frontier economics

Gas transmission charging reform

Assessment of National Grid Gas UNC modification proposal relating to the introduction of an entry revenue recuperation charge

November 2021

Contents

Introduction

- National Grid (NGG) has proposed a UNC modification that would introduce a new flow-based Transmission Services Entry charge (payable at all Entry Points except interconnection and storage), allowing a corresponding reduction in Entry Transmission Services Capacity Reference Prices.
- NGG has asked Frontier to assess the economic impacts of the proposed modification
- In the rest of this section, we:
  - Provide some relevant background on Gas Entry Transmission Services charging
  - Explain the issues with the current charging approach
  - Describe the proposed modification option and summarise its key expected impacts
- The rest of this pack is structured as follows:
  - Section 2 sets out how the proposed modification could affect efficiency of flows and competition in the GB gas market
  - Section 3 sets out the potential impacts on the costs for gas industry players of managing risks related to forecast errors in NGG revenue recovery
  - Section 4 sets out the impacts on gas customers

Background: Capacity charge volatility Gas Year 2020

Following the introduction of the new Postage Stamp regime in October 2020, shippers have been exposed to significant changes in the cost of transmission entry due to the introduction of an additional Revenue Recovery Charge (RRC) during the Gas Year (GY) 2020/21 to address an expected significant under-recovery of NGG's Allowed Revenue at Entry.

- Forecasting capacity sales is inherently uncertain (e.g. demand changes due to changes in weather) which can result in outturn capacity sales, and hence revenue, differing from forecast.
- However, historically NG forecasts of gas demand have been made with a reasonable degree of accuracy (i.e. within 5%).* Errors in the underlying demand forecast were therefore not the key reason for the implementation of an RRC in GY 2020.
- The error in the forecast was primarily the result of two features of the current regime:

Capacity neutrality

- Revenues received by NGG from Entry Capacity Charges in respect of Short Term Capacity Products were subject to Entry Capacity Neutrality arrangements, whereby NGG was held cash neutral by the socialisation of such revenues to users of the NTS.
- Higher than expected short-term sales during GY 2020/21 led to significantly more revenue being socialised than expected, leading a significant under-recovery.
- This issue was addressed during GY 2020/21 by Ofgem approving a UNC modification to end entry capacity neutrality for short term bookings.

Existing Contracts (ECs)

- All long-term capacity allocated prior to 06 April 2017 (coming into force of NC TAR**) was grandfathered under the new Postage Stamp regime. For the current gas year 2021/22, NG forecast 71% of NTS Entry capacity booking to be EC capacity.
- Grandfathered prices are relatively low † and therefore the bulk of NGG's Allowed Revenue is recovered from "new capacity" sales.
- In addition, the presence of ECs has significantly complicated forecasting of new capacity, because ECs are distributed unevenly across different NTS entry points.
- Therefore, in addition to aggregate gas flows, NGG must estimate gas flows through each NTS point in order to estimate the need for new capacity over and above that provided by ECs.
- Small errors in capacity forecast are amplified as any resulting revenue shortfall must be recovered over a relatively small share of total capacity.

**During GY 2020 the flow forecast was 1.8% different from the outturn amount. **Commission Regulation (EU) 2017/460 of 16 March 2017 establishing a network code on harmonised transmission tariff structures for gas, now incorporated in UK law by the European Union (Withdrawal) Act 2018 and the European Union (Withdrawal Agreement) Act 2020, as amended by Schedule 5 of the Gas (Security of Supply and Network Codes) (Amendment) (EU Exit) Regulations SI 2019/531. † ~23x lower than new capacity based on NGG data*

Problem definition: While the neutrality issue has been addressed, the forecasting problem created by ECs remains for future Gas Years

The combination of the Postage Stamp regime and the presence of ECs raises questions regarding distortions to competition, the costs of forecasting errors and hence price volatility, and distributional concerns

Potential efficiency considerations

Distortions to competition

- The uneven distribution of ECs over different Entry Points creates a potential for a competitive advantage for flows at certain Entry Points over others.
- To the extent that this results in gas entering the GB system from more expensive sources (relative to the case without ECs), this might increase the overall cost of serving gas demand.
- If inefficient flows are incentivised then future investments may also be distorted towards more expensive sources of supply (though in reality this concern may be of limited relevance in the gas sector)

Costs resulting from charge volatility

- As noted above, recent experience has demonstrated significant potential for volatile capacity prices from year to year (and potentially within year if an RRC is required)
- This potential for volatility creates risks for different parties (e.g. Shippers, NGG) in the gas system if they are unable to pass through the costs to customers immediately.

Distributional concerns

- The relatively narrow charging base over which costs are recovered has driven high PS prices for non-EC holders
- This has created significant value for the holders of ECs, and higher costs for customers.

Option under consideration: NG has proposed to recover a share of entry revenue via a supplementary flow-based charge

NG has asked us to consider the costs and benefits of its proposed modification. We consider the potential benefits in the three areas identified on the previous slides.

"Counterfactual": Current regime

- Allowed Revenue at Entry recovered principally from 'new' Entry Capacity bookings
- New Capacity exposed to full effect of under-recovery driven by forecast errors in capacity bookings

"Factual": Supplementary flow-based charge

- A percentage of Allowed Revenue at Entry is proposed to be recovered via a new flow-based charge across flows at all Entry Points (except for Storage and Interconnection Points)
- The percentage is determined based on the expected shortfall in revenue recovery had the 'standard' Entry Capacity Reference price been set without consideration of ECs (by assuming costs could be recovered across all capacity bookings) i.e. an estimate of the effect of the ECs on revenue recovery.
- The percentage would vary each year with changes to the remaining EC capacity holdings, and would decline to zero when all ECs have expired (in 2032)

Potential impacts of the modification (factual, compared to counterfactual)

Impacts on competition

Mixed effects (though unlikely to be material). Could reduce existing distortions to dispatch and barriers to entry (by reducing shipper risks). But exempting interconnection from the flow-based charge could create a new distortion.

See section 2 (qualitative assessment)

Reduced charge volatility

Could reduce the costs of risk management to the industry. While precise savings are highly uncertain, as an illustration costs could fall by up to £1.1 – £2.5 million for GY 2022/23 (£0.6 – £0.9 million savings to NGG and £0.6 – £1.6 million to shippers).

See section 3 (quantitative assessment)

Pure distributional impacts

Widening the charging base could result in a benefit for consumers (at the expense of shippers) of £73 - £140 million in GY 2022/23.

See section 4 (quantitative assessment)

We consider three groups of possible effects of the proposed modification on competition…

Distortions to dispatch reduced by the mod

- There are circumstances under which (in the counterfactual) EC holders' exemption from paying a capacity charge could distort dispatch
- By narrowing the gap between the charge paid by EC holders and the (combined flow-based and capacity) charge paid by New Capacity, the proposed modification would reduce the potential for any such distortion

Explained further on following slides

Distortions to dispatch created by the mod

- The proposed exemption for storage from the flow-based charge would not result in a distortion (it would be most efficient for storage to pay charges equal to incremental costs only – i.e. close to zero)
- The exemption from the flow-based charge for interconnection would, however, result in a distortion (from a GB/UK perspective, rather than from a wider European perspective). It will give flows entering at IPs an advantage, relative to flows at other Entry Points (e.g. LNG).

Reduced competitive advantage for larger shippers

- Our risk management cost analysis focusses on shippers and assumes all companies have the same cost of capital. As we explain in Section 3, we assume the cost of capital for shippers is equal to the industry average for suppliers cited by Ofgem in its March 2021 Supplier Licensing Review
- Ofgem suggests smaller suppliers may have a higher cost of capital. If this is also true for shippers, then, under the counterfactual, smaller shippers would experience higher risk management costs compared to larger shippers. Smaller shippers would therefore experience a larger reduction in risk management costs under the proposed modification.

… our overall judgement is that these effects are unlikely to be material

If ECs have the same value as non-EC capacity, there should be no distortions between Entry Points

There could be a concern that the existence of cheap long-term booked capacity results in a distortion to gas supplies

- A possible concern may be that a lower charge paid by EC holders (not reflective of any underlying difference in the cost of using the NTS) might mean that EC holders could under-cut cheaper sources of gas which must pay the full Entry Reference Price at the NBP
- If this were possible it could result in a distortion to the merit order of gas supplies and higher cost sources of gas being used to supply GB demand than would otherwise have been the case.

But there are economic reasons why the presence of ECs should not result in distortions to competition (between sources at a given Entry Point)

- As long as there is a party willing to purchase new capacity at (at least) the Entry Capacity Reference Price at a given Entry Point, use of EC capacity at that Entry Point has an opportunity cost: namely, the value forgone of selling that EC capacity to parties willing to pay the Entry Capacity Reference Price.
- In other words, as long as there is sufficient demand for capacity, using EC capacity should cost the same as new capacity because it can be sold at the Entry Capacity Reference Price
- EC holders still benefit from the difference between the price of new capacity and the price of EC capacity, However, this is a windfall (the value of which we consider in Section 4), rather than something that will drive a change in behaviour.

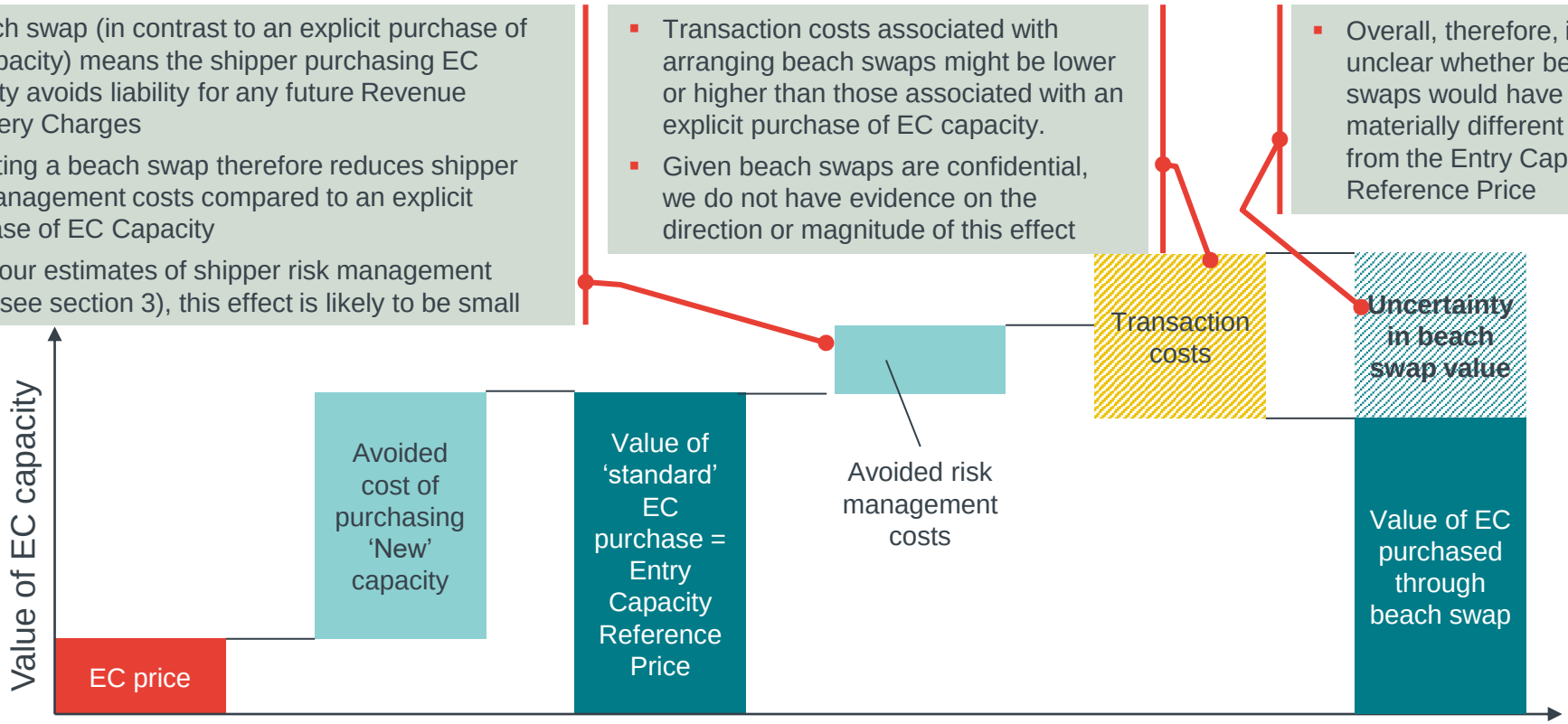
Use of ‘beach swaps’ might mean the opportunity cost of EC capacity differs from the Reference Price, but it is unlikely to distort the merit order

‘Beach swap’: An arrangement under which a shipper sells gas to an EC holder at the Entry Point and agrees to buy it back from the EC holder once the gas has entered the NTS

- A beach swap (in contrast to an explicit purchase of EC capacity) means the shipper purchasing EC capacity avoids liability for any future Revenue Recovery Charges
- Executing a beach swap therefore reduces shipper risk management costs compared to an explicit purchase of EC Capacity
- Given our estimates of shipper risk management costs (see section 3), this effect is likely to be small

- Transaction costs associated with arranging beach swaps might be lower or higher than those associated with an explicit purchase of EC capacity.
- Given beach swaps are confidential, we do not have evidence on the direction or magnitude of this effect

- Overall, therefore, it is unclear whether beach swaps would have a materially different value to from the Entry Capacity Reference Price



In any case, provided the costs (or cost savings) involved in arranging beach swaps are identical across Entry Points (and there is no clear reason for supposing that transaction costs might differ), transaction costs will not contribute to any differences between Entry Points in the opportunity cost of flows. In other words, **use of beach swaps should not contribute to further distortions in the merit order of gas supplies**.

