Department for
Business, Energy
& Industrial Strategy

Hydrogen Business Models: Expert Group meeting

Hydrogen Business Models Team

12:30pm 20th May 2021

Note: The content in the following slides does not represent BEIS policy, but provides ideas for discussion

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Meeting etiquette

Please can you:

- ✓ Turn off your video when not speaking
- ✓ Mute your microphone when not speaking
- ✓ Raise questions via the chat function or put your hand up

This meeting will be recorded.

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Agenda

	Item	Time	Lead
1	Introduction from BEIS	12:30-12:40 10 mins	Will Lochhead
2	Price support including: ▪ Reference price ▪ Indexation	12:40-13:40 60 mins	Chris Thomas
3	Volume support approach	13:40-14:00 20 mins	Shabana Jamil
4	Contract duration	14:00-14:20 20 mins	Shabana Jamil
5	AOB and end	14:20-14:30 10 mins	Will Lochhead

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Price support, reference price and indexation: Expert Group update

Chris Thomas
Hydrogen Business Models
Team

20th May 2021

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Preamble

At the April Expert Group, we set out options for price support and the emerging preference for a variable premium model. We committed to return to the May meeting with further detail on design features. The following pages focus on design features for a variable premium to enable stakeholders to consider the potential suitability of this model for the range of low carbon hydrogen projects.

A variable premium model requires a reference price. Ideally this reference price should reflect the market value of what is being produced – for example, the CfDs for renewable electricity utilise wholesale electricity prices as their reference price.

Although offshore wind was a new technology, its output was fully fungible with electricity from existing technologies – it required no new investment in specialised distribution or consumption infrastructure to enter the market place.

Hydrogen is different.

It is not fungible with the existing high carbon fuels that it would be seeking to displace, and will require new investments in both specialised distribution and consumption infrastructure in order to enter the market place (including to displace byproduct grey hydrogen).

There is also no existing market reference price for hydrogen (low carbon or otherwise), and so until one is available a proxy must instead be used.

The following pages examine some of these potential proxies.

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What should we be looking for in a reference price?

1. Enables level of subsidy to reduce over length of contract
2. Positively correlated to market value of hydrogen
3. Incentivises producer to maximise market revenue
4. Aids fuel switching/hydrogen deployment
5. Accommodative of other HMG policy levers
6. Independent and easy to monitor
7. Applicable to any hydrogen production technology
8. Applicable to any hydrogen operating archetype

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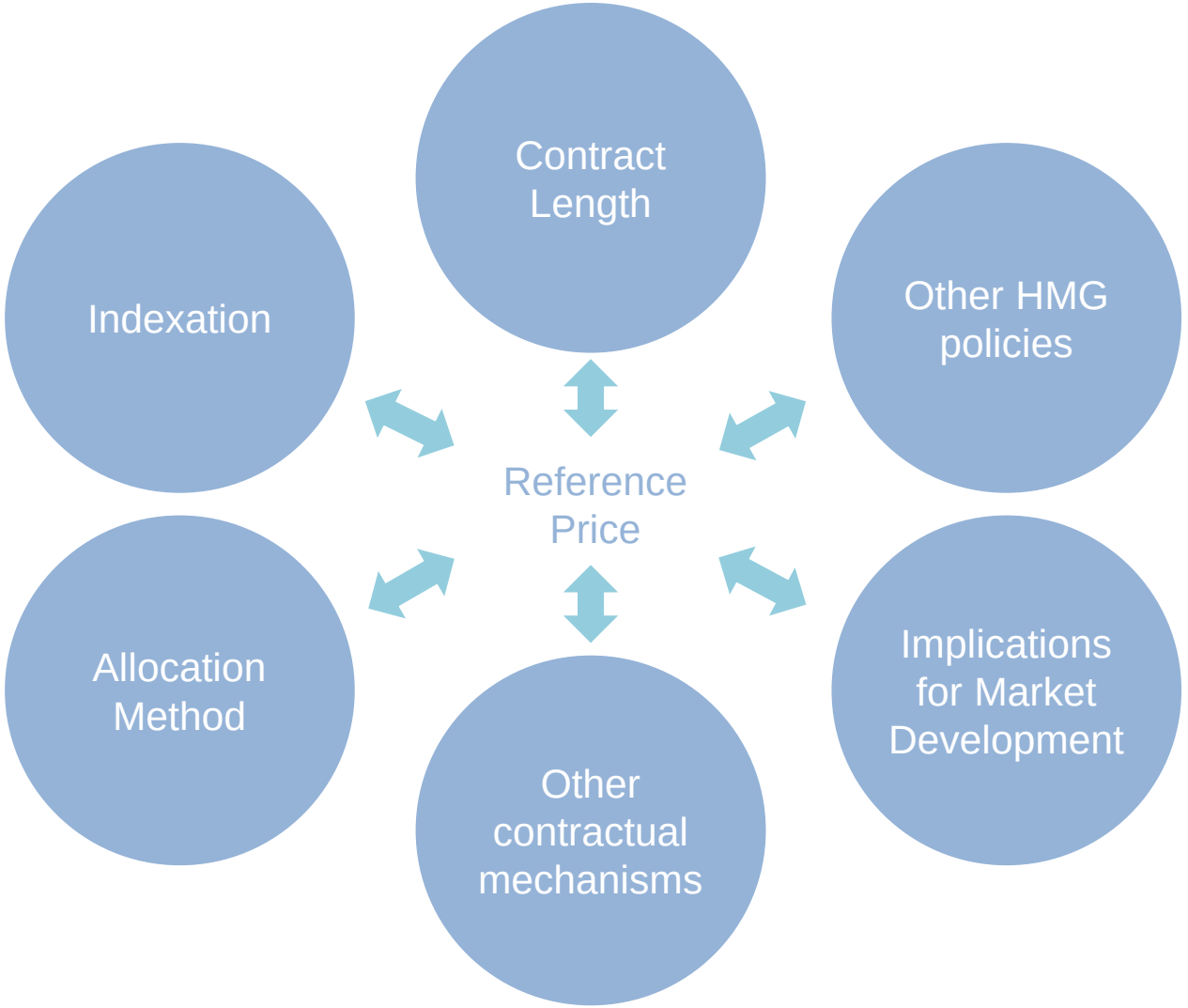
Interdependencies

Reference price not an isolated choice – it must be considered in conjunction with a number of other factors



