time: Time required for grid connection for new sites is long	Y
EPC	🟨	Potential bottleneck subject to large volume of construction	
		- Contractor shortage: Limited pool of contractors, aging workforce with recruitment challenges in competition from other engineering areas e.g. renewables	Y
Business case	🟥	Very challenging business case due to high-level of market and policy uncertainty	
		- CM price cap: CM price required to meet return requirements could be in excess of the current cap	Y
		- Policy sentiment: Policy direction of decarbonisation and sentiment reported by stakeholders as ‘anti gas’, but long-term role for unabated peakers is relatively clearer than for CCGTs	Y
		- Market design uncertainty: Ongoing reform such as REMA and CM reform creates significant uncertainty	Y
		- Emissions policy uncertainty: Limits proposed to constrain new-build gas plant operation from 2034 with uncertainty in carbon costs and potential further restrictions	Y
		- Uncertainty in upside scarcity payment: Potential for regulatory intervention limits the consideration of market revenue upside in the business case	Y
		- Decarbonisation pathway: Peakers could potentially decarbonise with a switch to hydrogen fuel but the investment pathway is unclear and technical complexities are a barrier	Y
Finance	🟥	Financing is a challenge, but the lower capex compared to CCGTs reduces the barrier and opens up a wider pool of developers	

	🟥	• Availability of capital: Very limited pool of capital for continued investment in unabated gas	N
		• ESG pressure: Public companies committed to decarbonisation will not invest in unabated gas assets	N
		• High return requirement: High hurdle rate is applied due to uncertainty of future margins and long-term role	N

