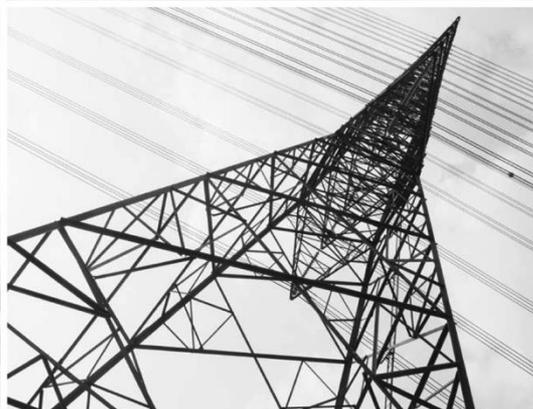


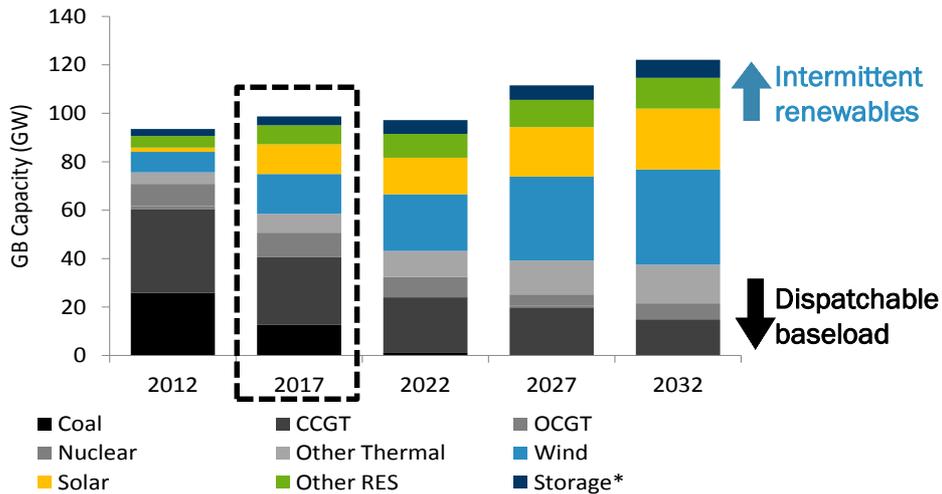
Gas as a key enabler of flexible electricity generation

THE ROLE OF GAS IN THE ENERGY TRANSITION

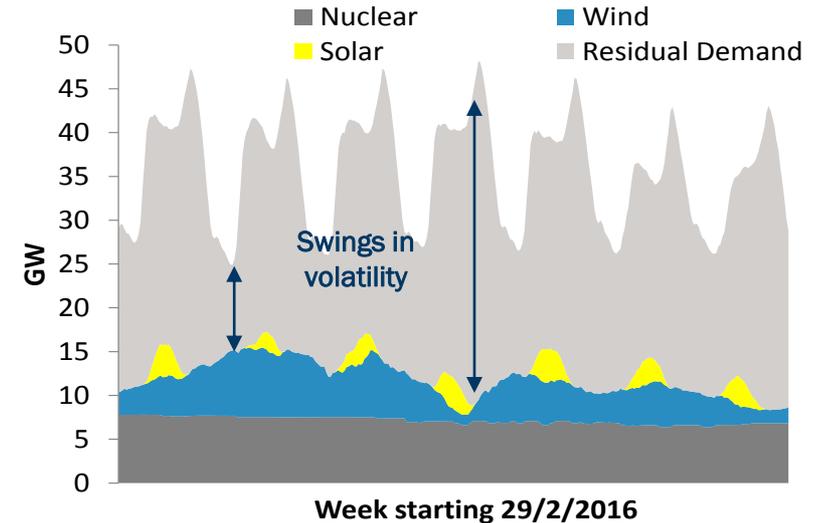


Rapidly growing intermittent renewables have created a compelling need for increased flexibility within GB power market

Intermittent renewables have been rapidly displacing conventional thermal generation in GB ...