However, there are other reasons why the presence of ECs could result in a distortion

We have identified two possible situations where the presence of EC capacity could lead to distortions

1

The value (i.e. opportunity cost) of EC capacity may be below the Entry Reference Price if an Entry Point is served by a **single* shipper**

- If there are **no other shippers active at an Entry Point** at which there are ECs, it is not possible to sell EC capacity to any other player.
- In other words, the opportunity cost of using EC capacity is zero, because its actual price is sunk (i.e. it cannot be avoided by not flowing gas).
- Hence the EC holder will be incentivised to flow gas if the NBP price is above the marginal cost of its source of gas, which depending on the size of steps in the merit order could lead to changes in gas flows

2

It may be profit maximising for an EC holder to value its capacity below the Entry Reference Price in order to increase flows through its EC capacity.

- This could be the case where, **at the Reference Price, EC capacity exceeds demand for Entry capacity (at a particular Entry Point)****.
- Acting rationally, if demand for Entry Capacity were elastic (i.e. responsive) with respect to price of capacity at that Entry Point, EC holders could increase revenues (and also profits, given the cost of using EC capacity is close to zero) by reducing the price of all EC capacity at that Entry Point to induce additional demand for capacity at that Entry Point.
- Demand at interconnection points is clearly likely to be price-elastic. Even demand for capacity at LNG entry points may be price-elastic over longer timescales.
- If this results in differences in the cost of Entry Capacity between Entry Points, the merit order could be distorted.

Assuming that the marginal cost of transporting gas does not vary between Entry Points (which would be consistent with Ofgem's logic for moving to a Postage Stamp charging regime)**, differences in opportunity costs of flowing at different Entry Points could distort the merit order of GB gas supplies**

**Or, more generally, where buying shippers have market power. **Data suggests this is in fact the case, e.g. for several storage entry points including Cheshire, Caythorpe, Garton, Hole House Farm, for LNG terminals including Isle of Grain and Milford Haven, and or a Beach terminals, including Easington.*

To the extent that such distortions exist, they will be reduced in the factual by introducing a flow-based charge

In relation to the two possible sources of distortion we have identified, the narrowing of the gap between the Entry Reference Price paid by new capacity and the opportunity cost of EC capacity reduces the scope for distortions to competition

In the factual:

- The Entry Reference Price is reduced as less revenue is recovered via this charge
- The opportunity cost of EC capacity is increased to at least the flow-based charge i.e. the charge can be avoided by not flowing gas (for non-exempt shippers)

1

Single shipper

- Where there is only a single shipper, the EC capacity holder will still be incentivised to flow gas when the NBP price exceeds the opportunity cost of gas.
- However, because the opportunity cost has increased due to the flow-based charge, and the Entry Reference Price has also decreased, the potential competitive advantage of EC capacity is much reduced and therefore its impact on flows is much reduced.

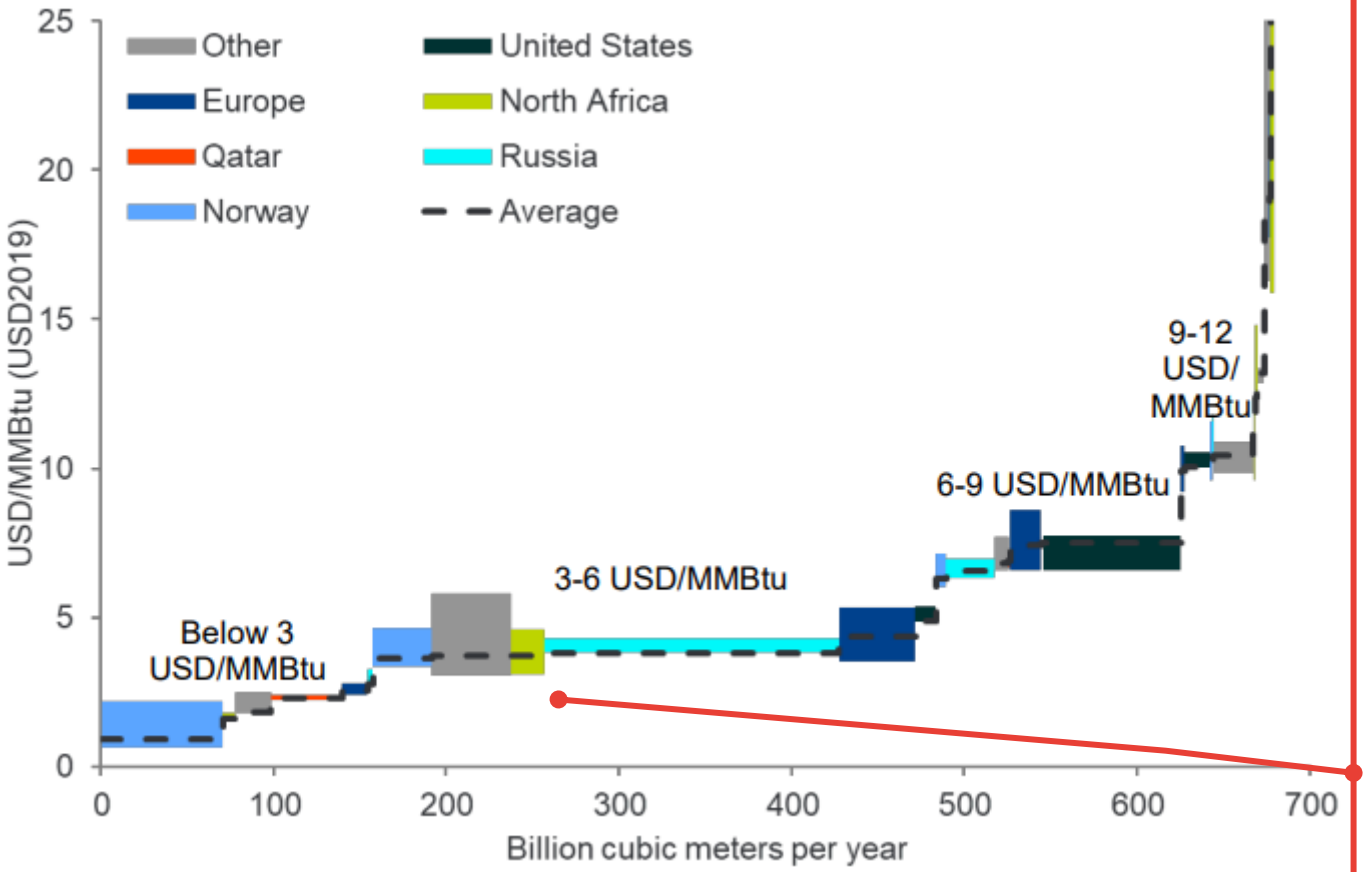
2

Demand below EC capacity at the Reference Price

- Where demand is below the total amount of EC capacity at the Entry Point, it may still be profit maximising for a shipper to value EC capacity below the Entry Reference Price to increase flows.
- However, the range in which it can reduce the price of EC capacity to induce an increase in flows is much reduced due to the lower Entry Reference Price and flow-based charge now paid by EC.

While distortions are possible in practice, in our view they are unlikely to be material

Base cost of supply for gas in 2025 by supplier and cost group



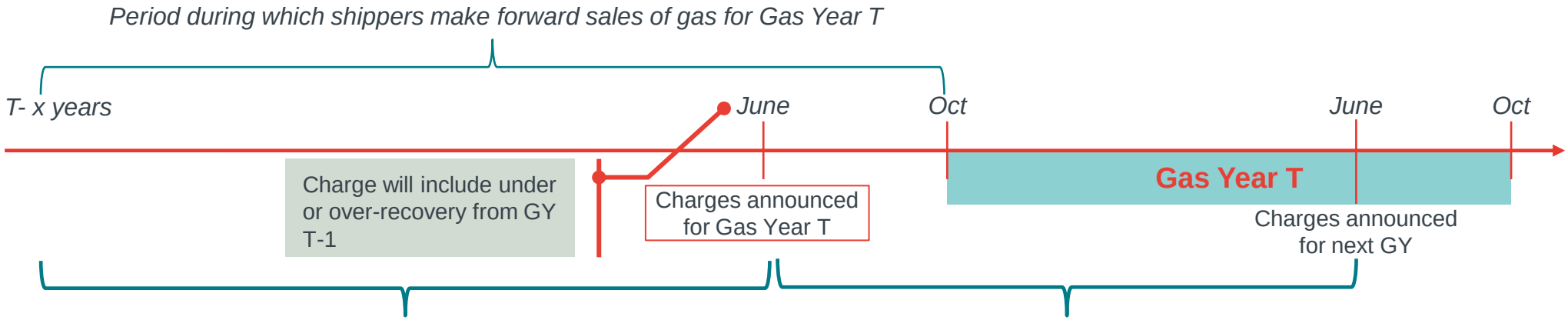
Source : BEIS Fossil Fuel Supply Curves, May 2019 (Fig 29). Height of bars represents the break-even price interval and the width the potential supply.

- As a reminder:
  - The mod would reduce the difference between the Reference Price and the price of ECs, reducing the potential for distortions arising from ECs
  - However, the flow-based charge would create a new potential distortion between pipeline imports and LNG
- As an indication of the maximum size of any distortion:
  - The reduction in the capacity price (from counterfactual to factual) for 2021/22 is 1-2% of the NBP price (according to data supplied by NGG)*
  - The flow-based charge for 2021/22 0.6-1.2% of the NBP price*
  - These amounts are very small compared to the range of cost uncertainty for gas supply to GB
- So while uncertainty regarding the cost of gas supplies (cost ranges for different sources overlap) means it is possible that these changes could influence the merit order of GB supplies; the fact that they are so small relative to the NBP makes this less likely

** Depending on the contracts and historical date range chosen – for example, 1.1% and 0.6% using 120p/therm as an average of the season +1 and season +2 contract prices (from 01/09/21 to present), 2% and 1.2% using season +1 and +2 from 2/10/20 to present. Data from Bloomberg*

ECs increase the risk of charge volatility and NGG and shippers must manage this risk

Charges are difficult to set accurately, principally due to the presence of Existing Contracts, and therefore there is the potential for significant under- or over-recovery which must be addressed as part of charges for future years. This creates risks for market participants



Period of shipper risk exposure

- Shippers sell gas forward based on an expectation of entry charges in GY T.
- Those without long-term capacity (e.g. ECs) face a risk that, once contracts are struck, they are unable to pass through changes in future network charges in the wholesale price should they be higher than expected:
  - They do not know what charge NGG will set to try and recover the prospective Allowed Revenue at Entry (although the methodology is transparent so the risk is likely to be relatively low); and
  - They do not know what the under- or over-recovery will be from the GY T-1 that will be included in GY T charges. The presence of ECs makes this by far the more significant uncertainty.
- From the point in time they sell the gas they must hold some risk capital to guard against the trade becoming loss making, up until the date the relevant charges for GY T are announced*

