LCP Delta

frontier economics

Zonal Pricing in Great Britain

Assessing the impacts on support payments

Report for sse

OCTOBER 2024

In this analysis we estimate the potential impact of increased locational risk in a zonal market on required levels of support payments

This analysis draws on the modelling results from LCP's analysis 'Zonal Pricing in Great Britain – Assessing the impacts of the 'Beyond 2030' network plans', using data produced across all the scenarios and sensitivities analysed.

In principle, implementing a zonal market in place of the current national market arrangements changes the risk profile of investments, and as a result, would change the level of support payments (whether CfD or capacity market) investors would require.

This analysis seeks to quantify the impact of increased uncertainty introduced by a move from a national to a zonal market design on the required support payments for two archetypal new build plants (offshore wind and gas)

Required Contracts for Difference (CfD) strike price

New build offshore wind farm located in Scotland, commissioning in 2030 and supported by the current CfD model.

Required Capacity Market (CM) payment

New build dispatchable gas plant located in England, commissioning in 2030 and supported by a 15-year CM contract.

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Overview of our findings – Enduring impacts of implementing a zonal market

Locational risk is likely to increase for many investors in a zonal market

- Movement to a zonal market is likely to introduce significant locational price and volume risk for investors.
- Plants are exposed to changes in the prices and sales volumes they are able to achieve as a result of congestion on the network.
- These changes in prices and volumes create more uncertainty (and may be more difficult to predict) as they rely on accurate forecasts of future demand, supply and network expansion.
- This increase in uncertainty would likely translate into an increase in the investor's cost of capital, and hence the required level of support payments.
- In a zonal market, plants may no longer pay locational TNUoS charges. Based on this analysis for wind plants, this reduction in risk is relatively small compared to the increase in price and volume risks.

This is likely to significantly increase CfD strike prices

- For an archetypal Scottish wind farm, **average strike prices increase significantly in a zonal market** compared to a national market due to increased price and volume risk, increasing total support payments required.
- The distribution of possible strike prices required to achieve a target rate of return is also wider in a zonal market than in a national market.
- As an illustration of this effect, we show that compared to the strike price which would be required to result in a target rate of return 50% of the time, a **27% premium is required in a zonal market** to be 90% sure of reaching the target, compared to a 4% premium in a national market.
- The impacts are dependent on the CfD design. For the zonal market, we have modelled the current CfD design with a system average price (SAP) reference price which exposes plant to locational price and volume risk.

We may also see similar increases in CM payments for dispatchable plants

- The impact of a zonal market on dispatchable plant depends on the extent to which a plant is already exposed to locational risk in the Balancing Market (BM) under the national market, in addition to TNUoS uncertainty.
- We calculate a distribution of CM bids for an archetypal CCGT* located in England, earning a mix of wholesale and BM revenues in the national market.
- We find that the distribution of capacity payments across the zonal market scenarios required to achieve a target rate of return is wider than the distribution in a national market driven by locational TNUoS risk and BM revenue risk
- Compared to the CM bid which would be expected to result in a target rate of return 50% of the time, an **8% premium is required in a zonal market** to be 90% sure of reaching the target, compared to a 5% premium in a national market.

** As an illustration we have modelled this as a CCGT. It is unlikely a new-build CCGT will come about, but in principle the impacts could be analogous to a low-carbon dispatchable plant.*