...which has resulted in a greater mismatch between supply and demand at particular periods of time



new business models
monetise flexibility

second-by-second balancing

stacking decline in dispatchable baseload

growth of intermittent RES

increasing demand/supply imbalances

back-up flexible supply

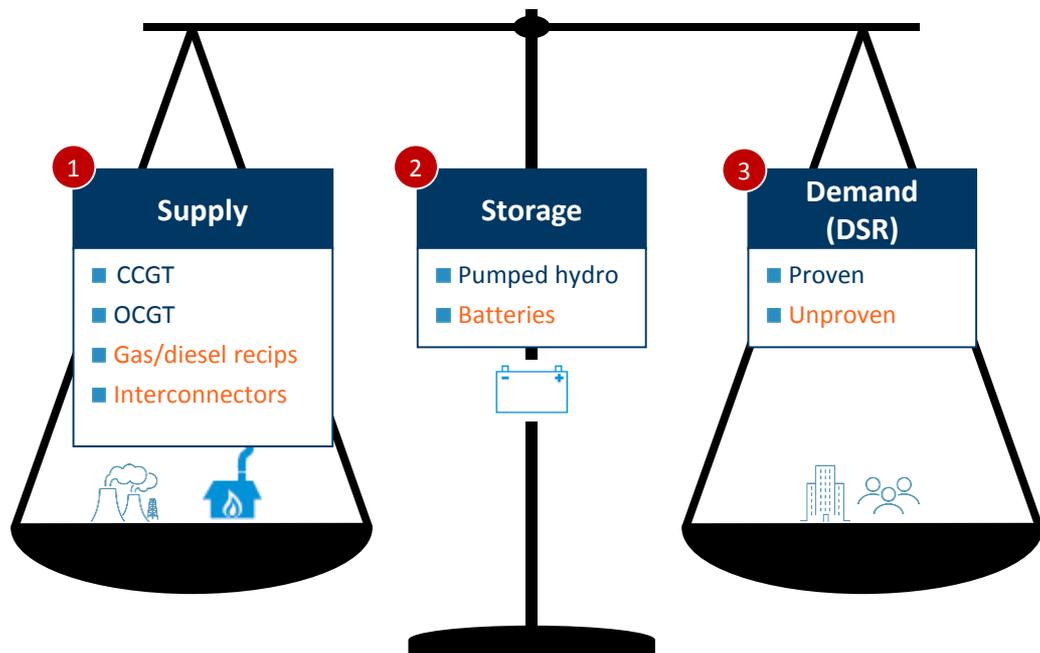
new flexibility services
arbitrage opportunities

Source: DUKES, NG – Slow Progression.

* Storage includes pumped hydro storage and batteries.

Value of flexibility offered by different technologies depends on their technical characteristics, but a role for gas remains in the short run

Supply, demand and storage solution can each contribute to the system's need for flexibility...



Legend

“Old world” sources of flexibility
 “New world” sources of flexibility

...but some technologies have their natural ‘niche’ areas where they can monetise their value

| | | |
|----------|-------------------------|---|
| A | Wholesale market | <ul style="list-style-type: none"> ■ Interconnectors and fossil fuels best placed ■ DSR / storage have not found route to arbitrage yet |
| B | Balancing Mechanism | <ul style="list-style-type: none"> ■ Fast flexibility required, ‘nimble’ plants have an advantage (e.g. recipcs, pumped hydro) |
| C | Capacity Market | <ul style="list-style-type: none"> ■ Recipcs have been the winners (initially diesel, later only gas), but less so in 2018 after the triads cut ■ Short-duration batteries now less prominent |
| D | STOR | <ul style="list-style-type: none"> ■ Long-term STOR contracts are an advantage ■ Recipcs have been successful, but market highly competitive |
| E | Fast Reserve | <ul style="list-style-type: none"> ■ Historically a niche area for pumped hydro... ■ ...but recipcs have been making some headway |
| F | Firm Frequency Response | <ul style="list-style-type: none"> ■ Very fast flexibility required, suited to storage ■ Recipcs have sought to enter this market too |
| G | Embedded benefits | <ul style="list-style-type: none"> ■ Historically a key source of revenue for distributed plants, but now reduced through triad cuts |

Gas recip. have exploded onto the scene but profitable growth is a complex game of 'bash the weasel'...