Period of NGG risk exposure

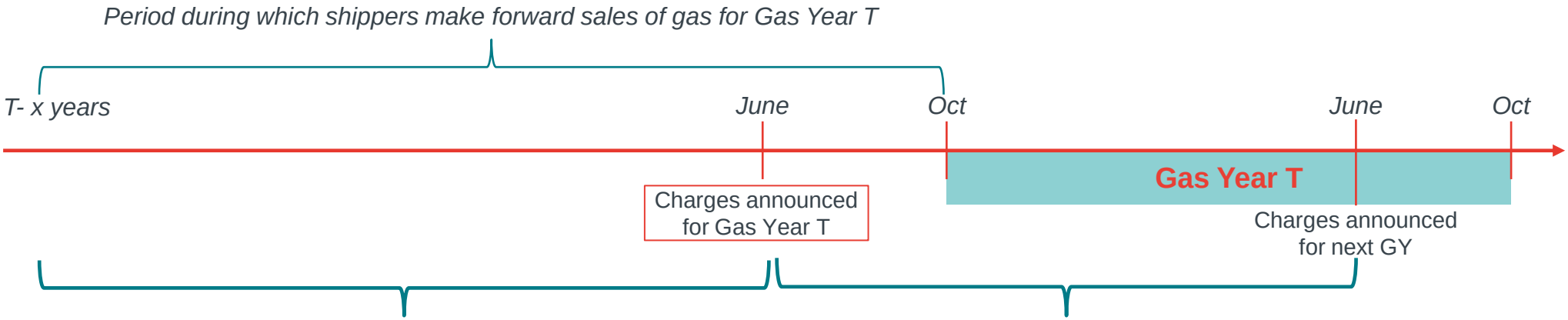
- NGG optimises its cash flows and if it under-recovers expected revenue it will need to draw on working capital for the period until it can adjust its collections in a subsequent GY (or implement a revenue recovery charge).
- The risk of under-recovery for a relevant GY begins when the charges are announced (i.e. at that point NG is committed to a particular set of charges), and continues until the point at which it can start to recover the under-recovery in the next GY.
- NGG must have the ability to access additional working capital during this period should it be required.

We go on to evaluate the costs these risks impose on market participants and how they change under NGG's proposed reform

*Once the charges are announced, a profit or loss may crystallise, but no further risk capital is required to be held to manage uncertainty

The risk exposure of NG and shippers changes over time

The level of risk capital held by shippers and NGG will change due to new information gathered over time.



Shipper risk exposure

- Once a forward contract is signed by a shipper it must hold risk capital to cover the possibility of an increase in future Entry Capacity Reference prices in the event of an extreme under-recovery
- Gas sold by shippers for delivery in GY T prior to the June charge announcement faces a risk of an uncertain entry charge.
- The risk exposure is highest in the period prior to GY T-1 when there is no information regarding the scale of the potential over or under-recovery that would affect charges in GY T.
- As the under or over-recovery develops during GY T-1, the risk starts to reduce (note this assumes that shippers can observe/calculate realised under- or over-recovery with each month that passes).

NGG risk exposure

- When the charge is announced in June prior to the start of GY T, NGG is exposed to the possible under-recovery risk related to 12 months of capacity sales.
- However, as the GY progresses and the outcome of part of the year becomes certain, NGG will only need to hold working capital to cover the possible under-recovery related to the remaining part of the year i.e. the working capital required will decline, before increasing again when new GY T+1 charges are announced.

Introducing a flow-based charge for transmission services improves forecasting, and hence reduces volatility in cost recovery charges*

Counterfactual

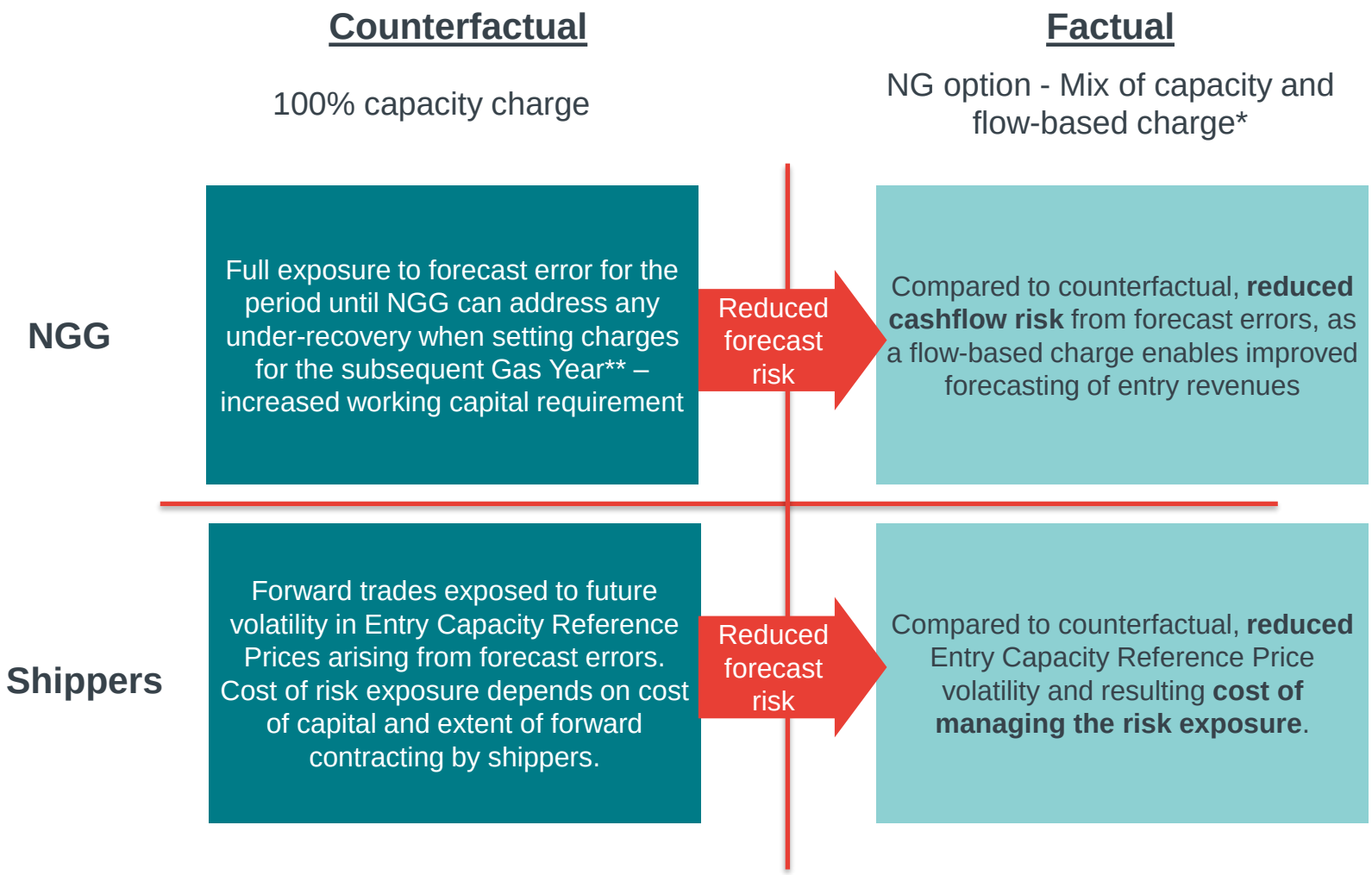
- As explained in Section 1, since ECs are distributed unevenly across Entry Points, in addition to forecasting aggregate capacity bookings, NGG must forecast at which Entry Points 'new' capacity bookings (over which most Revenue at Entry is recovered) are required
- Entry point forecasting has a high degree of uncertainty as it requires forecasts of the gas supply merit order which can change in different points in the year i.e. the short-run marginal cost of IPs may move continental gas above or below other sources (e.g. LNG) in the merit order.
- The impact of under- or over-recovery is amplified as it must be received over the relatively small charging base of new capacity alone.

Factual

- ECs are liable to pay a flow-based revenue recovery charge.
- In the extreme, if 100% of revenues were recovered via a flow-based charge, then EC capacity would be no different to new capacity purchases in revenue recovery terms.
- This means the charge setting is simplified so that it is only requires an aggregate flow forecast (similar to the case without ECs).
- By commoditising a share (<100%) of the revenue (as in NGG's option), the impact of ECs on NGG's capacity forecasting remains, though it is reduced.
- Forecast accuracy is therefore improved reducing risks to NGG and shippers.

** General non-transmission services are not affected*

To estimate the benefits of a flow-based charge we estimate the risks to NG and shippers in the counterfactual and factual



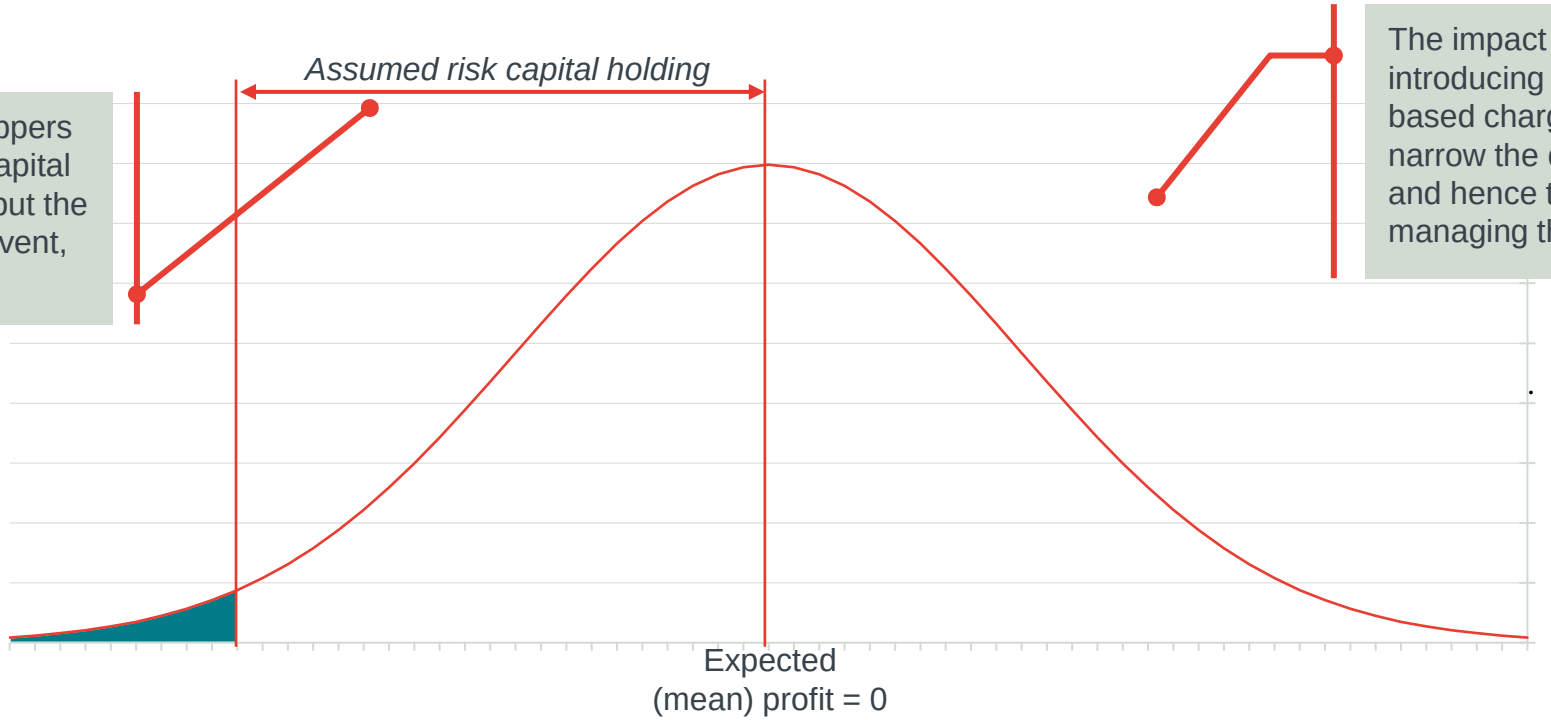
** General non-transmission services are not affected. ** We assume no RRC is introduced during a Gas Year under both the factual and counterfactual, though we note that this would in theory be possible under the UNC. Assuming a mid-Gas Year RRC would reduce cashflow risks to NGG but increase those faced by shippers.*

The cost of risk exposure management can (in principle) be quantified using the 'Value at Risk' approach

To indicate the potential scale of risk management costs ideally requires a distribution of entry charge uncertainty

- Even if, on average, we assume that shippers/NGG make unbiased forecasts of the expected Entry Capacity Reference Price (and that the different parties are equally able to forecast the expected Reference Price), future changes to the Entry Capacity Reference Price (arising from under- or over-recovery during the preceding Gas Year) cannot be known with certainty
- Depending on their risk preferences, we assume shippers/NGG aim to hold capital to cover their expectation of an extreme (upward) adjustment to the Entry Reference Price, for example, the worst 5% of possible outcomes (P95), or worst 1% (P99).
- The figure below illustrates a hypothetical distribution of Entry price forecast error around the mean

We assume that shippers and NGG will hold capital to guard against all but the most extreme loss event, e.g. up to a P95



The impact of introducing a flow-based charge is to narrow the distribution and hence the cost of managing the risk

Cost of risk exposure (for given time period*) = capital requirement x cost of capital

**As we later explain, the capital requirement will vary over time. The capital requirement will tend to increase as greater volumes are sold forward over time, but will tend to decrease over time as past losses/gains crystallise. The total cost is the sum of the cost across all time periods (in respect of trading carried out for a single year of gas delivery).*

In practice, estimating the (indicative) risk capital requirement in the counterfactual and factual involves a number of assumptions and steps

The objective is to illustrate possible risk management costs associated for a single year of gas consumption. We estimate this for NGG and shippers in the counterfactual and factual in three steps

1 Develop distribution of possible forecast errors

- We first make an assumption for the risk exposure (i.e. under-recovery) in an extreme scenario (i.e. a P95 type event).
- We have limited information from which to draw and therefore base the analysis on the under-recovery in GY 2020.