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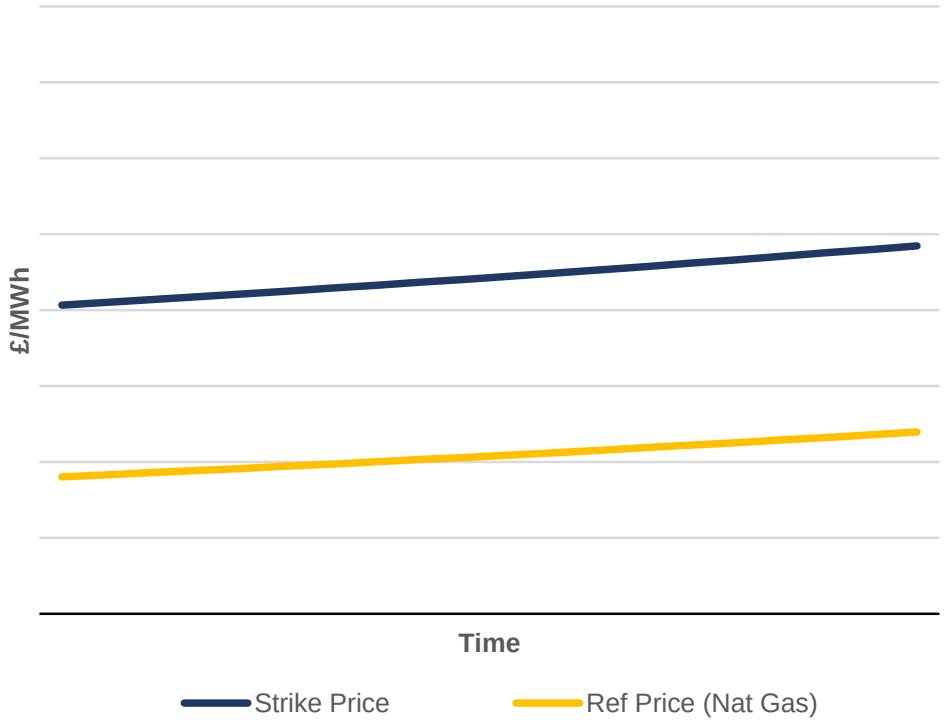
A. Natural Gas Price

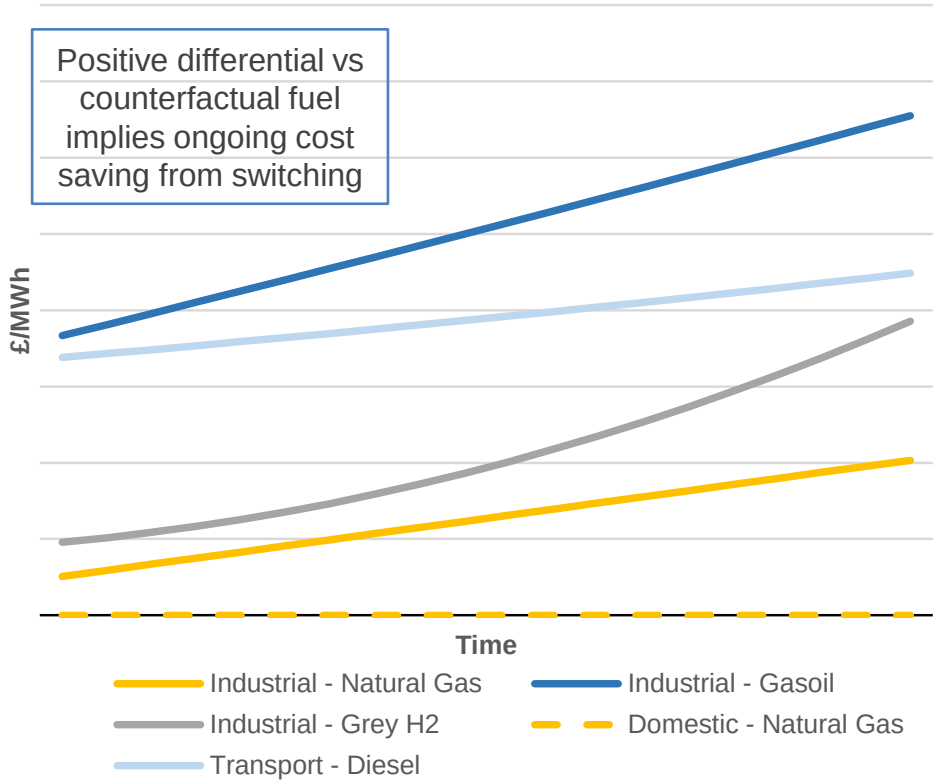
Portugal is using this approach for electrolytic hydrogen production

Strike Price vs Reference Price



Probability of subsidy reducing over life of contract would be limited irrespective of technology…

Price Incentive to Switch



…however, provides significant incentive for fuel switching in most use categories

Variation: Input Energy Prices

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A. Natural Gas Price

Benefits	Considerations
Transparent Natural gas is a liquid market, with a readily observable price	**Basis risk (I)** Linking only to input energy prices would detach the level of subsidy from the market value of the thing being subsidised, and could lead to over/under subsidy to the producer
Sets a floor Prevents the hydrogen plant from receiving additional subsidy for sales below the natural gas price	**Basis risk (II)** May pose a challenge for smaller electrolytic producers to assess the interaction between natural gas prices and their own project economics – though larger developers are likely to be able to manage this risk themselves
Alignment with offtake Natural gas is the main high carbon fuel for both industry and power, and so could be expected to form the basis of pricing contracts	**Indexation** If natural gas prices are rising against a static strike price, but the value of hydrogen is not, then support payments would be declining without a compensating increase in market revenue