....as recent regulatory interventions and market outcomes have reduced investor certainty

Initial business case: distributed gas

Capacity market

- Prices ~£20/kW in the initial auctions, but most recently at £8.4/kW
- Previously seen as reliable baseline revenue, but recently too low

Embedded benefits

- Initially seen as reliable revenue...
- ...but recent cuts to triads aimed at restoring 'level playing field' in CM to the detriment of recipis



Recovering lost EB revenue

Wholesale market

- Increasingly sharper peaks: harder-to-hit but more valuable opportunities
- Fundamentals may worsen as RES increasingly 'self-balancing'

Balancing mechanism

- Historically set up for large plants, so not everyone benefits equally
- BM Lite could increase competition for all parties

Ancillary services

- SO reforms likely to have limited impact...
- ...but competition already stiff and DSO reform might not help

Continued investment uncertainty

Capacity market

- Ongoing policy risks through CM reforms
- Uncertain future prices, which may only pick up in the mid-2020's when coal shuts down

Embedded benefits

- Benefits as such appear to be gone
- Value of being 'distributed' currently uncertain and not fully monetised

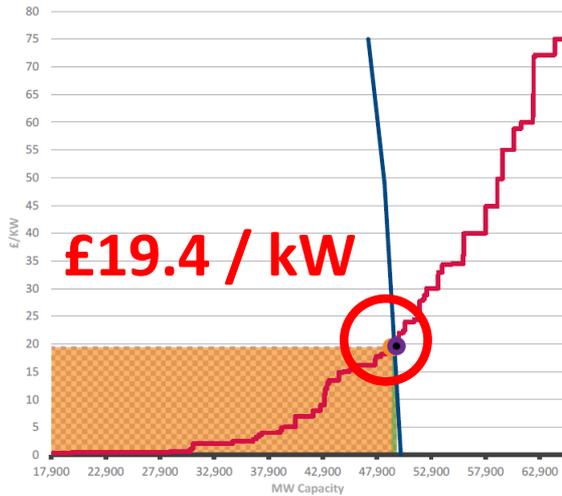
Wholesale market / BM

- Increasingly saturated markets where flexibility providers compete for a small number of highly valuable hours
- Forecasting capabilities and willingness to take risks key drivers of success



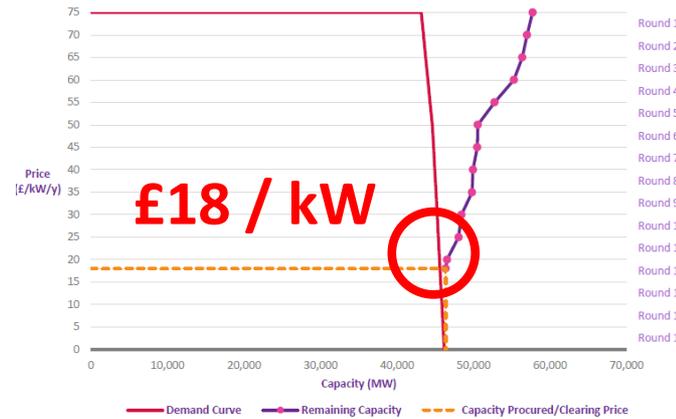
The Capacity Mechanism has been an important source of revenue for providers of flexible generation, but will this continue?