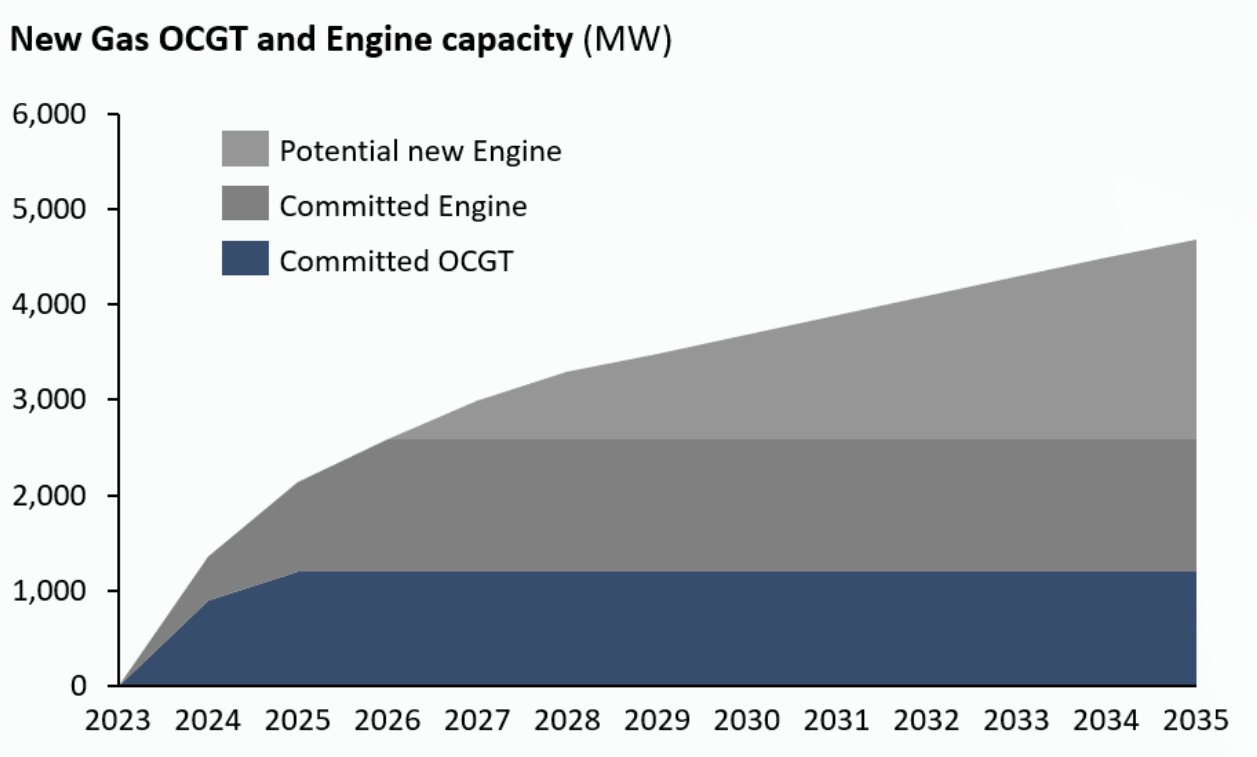
Key barriers

Among all the above barriers, (1) limited pipeline; (2) market design uncertainty; (3) availability of capital; and (4) high return requirement are considered to be the key barriers.

Baseline scenario capacity assessment

In the Baseline scenario (see Figure 15), we include committed capacity (capacity with CM agreements) for OCGTs and gas engines, with a view that OCGT projects are likely be delivered at 100%, while some delivery risk exists for gas engines with capacity decreased to 80% of total. The differing view is based on feedback through stakeholder interviews, noting there is still uncertainty on new OCGT build.

Figure 15: New gas OCGT and engine capacity in Baseline scenario



There is some risk that further non-delivery could lead to capacity being lower than assumed or delayed beyond expected commissioning dates.

We assume no further OCGTs beyond committed projects would be deployed due to identified deployment barriers and feedback from stakeholders. This is noted as an uncertainty and some further deployment of OCGTs could emerge. For gas engines, we assume that some further capacity will be deployed, although at a lower rate than the committed capacity, which is consistent with stakeholder feedback that some new build projects remain in the future pipeline.

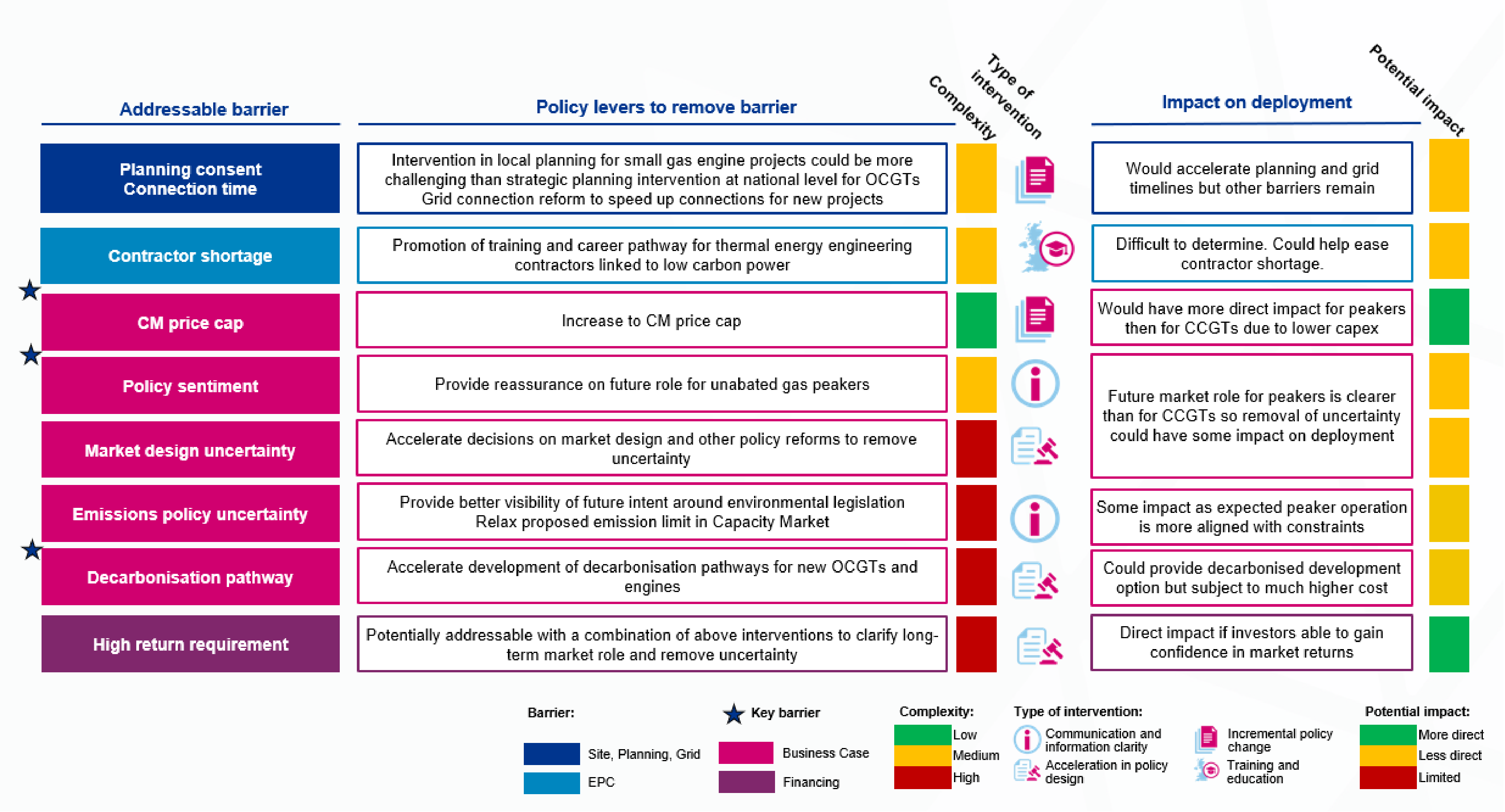
The annual rate of future deployment decreases from 400 MW in 2027 to 200 MW per year from 2029 which is reflective of stakeholder feedback on the challenges of developing new sites (planning and grid connection barriers) and reduced investor appetite for unabated gas (financing barriers). The continued deployment of gas engines, albeit at slower rate, is considered reasonable because:

- High CM clearing prices with 15-year contracts would cover the majority of required revenues
- The decarbonisation pathway for gas engine sites is potentially simpler than larger gas turbines with more manageable upgrade costs for hydrogen blending options.

Removing barriers

Figure 16 presents the policy levers that could be used to allow a further deployment of smaller flexible gas assets. Among all levers, increasing the CM price cap to unlock the business case is the one which could potentially be implemented with relatively less complexity, with the impact considered to be relatively direct. Some clarifications on the role of gas peakers in supporting security of supply could have an impact to provide investor reassurance. Similarly, interventions to facilitate developers receiving planning consent for unabated gas, at local or national level, could have an impact. However, the challenges around decarbonisation pathway are complex to resolve considering the nature of the hydrogen-to-power development.

Figure 16: Barrier removal for new gas OCGT and engine



Addressable barrier	Policy levers to remove barrier	Complexity	Type of intervention	Impact on deployment	Potential impact
Planning consent Connection time	Intervention in local planning for small gas engine projects could be more challenging than strategic planning intervention at national level for OCGTs Grid connection reform to speed up connections for new projects	🟨	📄	Would accelerate planning and grid timelines but other barriers remain	🟨
Contractor shortage	Promotion of training and career pathway for thermal energy engineering contractors linked to low carbon power	🟨	🎓	Difficult to determine. Could help ease contractor shortage.	🟨
★ CM price cap	Increase to CM price cap	🟩	📄	Would have more direct impact for peakers then for CCGTs due to lower capex	🟩
★ Policy sentiment	Provide reassurance on future role for unabated gas peakers	🟨	ⓘ	Future market role for peakers is clearer than for CCGTs so removal of uncertainty could have some impact on deployment	🟨
Market design uncertainty	Accelerate decisions on market design and other policy reforms to remove uncertainty	🟥	⚖		🟨
Emissions policy uncertainty	Provide better visibility of future intent around environmental legislation Relax proposed emission limit in Capacity Market	🟥	ⓘ	Some impact as expected peaker operation is more aligned with constraints	🟨
★ Decarbonisation pathway	Accelerate development of decarbonisation pathways for new OCGTs and engines	🟥	⚖	Could provide decarbonised development option but subject to much higher cost	🟨
High return requirement	Potentially addressable with a combination of above interventions to clarify long-term market role and remove uncertainty	🟥	⚖	Direct impact if investors able to gain confidence in market returns	🟩

Barier:
- 🟦 Site, Planning, Grid
- 🟦 EPC
- 🟥 Business Case
- 🟪 Financing

★ Key barrier

Complexity:
- 🟩 Low
- 🟨 Medium
- 🟥 High

Type of intervention:
- ⓘ Communication and information clarity
- ⚖ Acceleration in policy design
- 📄 Incremental policy change
- 🎓 Training and education