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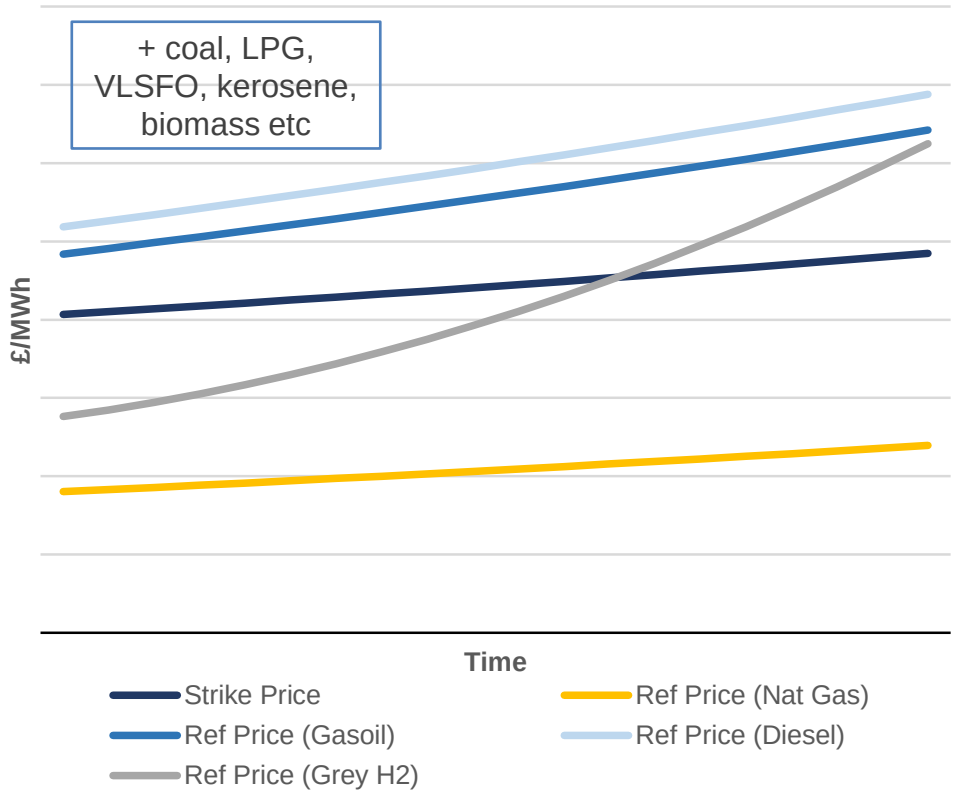
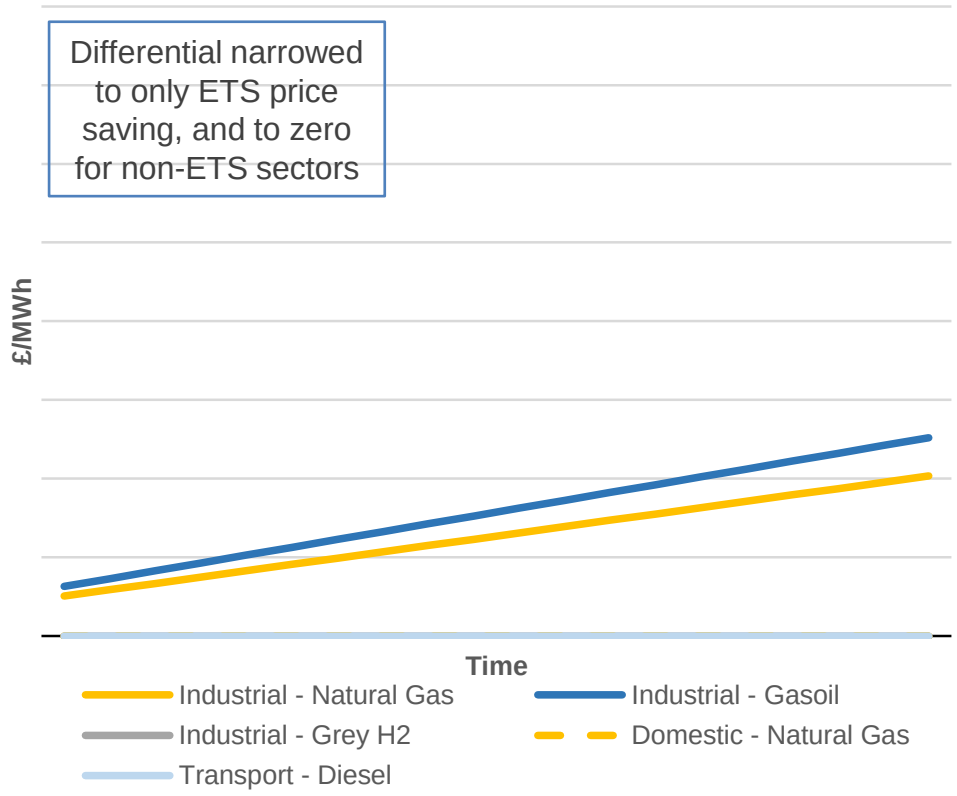
B. Counterfactual Fuel Prices

Strike Price vs Reference Price



Using multiple fuels adds significant complexity…

Price Incentive to Switch



…and dilutes price incentive to switch, with implications for pace of market development

Variation: Calculated Basket of Counterfactual Fuels

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B. Counterfactual Fuel Prices

Benefits	Considerations
Price Discrimination Ensures that hydrogen plant is incentivised to extract maximum value from every customer relative to the counterfactual fuel they would have used	**Impact on Fuel Switching** Choice to switch from one fuel to another is at least partly driven by price. If there is little or no cost saving in operation, it will be harder for end users to justify the investment to switch without additional intervention
	Administrative/Monitoring Burden Reference price would vary from offtaker to offtaker, which could become onerous to manage as the number of offtakers and projects increase
	Alternative equivalent measures available Various taxes and levies already used to discriminate between different users of the same fuels – may be simpler to use this existing apparatus rather than attempt to address in the model

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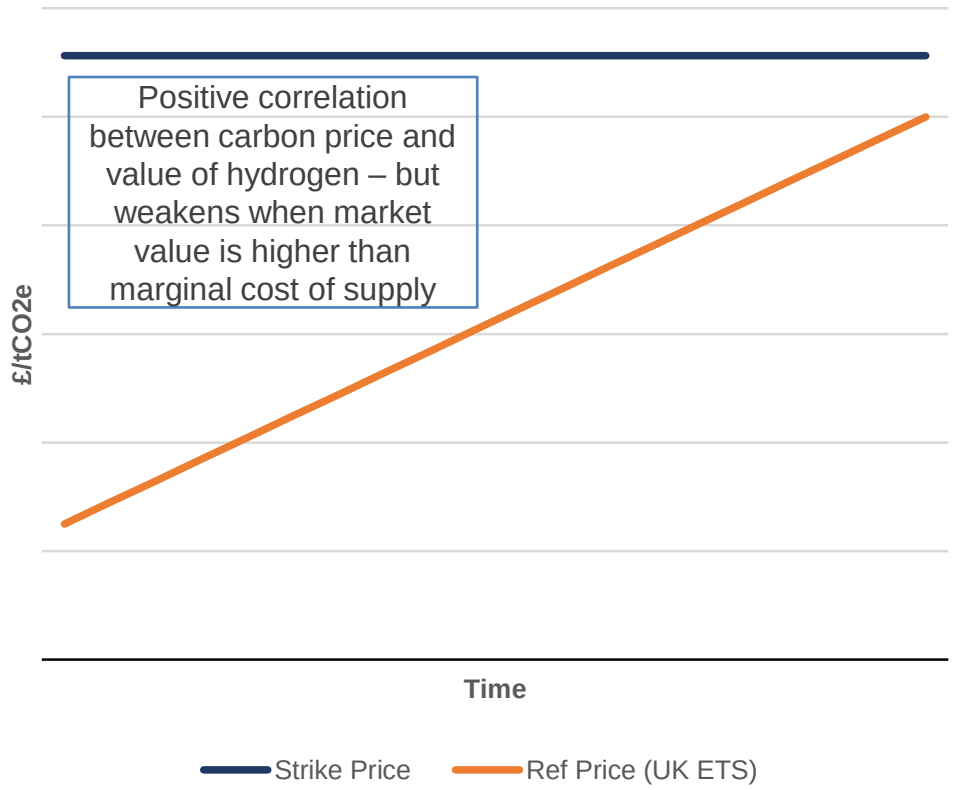
C. Carbon Price