2014



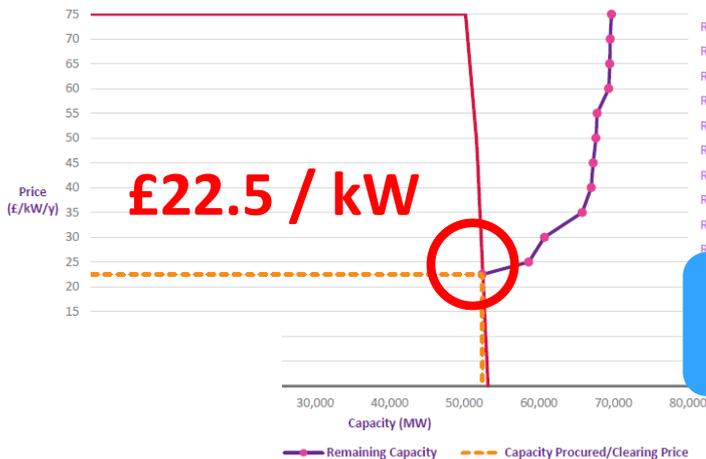
2.1 GW
OCGT + recip

2015



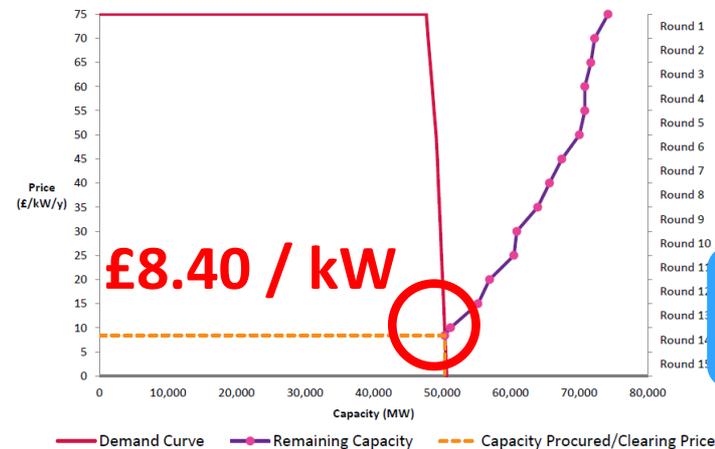
2.4 GW
OCGT + recip

2016



3.8 GW
OCGT + recip

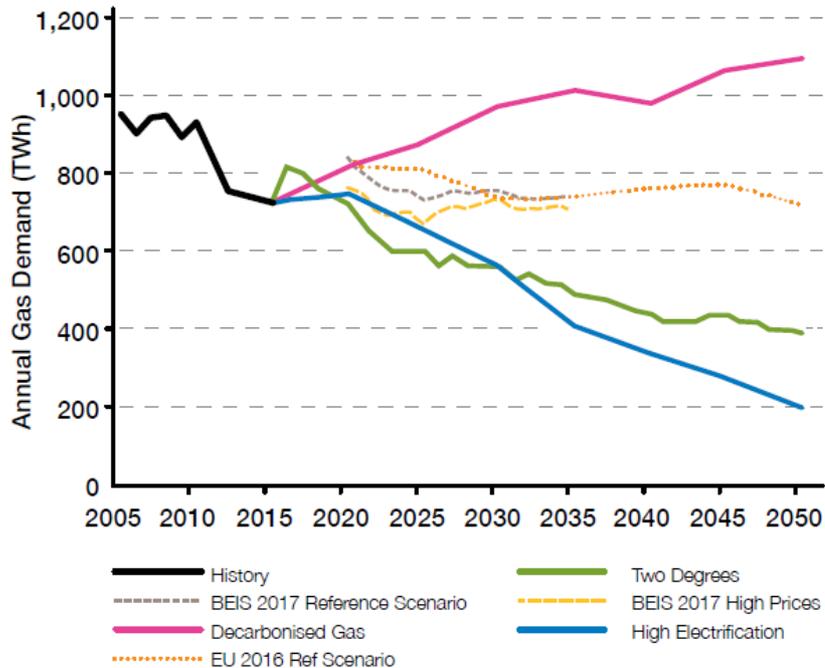
2018



2.7 GW
OCGT + recip

Gas power generation could grow significantly if 'green gas' becomes mainstream, but electrification is a potential game-changer

Gas demand to 2050 in the FOG sensitivities



Decarbonised gas

- Maximum use of gas in the power sector with **43GW of gas with CCS** supporting renewables
- Hydrogen-based transport and heat could drive growth in gas demand (avoiding roll-out of heat pumps)

Two degrees

- Mixed approach with some heat and transport electrification...
- ...combined with increasing volumes of 'green gas'

High electrification

- Power generation virtually decarbonised...
- ...but **21GW of gas with CCS** remains to balance renewables
- Electric vehicles and heat pumps dominate heat and transport sector