Potential impact:
- 🟩 More direct
- 🟨 Less direct
- 🟥 Limited

Upside Enabled by Policy

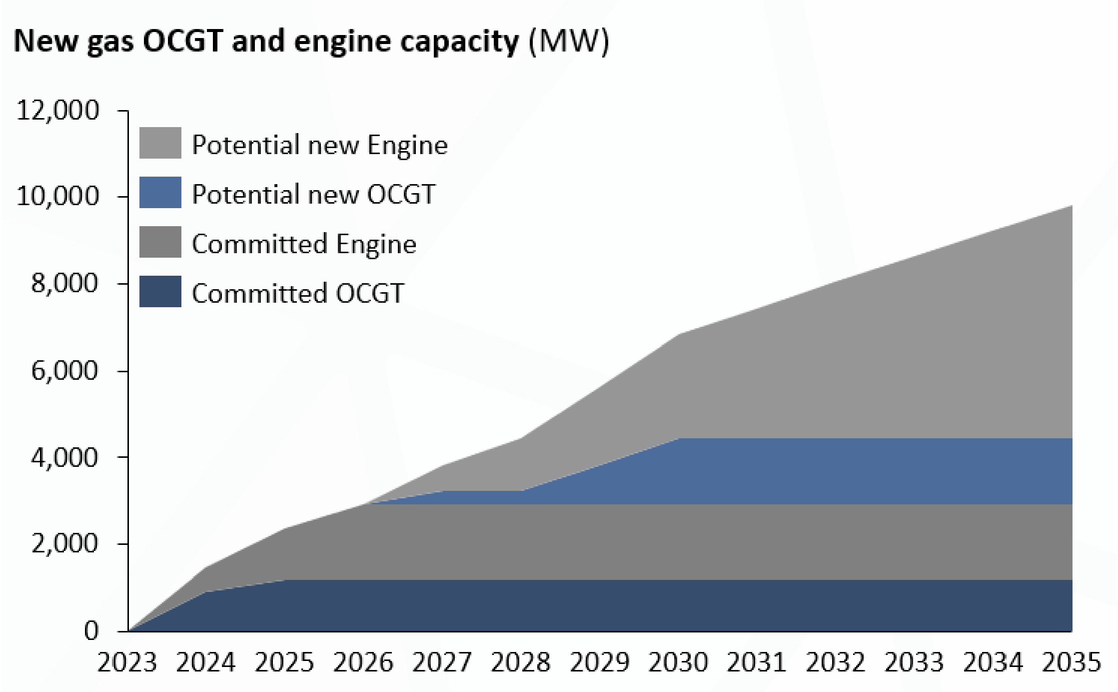
For the Upside Enabled by Policy scenario, we assume an increased CM price cap, and some effort to ease planning and grid constraints. This, along with efforts to remove business case uncertainty (across various levers such as role of peakers in the future and emissions policy), enables a higher volume of future projects to be developed. As with CCGTs, a detailed assessment on the deployment potential for new gas plants which are then converted to low carbon is out-of-scope of the study, and has not been considered in full in the Upside scenario,

We also take a more optimistic view of committed capacity delivery, with 100% of gas engines with existing CM agreements being delivered.

Figure 17 shows the capacity for Upside Enabled by Policy scenario. We assume a total of five new OCGT projects (300 MW each) in addition to the baseline capacity, with one delivered in 2027 from the existing pipeline, and four further projects delivered over 2029-30. These projects could come from those in the current pipeline with less certain status, or some newly incepted ones as developers see market opportunities.

Gas engine capacity is expected to increase at 600 MW/yr, consistent with approximate volumes coming through recent CM auctions.

Figure 17: New gas OCGT and engine capacity in Upside Enabled by Policy scenario



Downside Risk

No Downside scenario is presented for OCGTs and gas engines as the baseline is considered to be reasonably conservative.

Potential downside risks would include non-delivery of committed capacity and more extreme reduction in new gas engine capacity.

This publication is available from: www.gov.uk/government/publications/review-of-electricity-market-arrangements-rema-technical-research-supporting-consultation