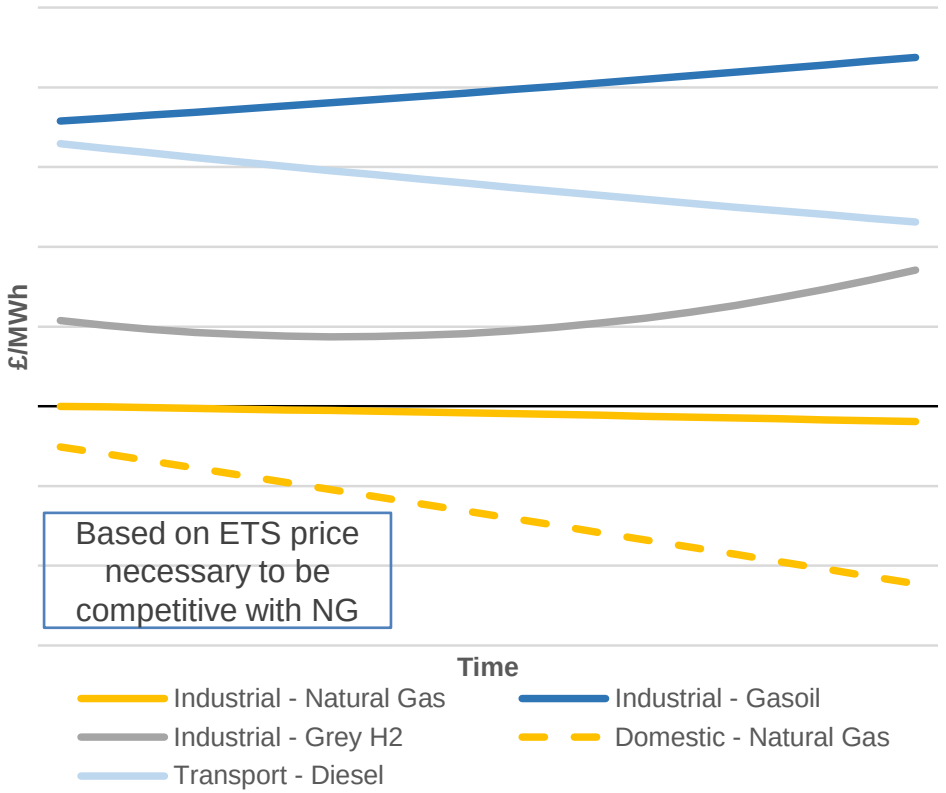
Netherlands & Germany are using this approach for production and consumption respectively

Strike Price vs Reference Price



Simple, but basis of strike price is no longer LCOH but target sales market…

Price Incentive to Switch



…creating potential for over/under subsidy if target market changes

Variation: Different CO2 strike prices for different end uses

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C. Carbon Price

Benefits	Considerations
Simplicity Single, market driven reference price	**Immature Market** UK ETS market will have limited trading history at the time of contract awards, and so linkage may attract risk premium
Precedent Industrial Capture Contract is referenced to UK carbon prices (preset in first iteration), and Netherlands' SDE++ scheme is underpinned by an EU ETS reference price	**Stability of Correlation** Strong correlation between carbon prices and relative value of low carbon fuels, but once price equivalency with high carbon fuel reached, this correlation may weaken/disappear
	Representativeness Strike prices would not reflect cost of hydrogen production, nor would reference price necessarily reflect market revenue

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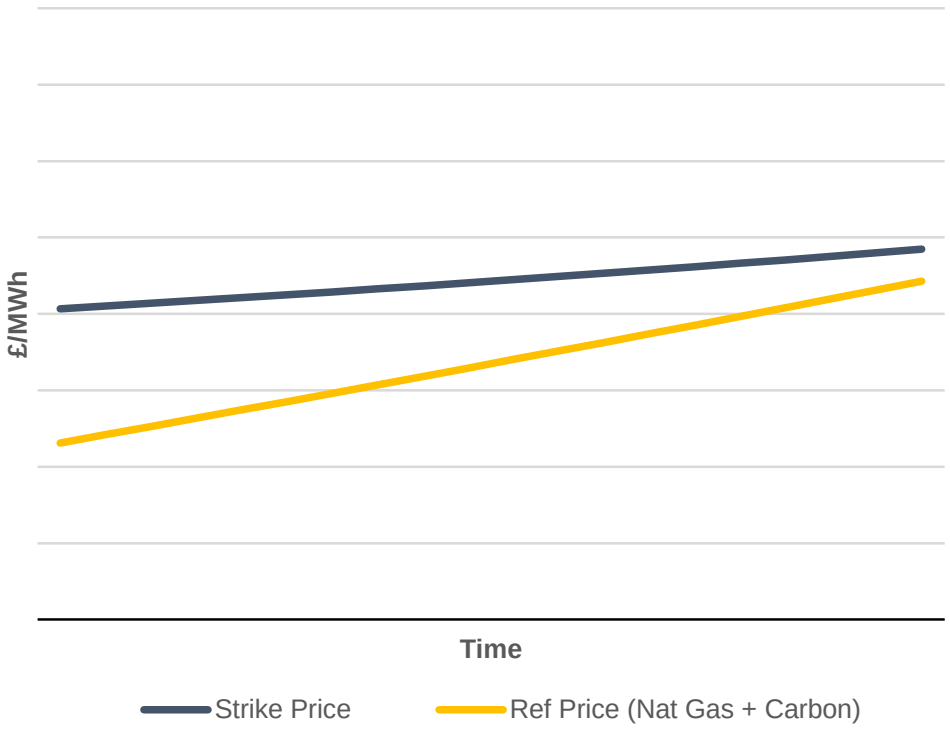
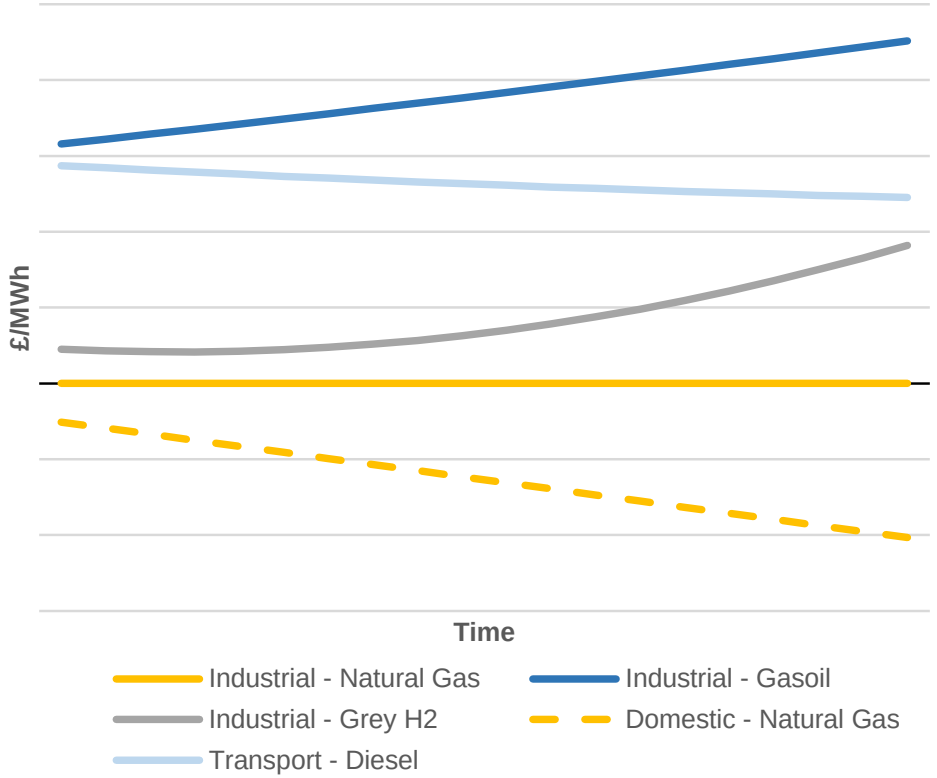
D. Natural Gas + Carbon Price