Key uncertainties

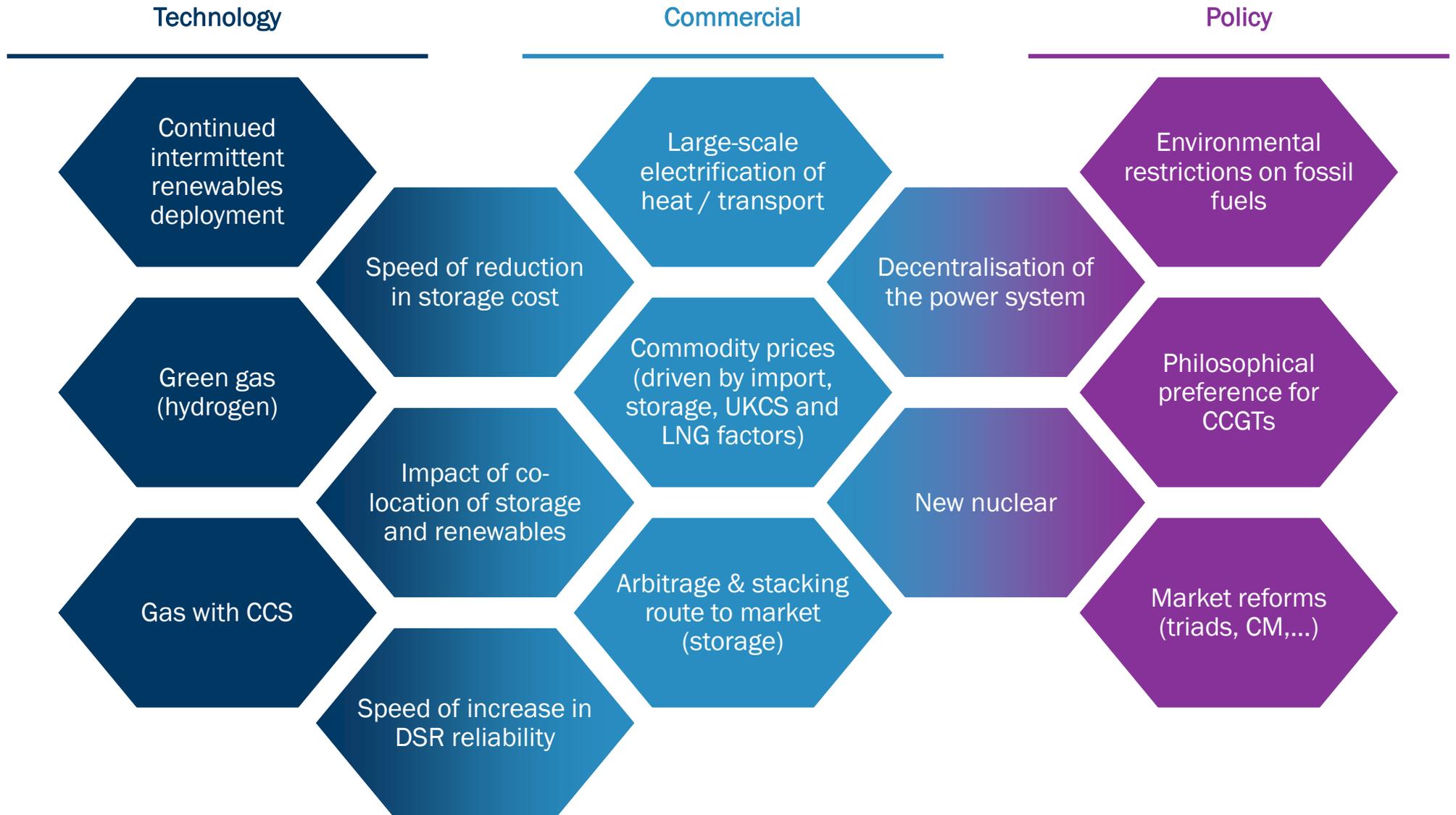
Hydrogen as 'green gas'