2 Make assumptions for how exposure risk develops over time

- We develop stylised assumptions regarding:
  - The profile of risk exposure to NGG across gas years; and
  - shipper contracting behaviour, and as a result the risks that shippers are likely to hold in relation to serving annual gas demand.

3 Estimate cost of risk capital requirement for annual gas demand

- We estimate the cost of managing the stylised risk exposure for NGG and shippers, based on the relevant cost of capital.

We describe these steps in more detail in the following slides

1

We base our forecast error distribution on the under-recovery in GY 2020

The new Entry Charge regime has not been in place long enough to estimate a forecast error distribution based on historic forecast errors. Therefore, we make the assumption that the GY 2020 under-recovery represents an extreme event (e.g. P95) against which industry participants would hold risk capital.

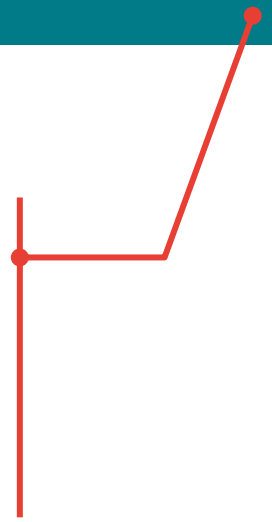
Under-recovery for GY 2020 was £150m

Adjustments to this figure

- We have adjusted the actual under-recovery to what it would have been had Capacity Neutrality been addressed prior to the start of the GY 2020, on the grounds that this does not represent an issue going forward.
- On the basis that the GY 2020 under-recovery was not driven by a significant change in demand (i.e. aggregate flows), it is reasonable to view remaining GY 2020 under-recovery as a relatively extreme outcome primarily related to errors in forecasting of capacity booking behaviour
- We assume that, in the absence of a forecast error distribution, this represents a reasonable basis from which to consider the costs associated in GY 2022/23 with managing risks associated with forecast error.

'Extreme' under-recovery assumption

NG estimated that its GY 2020 under-recovery would have been **£100m** if the Capacity Neutrality modification had been in place for the start of the GY 20/21

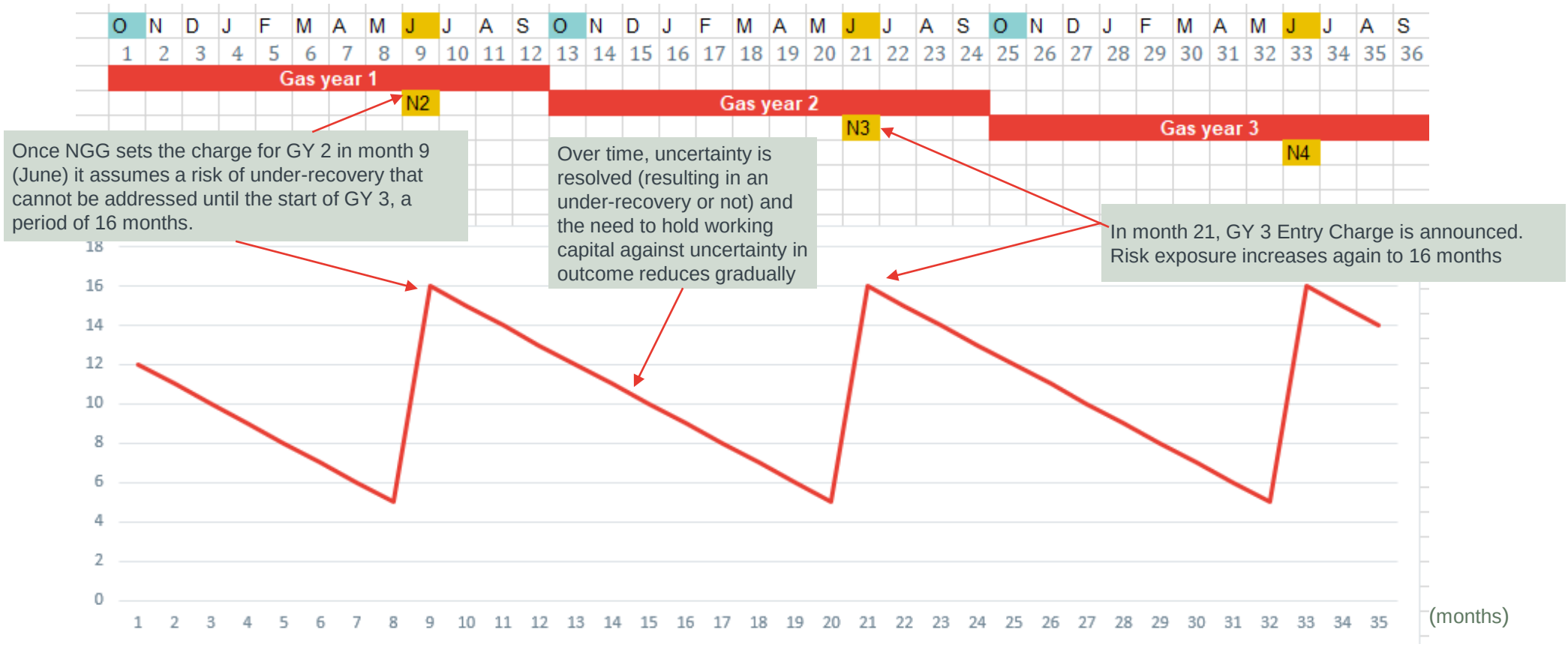


- This value represents the possible risk that shippers or NGG face with 12 months of cost recovery uncertainty. As already noted, the value of this risk exposure declines as information regarding the final under-recovery to feed into next year's charge is revealed during the course of the GY. We represent this using values generated from a monte carlo method with no autocorrelation – i.e. that forecast errors are not correlated from one month to the next
- The assumed £100m 12-month risk exposure for the counterfactual largely relates to forecast error due to ECs. Under the factual, 34% of revenues at Entry are shifted to the flow-based charge. We assume risk exposure falls in proportion (i.e. also by 34%), reducing costs to both NGG and shippers.

NGG's exposure is determined by the timing of the announcement of tariffs for the new Gas Year

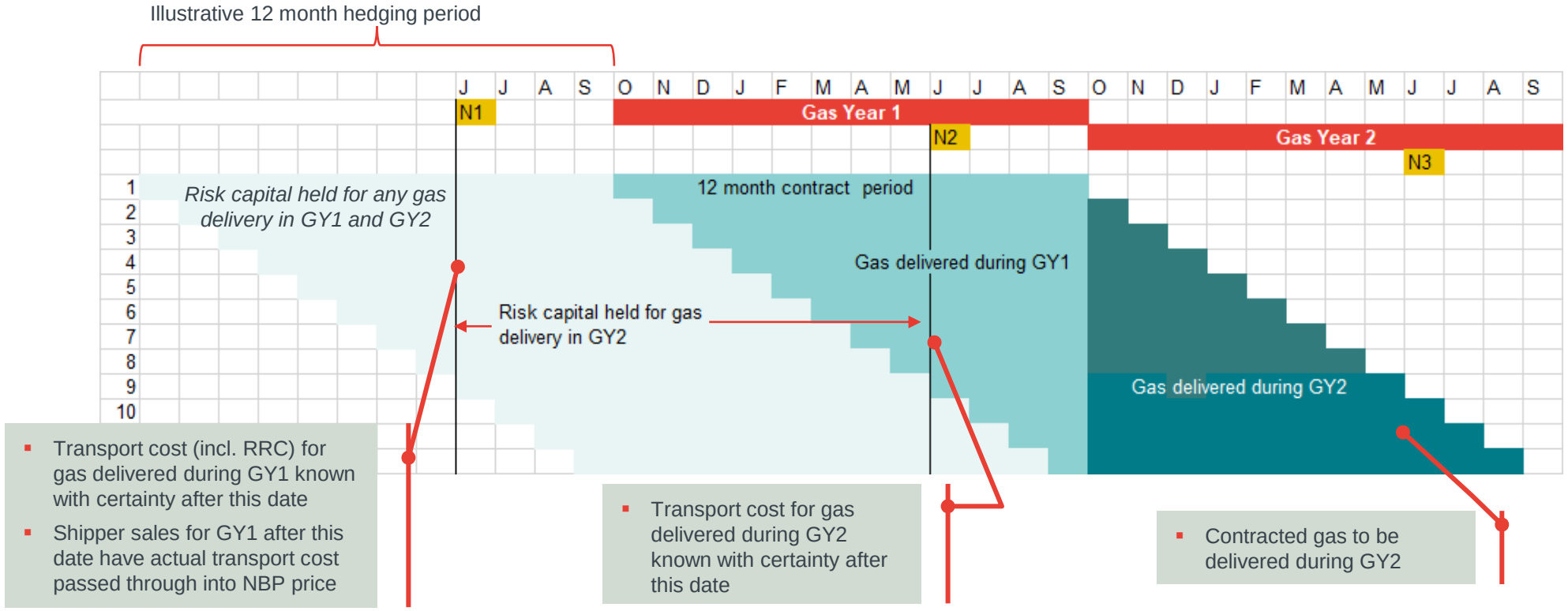
NGG's exposure peaks with the announcement of a charge, after which it declines to the point when the next charge is announced as new information is revealed about cost recovery

- We consider one scenario, in which a new Entry Charge (addressing any under-recovery for previous GY) is set 4 months ahead of the new GY, and fixed for the whole duration of GY (12 months), making a maximum risk exposure duration of 16 months (note: an earlier announcement would increase the risk exposure for NGG, but reduce it for shippers)
- We assume that each charge setting point (N2, N3, etc) will fully account* for any over- or under-recovery accrued since the last charge setting point but will not anticipate future over or under-recovery**



** Whether or not the following GY's charge fully recovers the under-recovery for the current GY depends on the accuracy of forward capacity booking forecasts ** From a modelling perspective, there would be no basis to anticipate over- or under-recovery in any case.*

Shippers' risk exposure will change over time with greater visibility of Entry Charges but will also depend on the approach to selling forward



- If shippers sell gas forward at a fixed price, the Entry Charge for these volumes is embedded in the fixed NBP. The risk of variations of Entry charges over the duration of the contract is left with the shipper.
- In our illustration, each month, shippers sell forward 1/12th of their annual gas demand, spreading it over a series of 12 fixed price contracts, each starting in a different month, the delivery period for each of which is 12 months. An equal amount of each fixed price contract is sold in each month over the 12 months before the start of the contract. We calculate the cost of risk capital in this example but also illustrate the implications of selling forward over a 2 year period.
- We assume shippers hold risk capital related to the uncertainty in transport costs for the volumes traded until charges are known with certainty. We assume that charges are announced at the start of June each year (i.e. 4 months ahead of the start of the new Gas Year), and that the new charge addresses any under-recovery since the previous charge announcement.
  - For a forward contract with 100% of volume delivered in GY1, risk capital is held by shipper for forward sales made up until 'N1' above (June ahead of GY1) (for trades made after this, there is no longer a need for the shipper to hold risk capital as the Entry Charge is then known for the entirety of the delivery period)
  - For a forward contract signed part way through GY1 (i.e. some gas is to be delivered in GY2) but before 'N2' above, risk capital must continue to be held by the shipper to insure against the uncertain GY2 charge for the GY2 volumes until a new announcement is made at 'N2'

Cost of risk capital assumptions

The previous steps of the analysis allow us to identify the scale of the capital held by different parties across time to address charge volatility. It is then necessary to apply a cost of capital to reflect total cost of capital for NGG and shippers related to one year's delivery of gas.