Strike Price vs Reference Price



Compared to (A), the inclusion of the carbon price should allow for subsidy reduction over contract length…

Price Incentive to Switch



…but removes price incentive for industrial natural gas users to switch (unless strike price is bid up)

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D. Natural Gas + Carbon Price

Benefits	Considerations
Reasonable Market Proxy Reflective of the value that many industrial users will see for low carbon hydrogen	**Impact on Fuel Switching** Choice to switch from one fuel to another is at least partly driven by price. If there is little or no cost saving in operation, it will be harder for end users to justify the investment to switch without additional intervention
	Immature Market UK ETS market will have limited trading history at the time of contract awards, and so linkage may attract risk premium
	Stability of Correlation Strong correlation between carbon prices and relative value of low carbon fuels, but once price equivalency with high carbon fuel reached, this correlation may weaken/disappear

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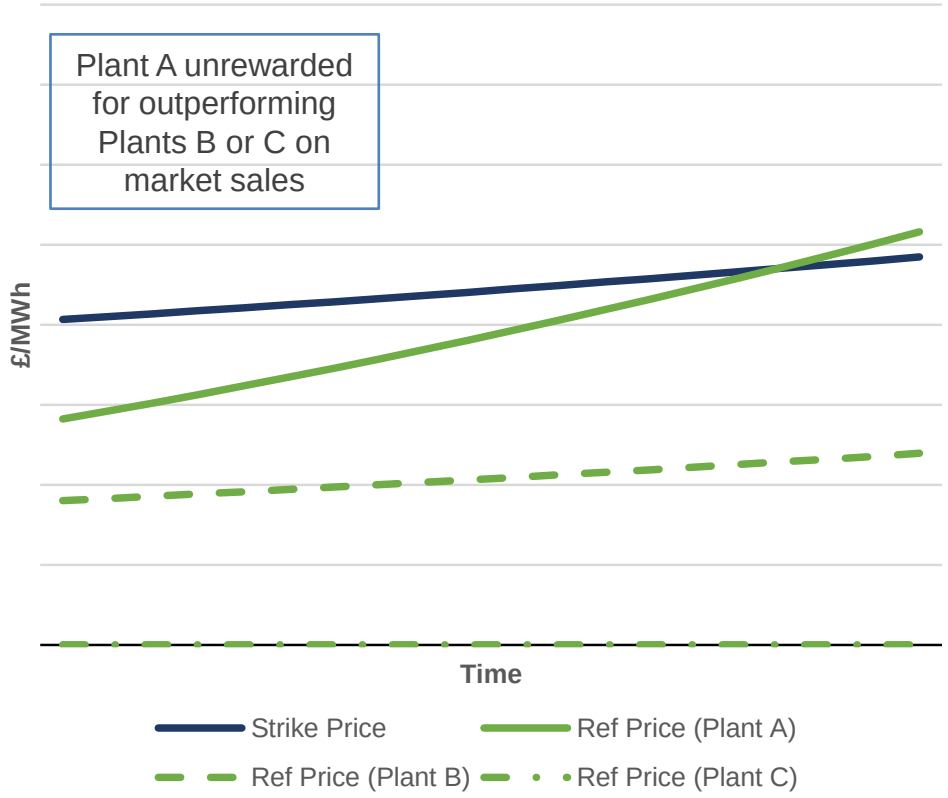
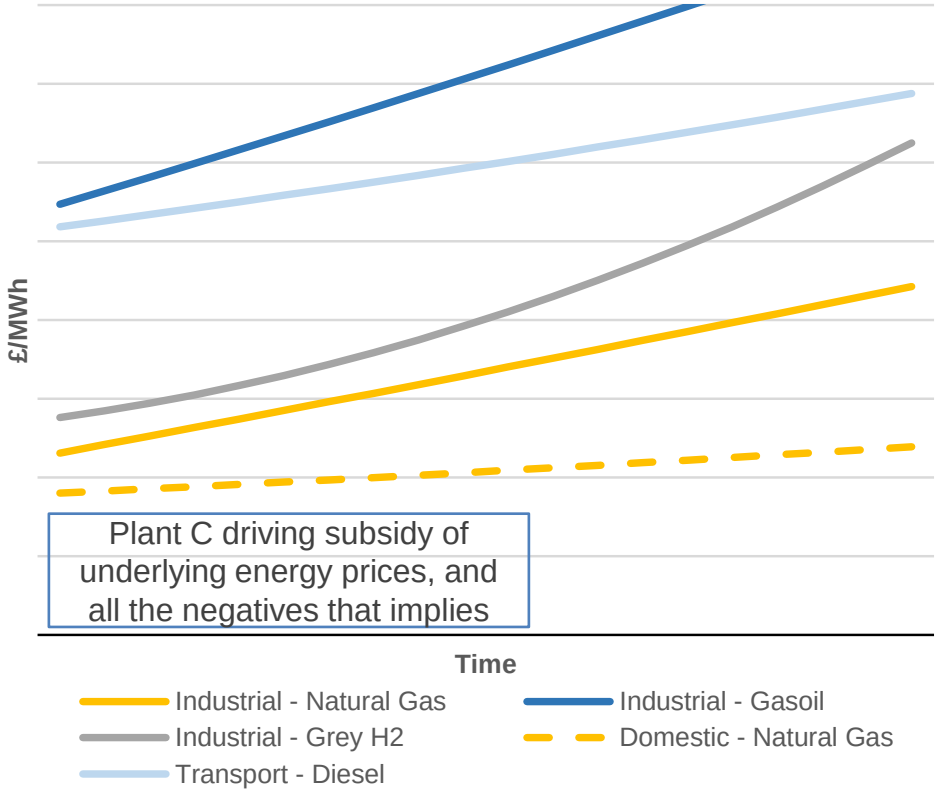
E. Achieved Plant Sales Price