Carbon Capture and Storage

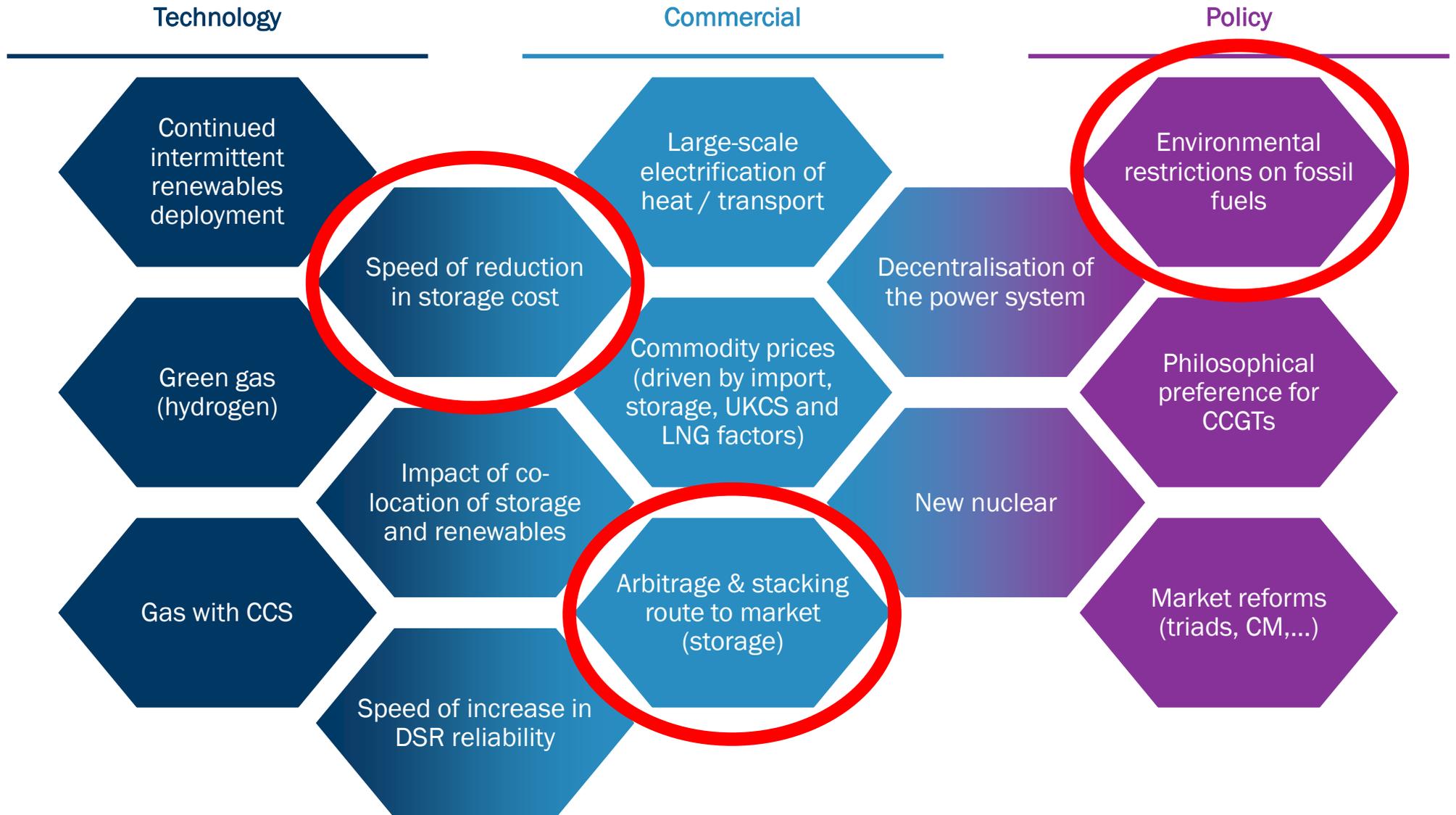
Heat pumps

Electric / CNG transport

Long-term drivers of gas-based flexible power generation are complex, creating significant uncertainty for prospective investors



Long-term drivers of gas-based flexible power generation are complex, creating significant uncertainty for prospective investors





Any questions?



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