Key Assumptions

- We consider the nominal cost of capital - risk management costs are assumed to represent 'in-year' cost to parties
- Our starting position is to assume a WACC for shippers but a cost of debt for the NGG because NGG faces only a cashflow timing risk whereas shippers face a recoverability risk.
- However, we also present the results assuming a cost of capital for NGG

Cost of capital assumptions

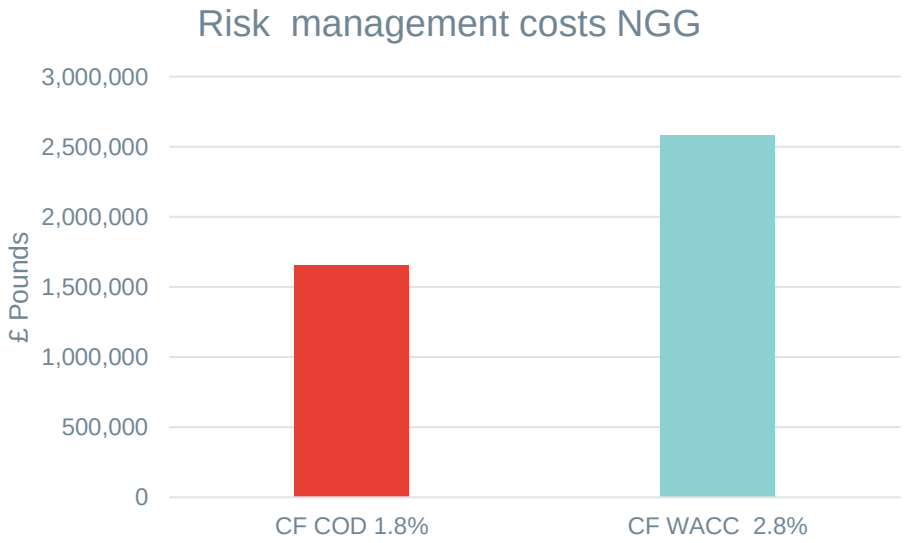
	Assumption	Discussion
Shippers	**9.6%**	▪ Ofgem's March '21 "Supplier Licensing Review reducing credit balance mutualisation" presents a range for supplier WACCs of 8-20% ▪ The low end is representative of large suppliers, while the high end is representative of small suppliers. The Licensing review suggests that the industry average is **9.6%.** ▪ We assume that shippers and (larger/average) suppliers have the same WACC
NGG	**1.8-2.8%**	▪ The low end is NGG's nominal allowed return on debt according to Ofgem's Dec '20 RIIO-2 Final Determination* for NGG. ▪ The high end is the allowed WACC according to Ofgem's FD. The high scenario corresponds to NGG's WACC because we consider that equity injections could in theory be made to preserve financeability ratios*

Note: We understand NGG's allowed return on equity (and therefore WACC) are subject to change following appeals to the CMA

Results – Risk Management costs: Under the counterfactual, NGG faces a cost of between £1.7 m to £2.6 m on average over the year

- The average capital requirement to cover the risk of under-recovery is just over £92m
- This calculation has been carried out for one year based on the 2020/21 £100m under-recovery figure from NGG. As ECs expire, this cost will fall

NGG sets the new Entry Reserve Price in June based on the previous 12 months since the previous price setting announcement. As such the period of uncertainty includes 4 months remaining in the gas year plus 8 months of the new gas year



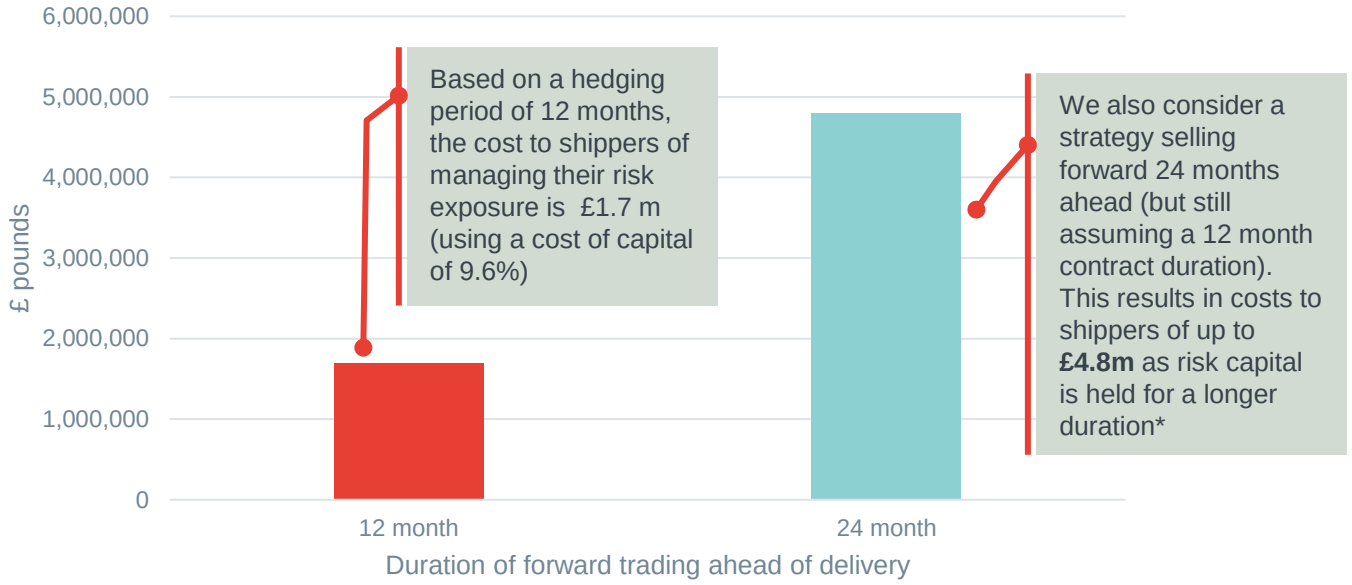
- The cost to NGG of covering its risk exposure varies from £1.7 m with a cost of debt of 1.8% …
- …to £2.6 m with a cost of capital of 2.8% over the year

Results – Risk Management costs: Under the counterfactual, shipper risk management costs vary between £1.7m and £4.8m annually

The longer the period over which shippers sell forward gas in advance of delivery, the greater will be the risk exposure

Two opposing trends determine capital requirements

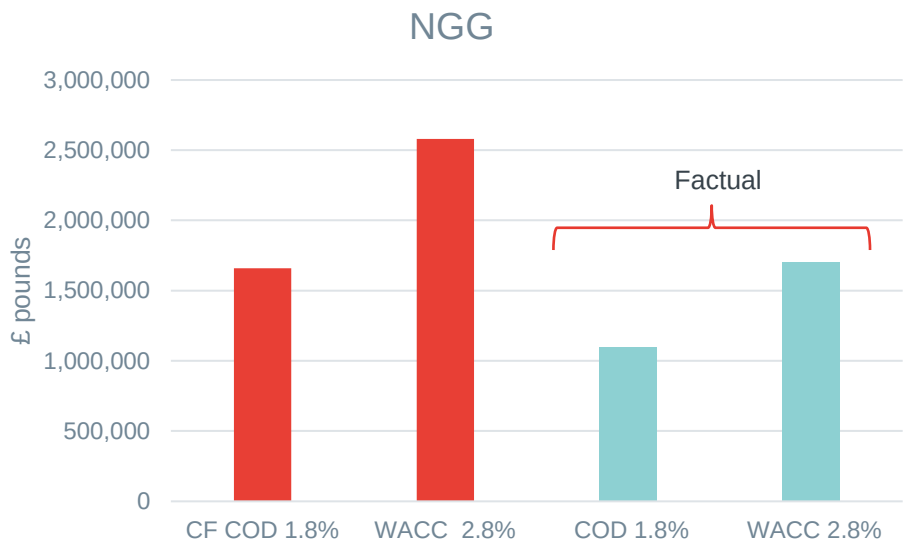
- Over time, increasing amounts of annual gas demand is sold forward, increasing capital requirements
- Approaching the June charging announcement, uncertainty regarding the following year's entry charge falls, reducing risk capital requirements on volumes of gas sold forward



- The average capital requirement to cover the risk of under-recovery is just over £18 million (12 month) and £52 million (24 month)
- Because of the two opposing trends, the capital requirement is lower than if the entire year's gas demand were sold exactly 12 months ahead of the charge announcement (i.e. 9.6% multiplied by assumed 12-month volatility of £100m).
- Note: this calculation has been carried out for one year based on the 2020/21 £100m under-recovery figure from NGG. As ECs expire, this cost will fall.

** We assume that risk exposure more than 12 months ahead of the charging announcement is capped at the 12 month level*

Results – Risk Management costs: Under the factual, costs are reduced for both NGG and shippers



- Estimated savings to NGG range from £0.6m per year (at 1.8% cost of debt) to £0.9m per year (at 2.8% WACC)
- Estimated savings to shippers range from £0.6m per year (12 month hedging) to £1.6m per year (24 months hedging)
- Note:
  - These results all assume expectations of an extreme event of £100m under-recovery. If expectations of industry or NGG were different to this the results would scale accordingly.
  - This calculation has been carried out for a single year based on the 2020/21 £100m under-recovery figure from NGG. We assume this represents a reasonable basis from which to consider the costs associated in GY 2022/23. We note, that as ECs expire, the cost savings from the option will fall.

In addition to those highlighted above, our calculations involve a number of key simplifications / conceptual assumptions

Our approach is to consider the industry-wide savings in risk management costs from the proposed modification and we assume no change in the cost of capital for different levels of risk exposure

- In practice, there will be distributional effects between different shippers. For example, the modification would result in a decrease in risk management costs for New Capacity, but would create a new risk for Existing Capacity holders (at least, at Entry Points other than interconnection and storage), as they would now face some risk related to the proposed flow-based charge (where previously there was none).
- We do not capture these distributional effects in our analysis. Doing so is unlikely to have a material impact on our analysis of societal costs, unless one were to assume that EC holders and non-EC holders have different costs of capital (for which there is no evidence) or that the cost of capital varies over different levels of risk exposure. Compared to the significant volatility managed by shippers in respect of wholesale gas prices, any cost of capital differences over the risk exposure scales we consider are likely to be minimal.

In practice suppliers may bear some of the risk we attribute to shippers, but we think our approach is a reasonable simplification

- Suppliers may not actually hedge 100% over the duration of a retail contract (e.g. a monthly product may not be available until nearer the time of delivery, or weather may deviate from forecasts requiring some fine tuning closer to time).
- The greater proportion of sales made by shippers to suppliers with full knowledge of the Entry Charge (which can therefore be passed through in the NBP price), the lower shippers' risk exposure will be.
- However, increased trading closer to delivery means the risk of Entry Charge volatility is then partly transferred from shippers to suppliers, to the extent suppliers must fix the retail price (before knowing what Entry Charge will be passed through in the NBP price).
- Provided that suppliers and shippers have similar costs of capital, the precise distribution of risks between suppliers and shippers should not materially affect the analysis

NGG and shippers are equally able to forecast capacity bookings / Entry revenue and have similar expectations of forecast errors in capacity bookings

- For example, if shippers actually assume a wider distribution of forecast errors than NGG, shipper risk management costs could be higher than we have estimated.

We assume Entry Charge volatility risk is independent of other shipper/NGG risks

- I.e. we assume no correlation with other risks held by shippers/NGG.