Strike Price vs Reference Price



Actual plant sales prices are a proxy for market value, but are partially controlled by the individual plant…

Price Incentive to Switch (Plant C)



…and so would need other contractual mechanisms to prevent H2 subsidy becoming an energy subsidy

Variation: Average Achieved Sales Price across all plants

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E. Achieved Plant Sales Price

Benefits	Considerations
Simplicity Eliminates basis risk, as sum of support payments and market revenue would always equal strike price	**Moral Hazard** Reference price is under the effective control of the hydrogen plant, leaving it an incentive to price for volume only
Reflective of market value Achieved sales prices would be a measure of what the market is actually paying for hydrogen rather than its theoretical value	**Downstream Market Distortions** If producer is ambivalent to market revenue, potential for subsidised energy rather than subsidised hydrogen is created – which would have implications for profitability of downstream users and competition more generally
	Skewed Incentive Would remove the incentive to seek higher levels of market revenue, as there would be no reward for effort

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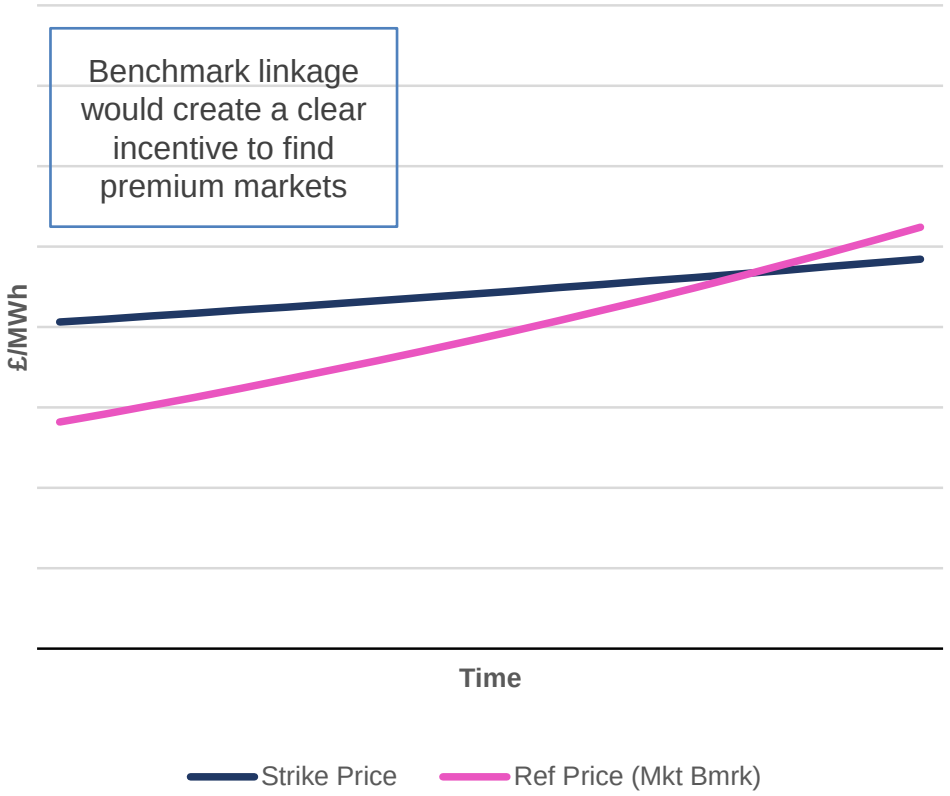
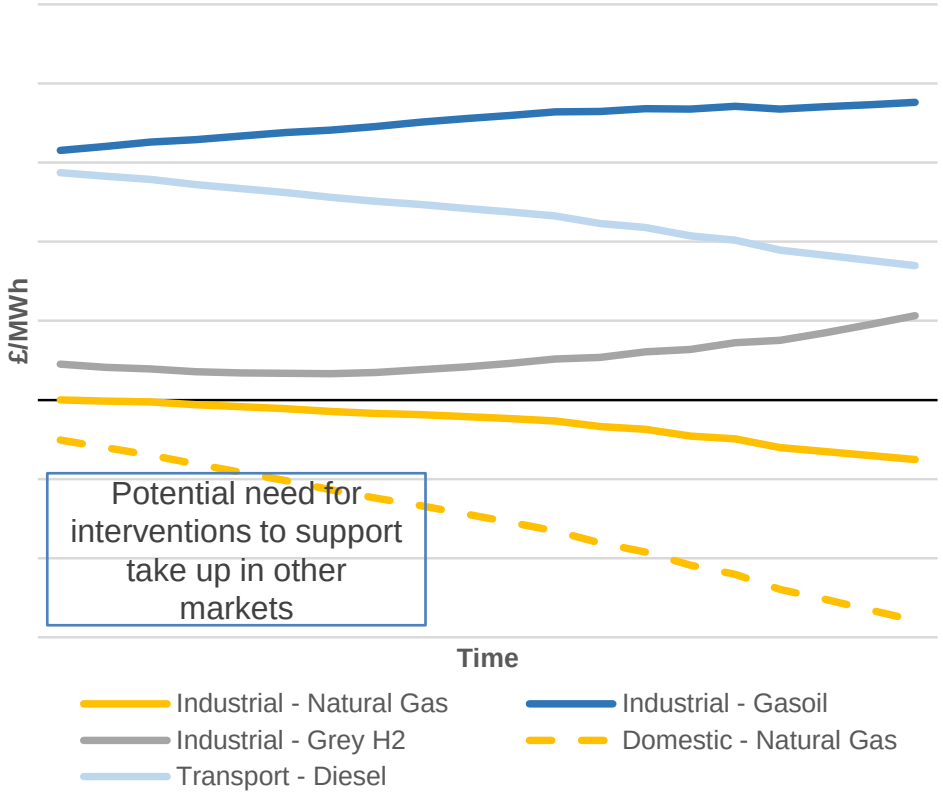
F. Market Benchmark Price (when available)