We assume that forecast errors are not correlated with one another from one month to the next (i.e. no 'autocorrelation')

- In practice there may be some (positive) autocorrelation, at least within a Gas Year (e.g. the same factors driving an under-recovery in one month may contribute to an under-recovery the following month). Starting with an estimated annual (fixed) VAR of £100m, assuming positive autocorrelation would reduce the estimated monthly volatility and, in turn, reduced estimated risk capital requirements.

Distributional impacts: introduction

In this section we consider the distributional implications of shifting a share of cost recovery to a flow-based charge and hence widening the charging base. We consider the implication for shippers and customers.

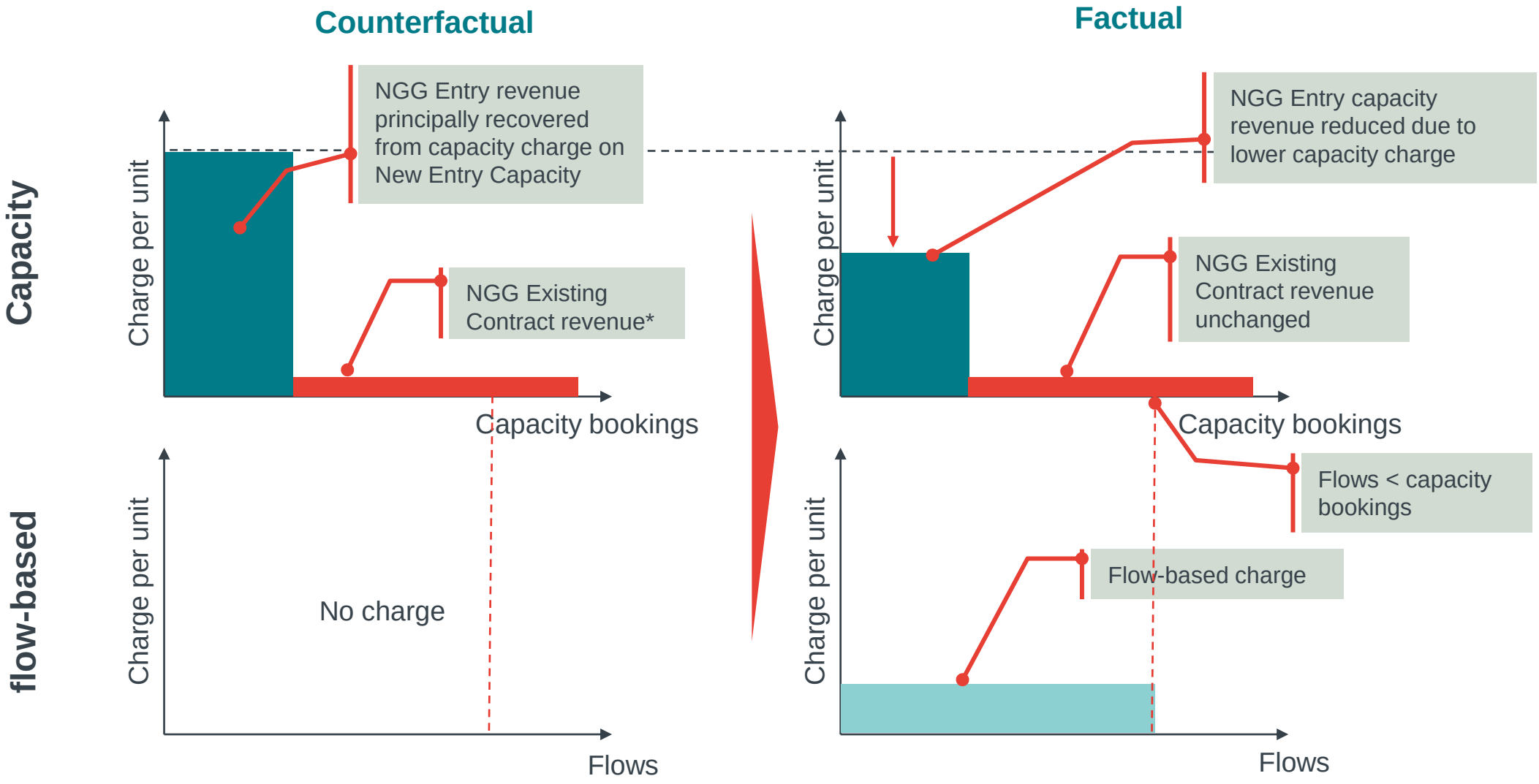
- The impact on customers is made up of 2 effects:
  - **Risk management costs:** Savings in risk management costs (societal costs) may be passed onto customers
  - **'Pure' distributional effect:** Widening the charging base leads to a reduction in the total entry charge passed through to NBP prices. This is a pure transfer from shippers (principally EC holders) to customers (this effect is described in greater detail in the following slides)

Impact on customers (within price control period) = **Change in shipper revenue (pure distributional effect)** + **Change in shipper risk management costs**

See next slides

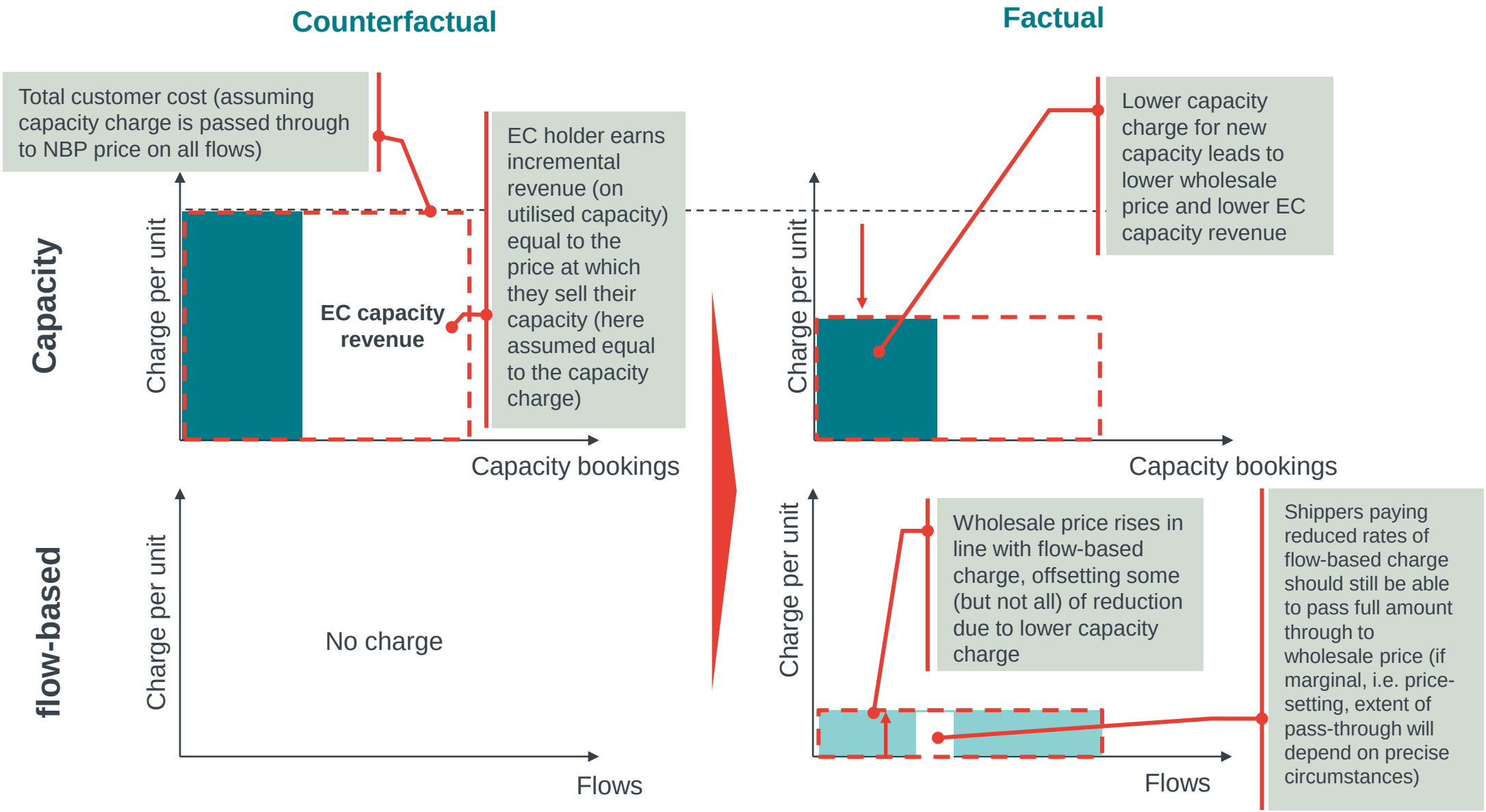
- Savings in NGG risk management costs are unlikely to be passed on to customers within the current price control as they will not result in a change to allowed revenue as determined by Ofgem.
- For shippers, the extent to which cost savings are passed onto customers will depend on:
  - How risk management cost savings are distributed across shippers (i.e. Existing Contract holders might experience additional costs of risk management, while New Capacity bookings face reduced costs)
  - The extent to which different shippers are marginal (i.e. price-setting)
  - The intensity of competition between shippers
- There is some uncertainty around this. However, as we later show, the pure distributional effect likely to be more significant, so the precise assumption on the extent to which shipper risk management cost savings are passed on to customers has only a limited impact on the overall result.
- Note: We have not included the small estimates of shipper risk management savings in the customer savings presented at the end of this section.

Pure distributional effect: the proposed mod would widen the charging base: the capacity charge falls by more than the new flow-based charge



*The simple average price of ECs (based on data from NGG) is much lower than the standard Entry Charge (~23x) (based on the average Entry Reserve Price for October 2021)

Assuming full pass-through of capacity charges, there is a reduction in EC capacity revenue and the cost to consumers



A few conditions must hold for the full capacity charge to be passed through to wholesale prices

Capacity bookings incremental with flows

- For the capacity charge to be passed through to NBP, new capacity bookings would need to be incremental with flows (i.e. short-term bookings), as opposed to 'sunk' (i.e. long-term). We assume the former.
- We assume these bookings are also incremental for use of EC capacity (while we do not have information on the contractual structure of EC sales, this is arguably likely)

EC holders not marginal

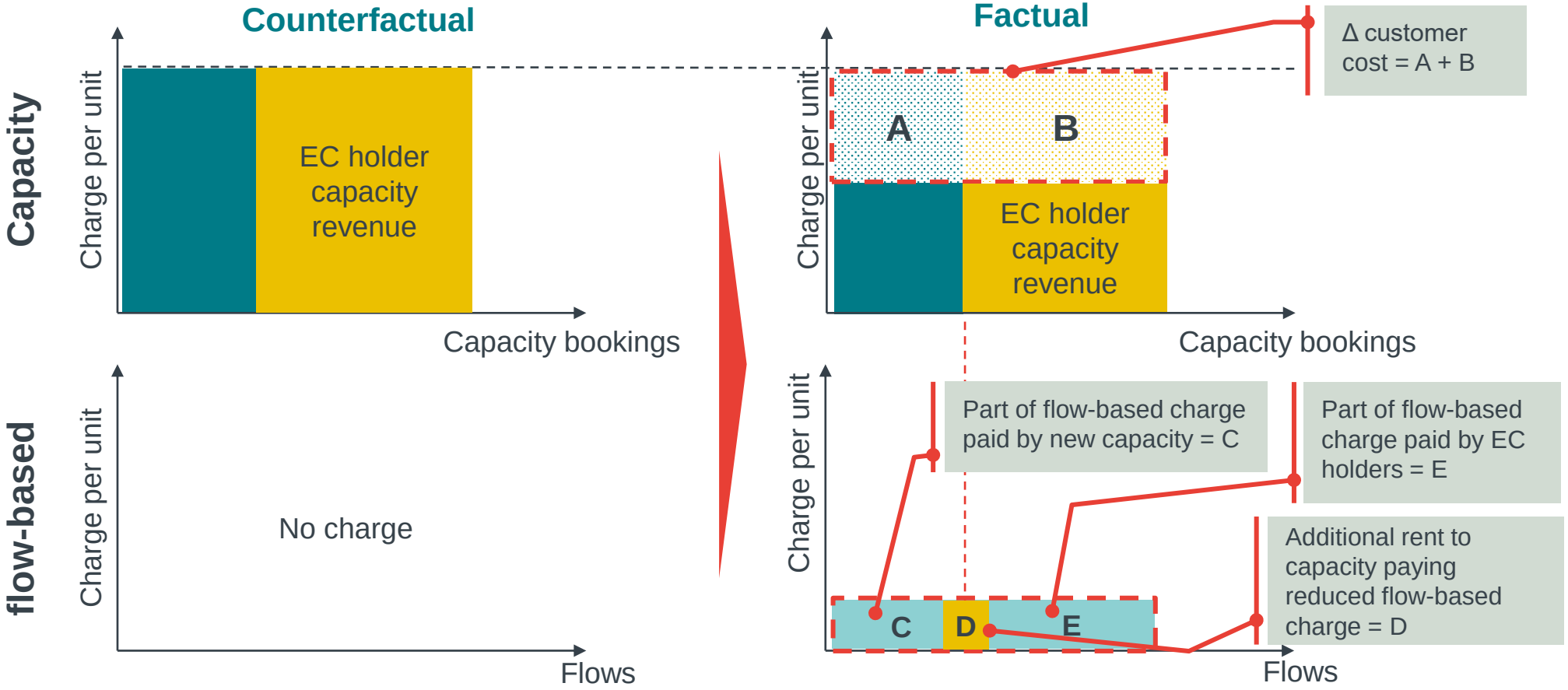
- As long as EC holders are not marginal and new capacity bookings are incremental with flows, then the full capacity charge will be passed through to the wholesale price

EC can pass on the full capacity charge

- If EC holders are marginal, they may still be able to price capacity at the full value of the capacity charge (as described in Section 2) and pass on this value

We explore in a accompanying note the possible implications of these assumptions not holding.