Strike Price vs Reference Price



Using a hydrogen market benchmark would give equivalency of approach with OSW CfDs…

Price Incentive to Switch



…and would create an incentive to focus primarily on the highest financial value offtake markets

Variation: Calculated Basket of Counterfactual Fuels, Average Achieved Sales Price across all plants

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F. Market Benchmark Price (when available)

Benefits	Considerations
Correlation A liquid benchmark would provide the clearest indication of the market value of low carbon hydrogen	**Availability** Only hydrogen benchmarks currently available are based on estimated cost of production, rather than market value
Competitive Tension Creates an incentive to develop higher value offtake markets/limit volumes to lower value markets in order to maintain profitability versus the benchmark	**Achievability** Relies upon access to actual sales prices to compile. If these are unavailable/thinly available, the benchmark may not offer a useful representation of the price at which hydrogen is actually being traded
Influence on Offtake Contracts If support mechanism is based upon benchmark, offtake contracts are likely to take it as a reference in order to manage basis risk	**Market Development** Would deter projects from selling into lower than benchmark markets, potentially requiring other interventions to assist those markets in paying the benchmark price

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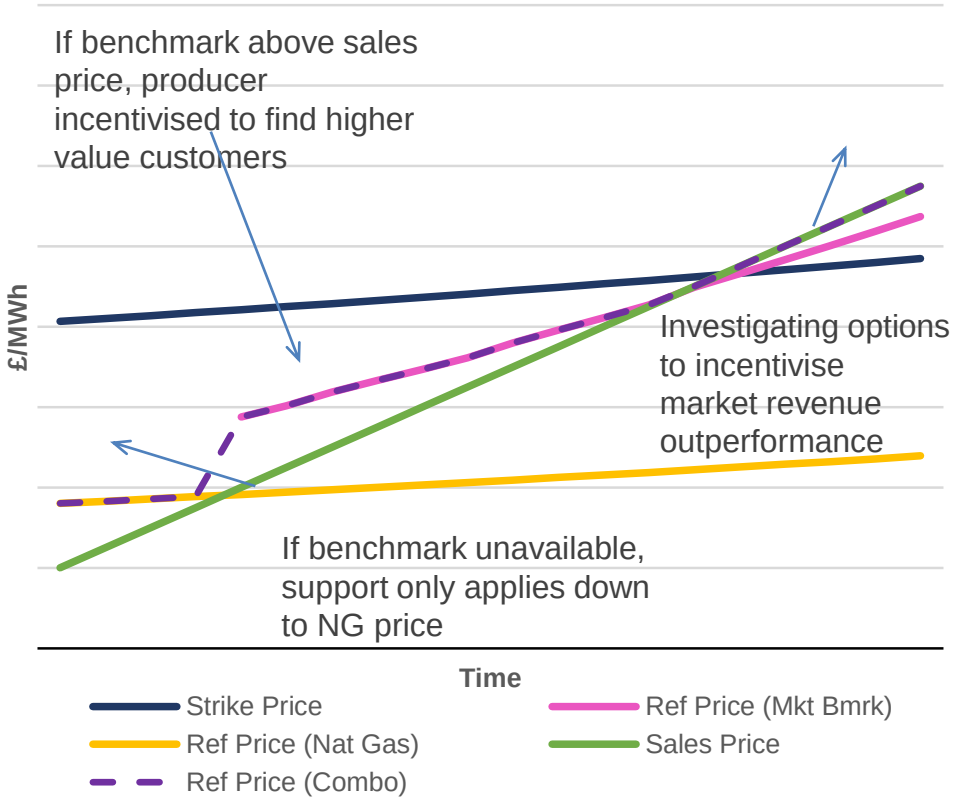
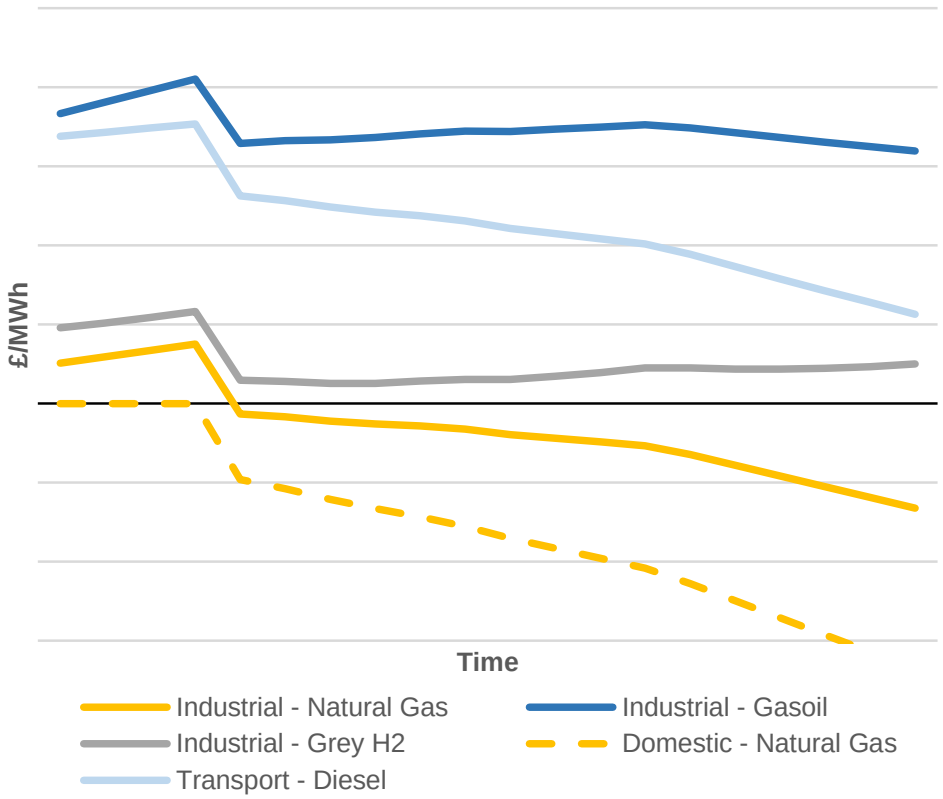
Potential Alternative Approach – Highest of A, E & F

Strike Price vs Reference Price



Price Incentive to Switch



Combining approaches may provide better incentive alignment/subsidy control

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Strike Price Indexation

	Inflation Linked	Natural Gas Price Benchmark	Electricity Price Benchmark	Actual Input Energy Cost
Benefits	▪ Easily observable ▪ Reflective of general cost escalation ▪ Relatively stable	▪ Easily observable ▪ Reflective of main input cost for methane reformers ▪ Would generate both positive and negative values ▪ Electricity/Gas spread well understood by market participants	▪ Easily observable ▪ Reflective of main input cost for electrolysers ▪ Incentivises electrolytic projects to come forward ▪ Allows strike price to adjust to falling cost of renewables	▪ Perfect reflection of input energy costs ▪ Adaptive to individual projects
Considerations	▪ Weak linkage to escalation in key input costs ▪ Tends to only have positive values ▪ Cost over life of contract	▪ Increased penetration of low carbon electricity will alter Electricity/Gas spread ▪ Provides incremental benefit to those with fixed/less variable input energy costs	▪ Reference price interaction ▪ Imperfect reflection of input costs ▪ Impact on electricity grid balancing	▪ Limited transparency ▪ Administrative burden ▪ Transfer Pricing issues ▪ Removes incentive to seek lower cost energy inputs

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Volume support: Expert Group update

Shabana Jamil
Hydrogen Business Models Team

20th May 2021

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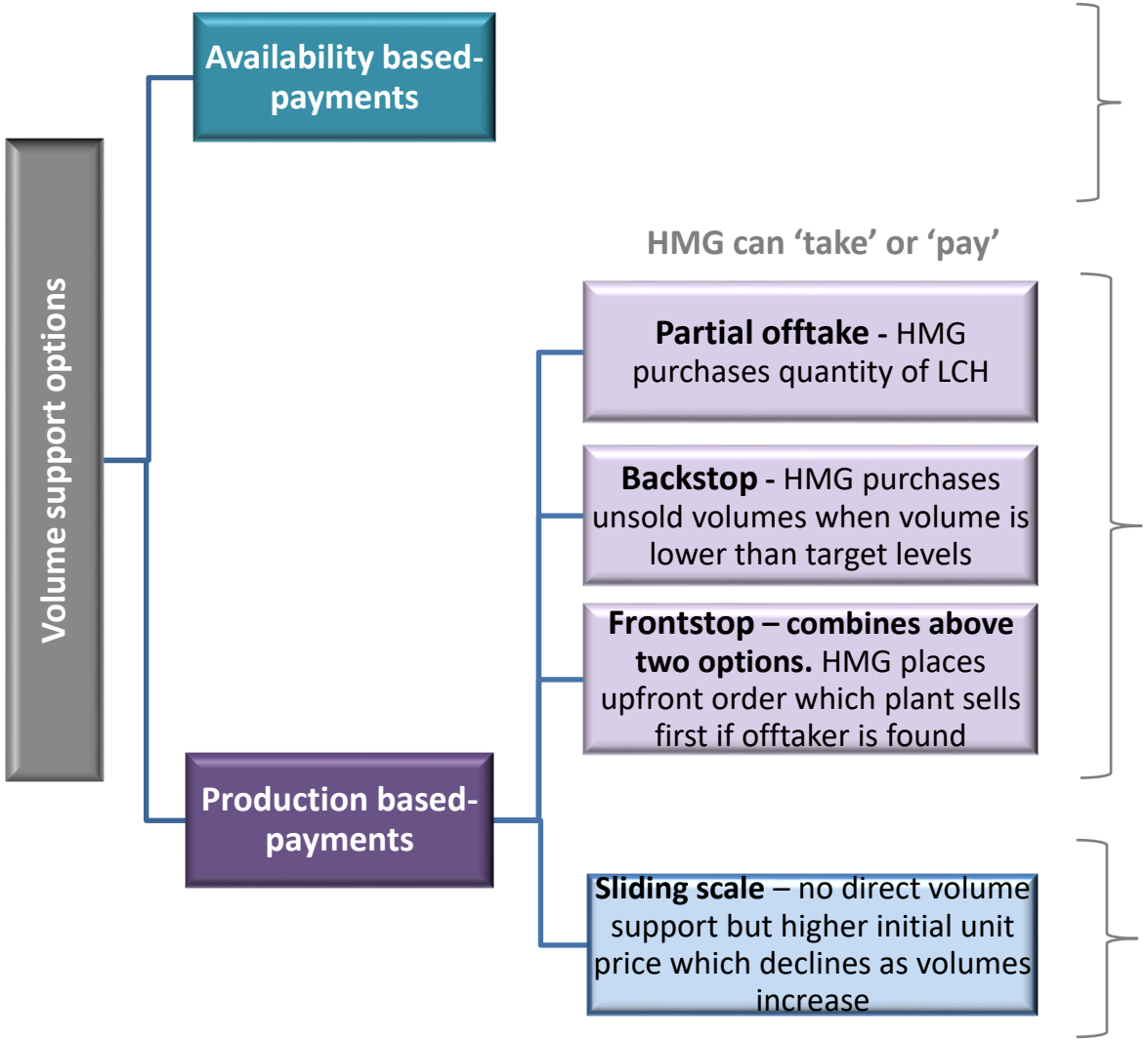
Recap of volume support options
Do you agree with sliding scale as emerging preferred option?



High level summary[1]

Volume risk removed but budget spent on non-production, with no guarantee of decarbonisation benefits, and no evolution over time as market develops. **Not preferred starting point**

Volume risk is reduced, however:

- Potentially crowds out commercial offtake
- Limited options for HMG to remarket or store acquired h2, might 'pay' instead – leading to non-production payments (as above)

- May create weaker incentives for producers to seek demand
- Again, as above HMG may pay instead – leading to non-production payments

- Reduced distortionary effects from HMG purchasing volumes
- But not suitable for intermittent operations

Our emerging preferred option is the sliding scale, as it:

- Minimises distortions as no physical delivery or payment required from HMG
- Is less complex from HMG delivery perspective
- Is suitable for both continuous and intermittent operations

Design of the sliding scale is key next step to realise benefits

1 Volume support options were presented in detail at April's Expert Group – this slide summarises only the high level points from our evidence base

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Contract duration: Expert Group update

Shabana Jamil
Hydrogen Business Models Team

20th May 2021

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Contract length - **What is the right contract length for hydrogen production business model?**

Defining contract length is important:

- For producers to have certainty of support whilst the market develops, and
- For government to ensure the contract represents value for money

Factors influencing length of contract:

Lifetime of the asset

Financing of the capital asset

Evolution of market conditions

Precedents already created in the energy sector

- **10 years** – Industrial carbon capture business model, with period for recovery of capital expenditure over a shorter-time period
- **12-15 years** – Dutch SDE++ for sustainable energy production
- **15 years** – CfD for low carbon electricity generation, with capital recovery across duration of contract

Emerging HMG preferences

- For revenue support (assuming variable premium price support, and indirect volume support via sliding scale of price support) to apply for the entire duration of contract
- For capital recovery across entire duration
- Standard contract length across all projects