Under this approach, the benefit to customers is equal to the (net) reduction in shippers revenue



NG

- Lose A (lower capacity prices)
- Gain C + E (flow-based charge)
- **Net = neutral (A = C+ E)**

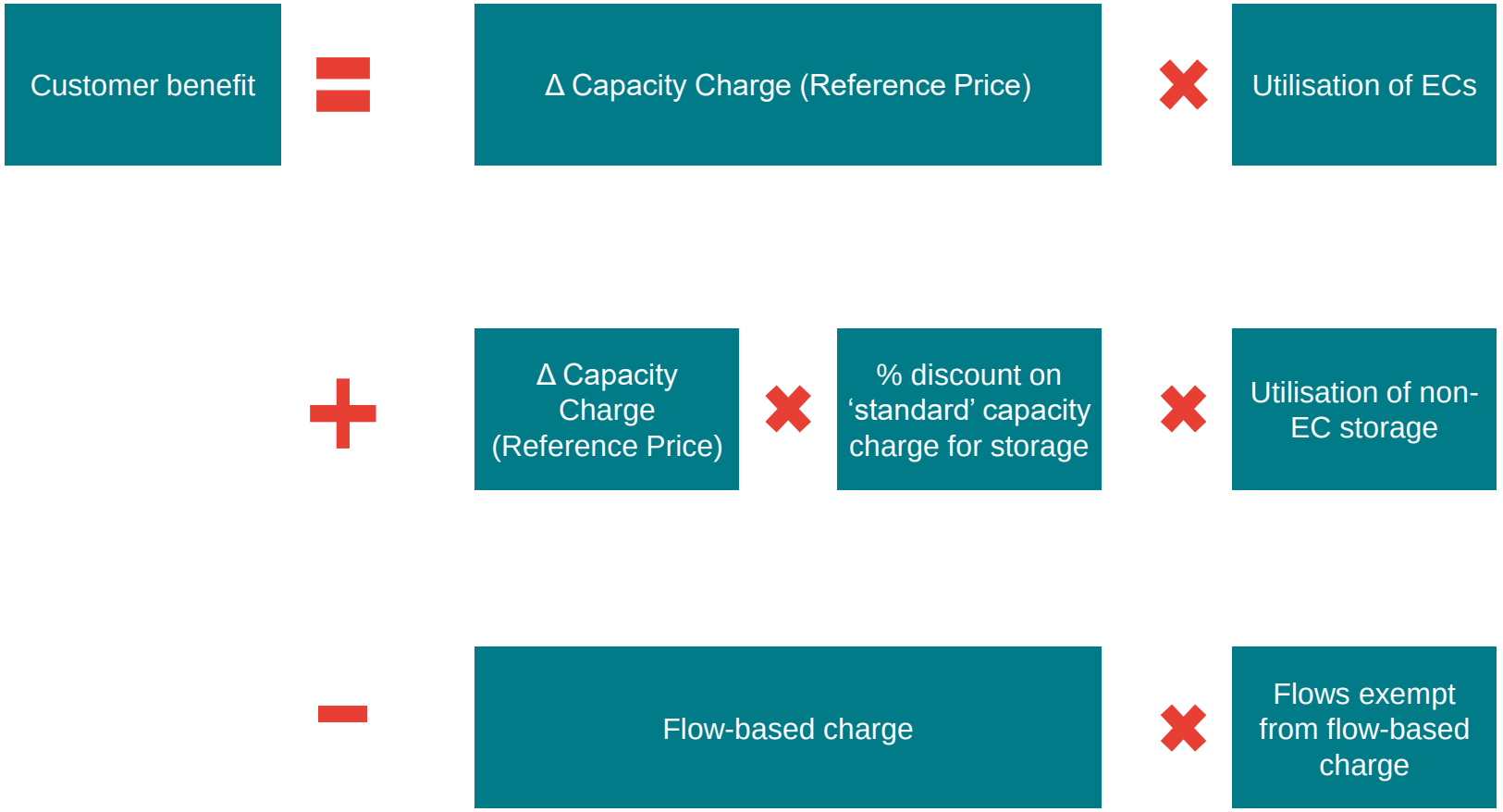
Customers

- Gain A + B (lower capacity prices)
- Lose C + D + E (higher flow-based charge)
- **Net = B – D (i.e. A+B - (C+D+E))**

Shippers

- Lose B (lower EC capacity revenue)
- Gain D (rent from flow-based charge)
- **Net = D - B**

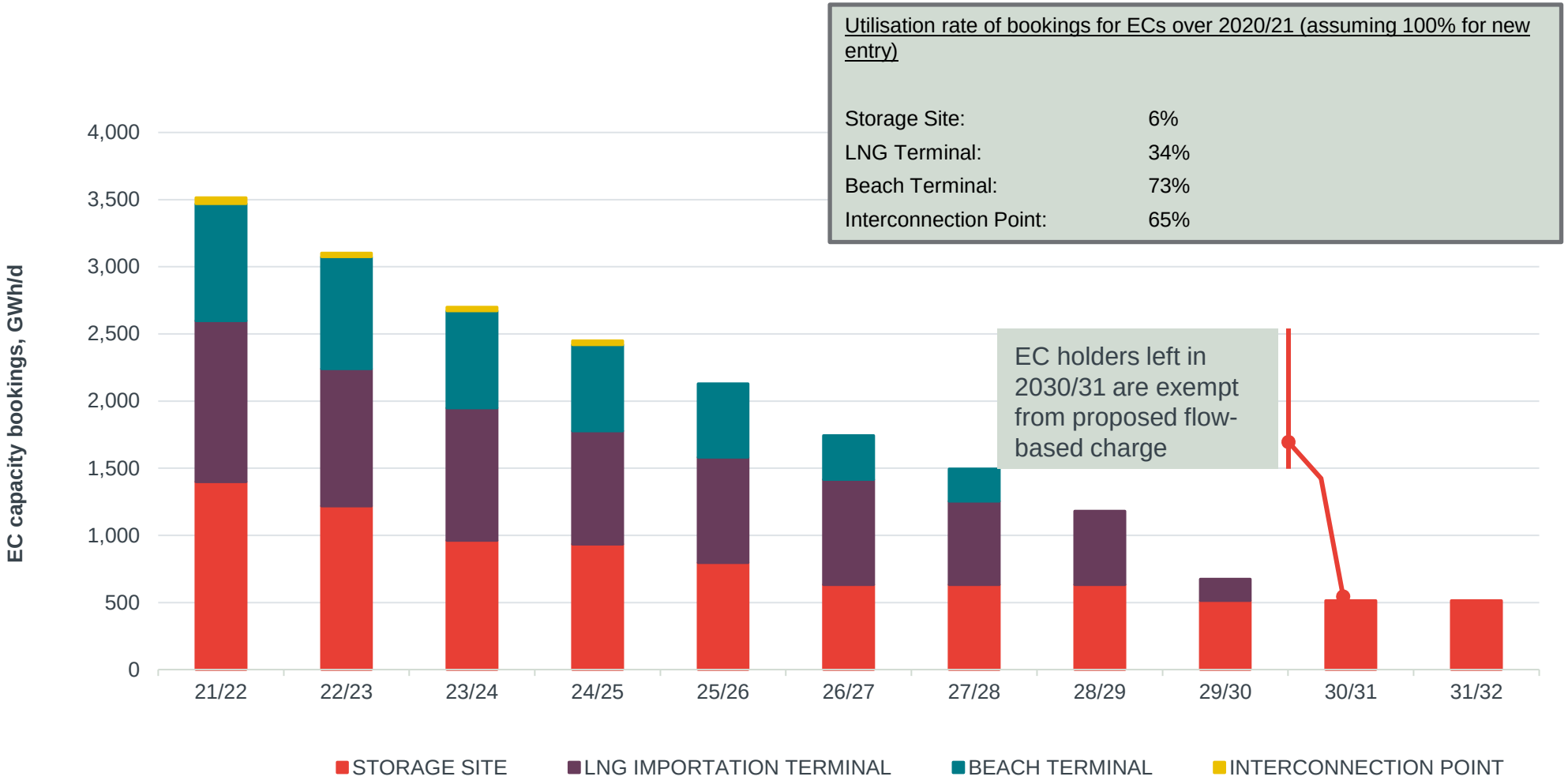
We calculate customer benefit as the sum of the following changes in shipper revenue



This effect is not shown on the diagrams in the previous slides (for simplicity). It arises since the capacity charge faced by storage falls by less than the reduction in the wholesale price (driven by the reduction in the 'standard' Entry Charge).

***Assuming that neither is marginal (price-setting).*

EC capacity contracts decrease progressively with no EC contract holders paying the flow-based charge by 2030/31



Our calculations are based on the following key assumptions

Charges

- For 2022/23 to 2025/26, we use counterfactual / factual entry reference prices provided by NGG
- For 2025/26 onwards in the absence of available forecast entry reference prices, we assume that the flow-based charge (and the difference between the counterfactual and factual capacity charges) decreases linearly to zero from 2025/26 to 2031/32.

Utilisation of existing contract holders

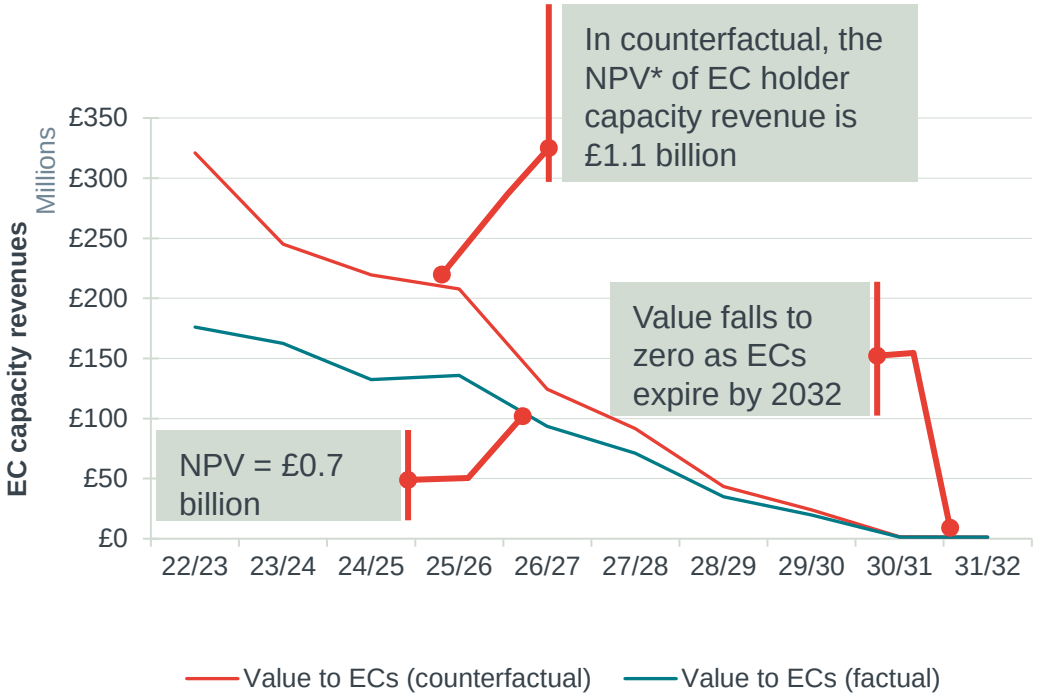
We consider two scenarios for utilisation (identical under factual and counterfactual):

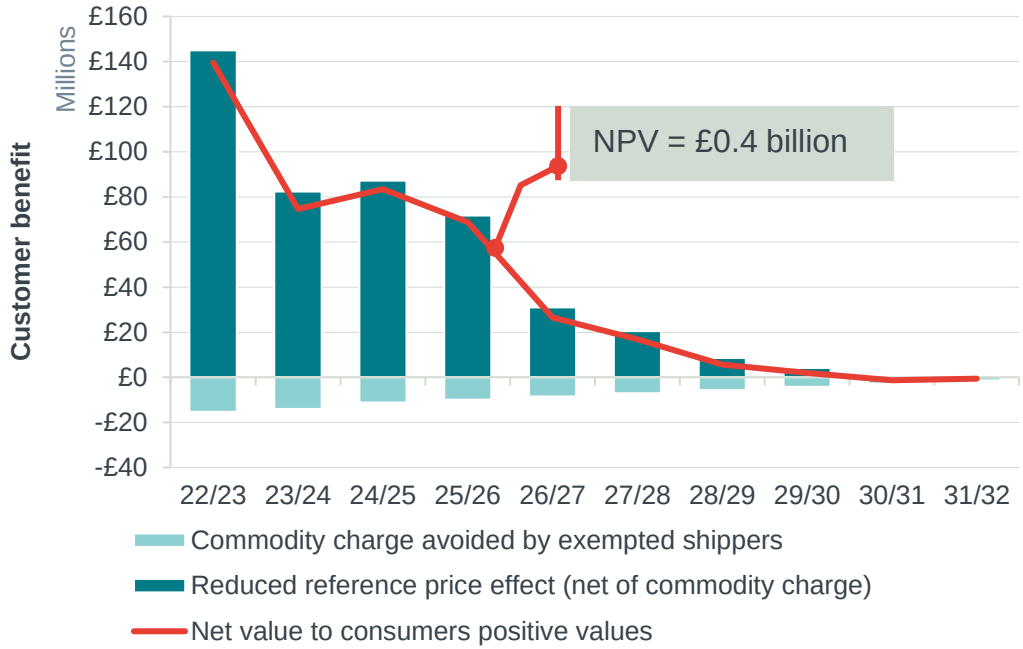
- We calculate a 'maximum' EC utilisation rate, assuming EC is fully utilised as long as flows (i.e. demand for capacity) are first accommodated by ECs, and that new capacity bookings are only made if ECs are fully utilised (this calculation is done at an annual level, and so it may somewhat overstate maximum EC utilisation).
- We also project EC utilisation, by type of entry point, based on historical data provided by NGG on total flows, EC capacity bookings and other capacity bookings for 2020/21. This is since we observe (see previous slide) that, over 2020/21, new capacity is sometimes booked even where ECs are not fully utilised. This may suggest some 'inefficiency' in new capacity bookings (although booking behaviour may change going forwards with greater experience of the postage stamp regime), and/or the seasonal profile of ECs relative to flows.

Shorthaul capacity

- We have not explicitly considered the change in value accruing to shippers that avail themselves of the shorthaul discount. This discount is applicable on the capacity charge in the counterfactual and in the factual and is also applicable in the flow-based charge in the factual.
- These discounts are reflected indirectly insofar as NGG has included this discount in its forward projection of capacity and flow-based charges that we use in our calculations.
- However, we do not directly account for reduction in capacity revenue for shorthaul capacity (similar to the effect we capture for non-EC storage capacity) or the increase in revenue for shorthaul capacity on the flow-based charge (similar to the effect we capture for interconnection and storage). We do however expect these impacts would be small.

Assuming maximum utilisation of EC capacity, we estimate that, as a result of the modification, customers benefit by around £0.4b NPV



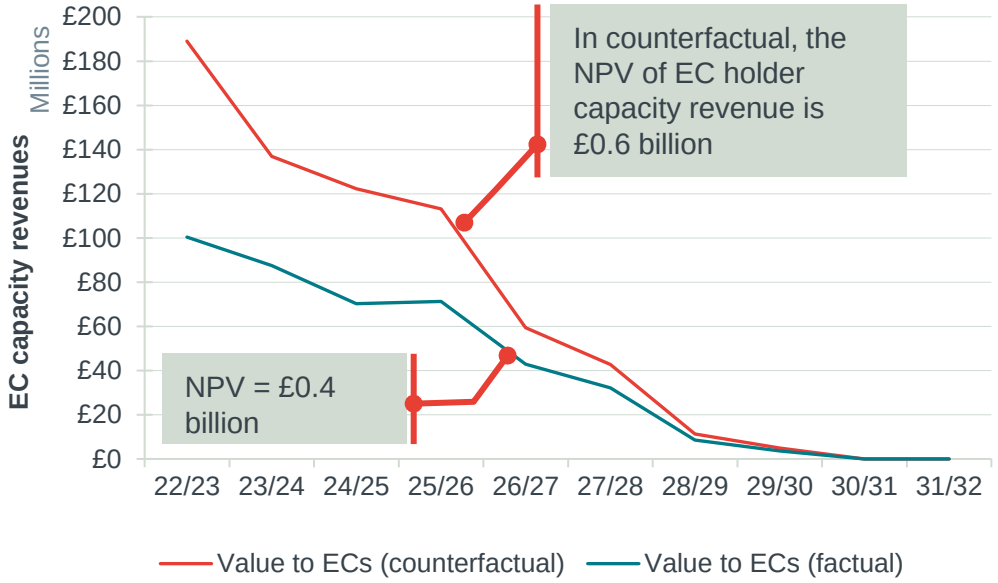


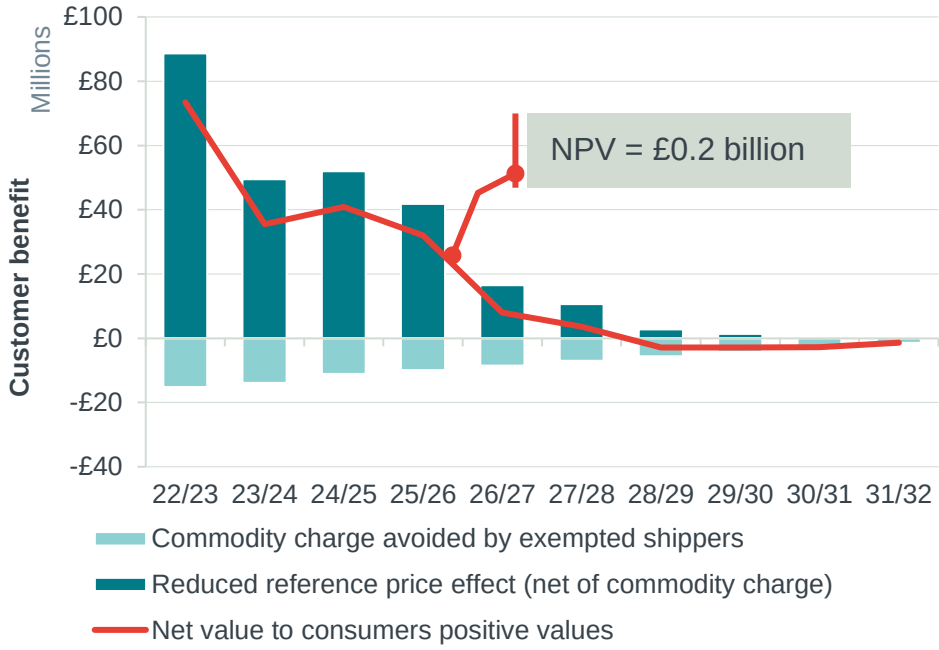
- These values exclude customer benefit from risk management costs (which are small in comparison)
- Shipper revenues at Interconnection and Storage points increase by £15 m in 2022/23 due to the exemption they receive from the flow-based charge.
- We note that the factual creates small negative benefits from 2030/31 (as a result of the additional value to shippers exempted from the flow-based charge being higher than the benefit from the reduced postage stamp reference price). The impact of these negative benefits is very small and the total discounted sum includes these.

We assume a 3.5% real / 5.65% nominal discount rate with 2022/23 as year 0

Assuming historic utilisation of EC capacity the customer benefit falls to £0.2b NPV

In this scenario we assume that EC holders do not utilise 100% of their capacity* and that they therefore derive lower value from their contracts





We assume utilisation for different categories of entry point as per slide 37

Within a given year, we assume that customer benefits are distributed evenly across time periods

Reduction in Entry Capacity Reference Price	▪ We assume new capacity bookings are incremental with flows (i.e. short-term), as opposed to sunk (i.e. long-term). As a result, reductions in the Entry Capacity Reference Price are likely to feed directly through to reductions in NBP in all periods ▪ We assume the Entry Capacity Reference Price sets the opportunity cost for use of EC, and that this price is also typically commoditised
Flow based charge	▪ The flow based entry charge is likely to pass directly through to the NBP in all periods. ▪ If an exempt source (interconnection, storage) is marginal extent of pass-through will depend on precise circumstances. If the flow based charge does not pass through, customer benefit will increase relative to our estimate
Shipper risk management costs	▪ Based on our assumptions, shipper risk management costs are proportionate to demand, and so would pass through to NBP evenly across periods ▪ In reality, this may not be entirely true – for example, because shippers are likely to sell greater volumes forward for winter than summer. However, given the overall risk management costs are low, this effect is unlikely to be material

As a result, we consider that the benefits for individual customers are proportionate to customer size

We can therefore estimate the impact of the modification on different customer types*

	Unit	2022/23	Total to 2031/32 NPV
Net value for consumers due to distributional effect	GBP	73 - 140 m	174 - 382 m
Total forecast flows (i.e. demand)	TWh	903	
Net value for consumers per kWh	p/kWh	0.01 - 0.02	

Impact by consumer type	Estimated consumption (MWh/y)**	2022/23 (£)	Total to 2031/32 NPV (£)
Domestic (vulnerable)	11	0.9 – 1.7	2.2 – 4.9
Domestic (medium)	12	1.0 – 1.8	2.3 – 5.2
Industrial & commercial LDZ	149	12 - 23	29 - 64
Industrial & commercial NTS	400 000	32 k – 61 k	77 k – 172 k

The range in values refers to the two scenarios for EC utilisation shown in slides 39 and 40. Figures do not include the small estimated savings in shipper risk management costs

***https://www.ofgem.gov.uk/sites/default/files/docs/2021/01/cepa_unc728_analytical_support.pdf*

NGG and Ofgem are discussing a possible additional modification that would change the spread of revenue recovery across Gas Years

While we have not considered the impacts in detail, our initial thoughts on the incremental impacts of this option, compared to a baseline that includes implementation of the supplementary flow-based charge modification, are as follows:

Additional option

Amending the target revenue calculation for a given Gas Year in a way that takes better account of the misalignment between the Gas Year (October to September) and Regulatory Year (April to March)

- Current methodology for determining the Gas Year target revenue focusses on revenues related to the Regulatory Year that ends in the Gas Year in question. This can cause volatility in the target revenue across years
- Conceptually an alternative approach could take values for revenues from each of the Regulatory Years the Gas Year bridges, therefore potentially smoothing target revenues across Gas Years and reducing volatility over time compared to the current approach

Impacts on competition

Could further reduce competitive advantage for larger shippers relative to smaller shippers (by reducing risk management costs – see below). Uncertain impacts on distortions of flows.

Charge volatility

Likely to increase cashflow timing risk for NGG but decrease it for shippers. Given the cost of debt and cost of capital are cheaper for NGG this may result in a net gain.

Distributional impacts

It is difficult to provide a qualitative view on impacts. Given a revised set of projected capacity and flow-based charges under the counterfactual and factual, it should in principle be possible to quantify the impacts on customers.