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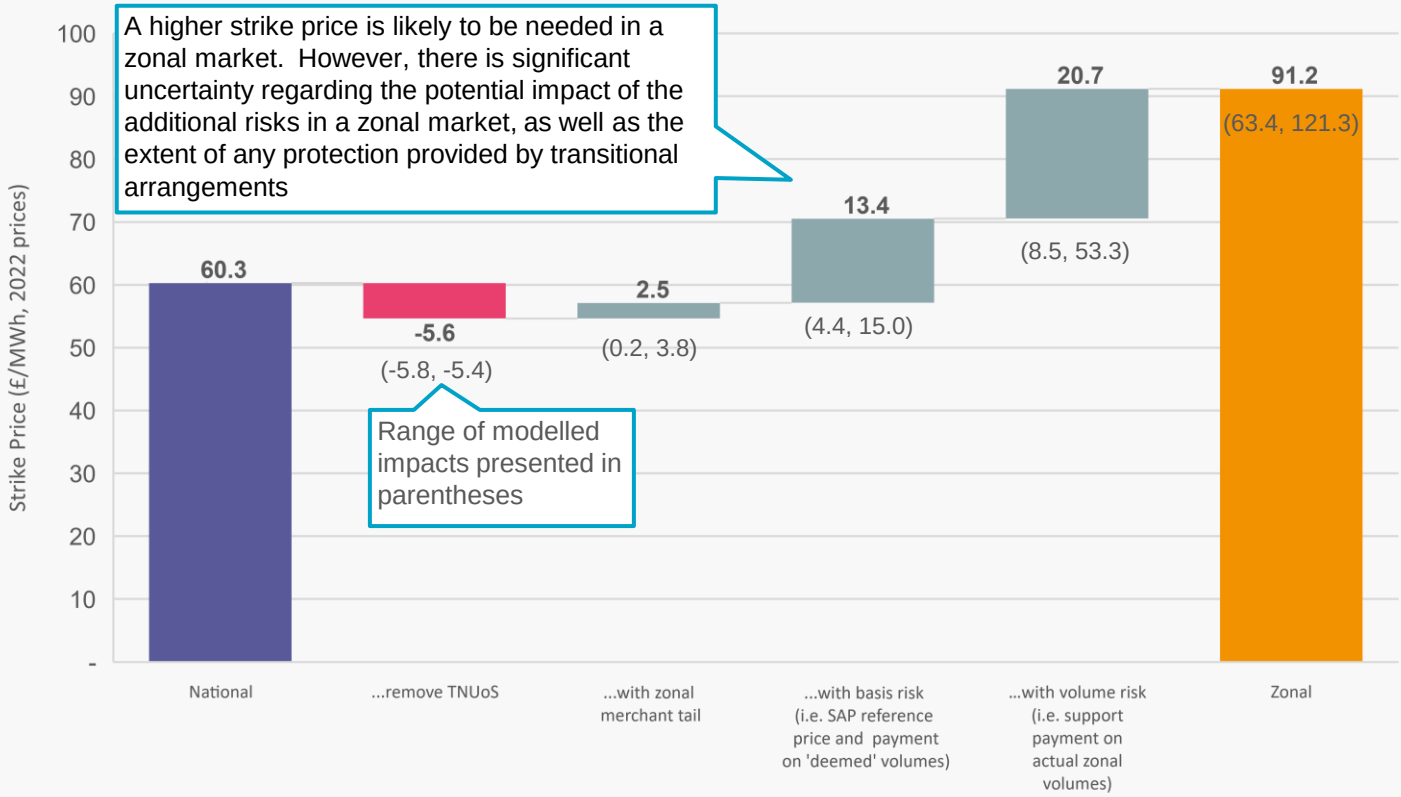
Overview of findings – Transitional effects related to the implementation of a zonal market

Applications for AR7 open in March 2025. Depending on policy decisions made at that time, bidders may face different levels of transitional uncertainty

- What terms will bidders face if a zonal market is announced and then implemented during the term of the CfD? In particular:
  - Will the reference price move to SAP or local zone?
  - Will top ups be paid on deemed or actual volumes?
  - What degree of protection will be offered by transitional arrangements?
- If a zonal market is to be implemented, what are reasonable expectations for the relevant details?
  - How many zones are expected? Where are the boundaries relative to individual connection points?
  - What is the re-zoning process?
  - When is the planned implementation date?
- If these design details are clear, what are reasonable expectations for the pricing dynamics in the market?
  - Patterns of price formulation over time?
  - Levels of constrained volumes?
- How much risk is there around these variables?

Our analysis suggests that these details will be highly material in determining bids into the auction…



… which may result in either high risk premia or low participation in near term allocation rounds

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Introduction and methodology

The locational signal under national and zonal market designs are fundamentally different in nature

- An efficient locational signal should reflect the forward-looking costs (or benefits) that users impose on (provide to) the network based on where they connect and how they use the system.
- In other words, a locational signal is a cost reflective charge that users of the system can predict at the point of investment and therefore internalise into their own investment the incremental societal costs or benefits that they cause.
- A move to zonal pricing in GB will change the form of the locational signal, and in doing so, the risks that different investors face.

Locational signals under national market design with TNUoS charge

Locational signal is embedded in locationally varying transmission charges (TNUoS) determined annually. The signal can be expressed as the spread between the TNUoS charge paid by the generator in its given TNUoS charging zone and the average generation TNUoS charge across all TNUoS charging zones.

The component of TNUoS charges which varies locationally is a form of long-run marginal cost (LRMC) signal, because it reflects the cost of incremental network expansion triggered by additional network use at a particular location.

Locational signals under zonal market design

Locational signal is embedded in locationally varying wholesale revenues. The locational signal can be expressed as the spread between the zonal revenues received by the generator and the average (or 'traded hub') wholesale revenues across zones.*

This is a short-run marginal cost (SRMC) signal as the wholesale signal is based on today's network capacity (i.e., it is not based on the cost of new investment).

The extent to which generators are exposed to these signals can be dependent on the design of any support arrangements.

**Note, we assume for the purpose of this study that no locationally varying transmission charges are retained under a zonal market design. I.e., the locational signal is only transmitted via wholesale prices. However, we note that charges reflecting intra-zonal congestion are still possible.*

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Changing the locational signal can affect the level and distribution of returns investors expect to face, and hence the level of support required

From an investor point of view, it is not the locational signal *per se* which matters, but its impact on investment returns (and hence the consequent impact on any support payments required to meet a desired hurdle rate).

In principle, changes in the form of the locational signal from a move to zonal pricing could impact both:

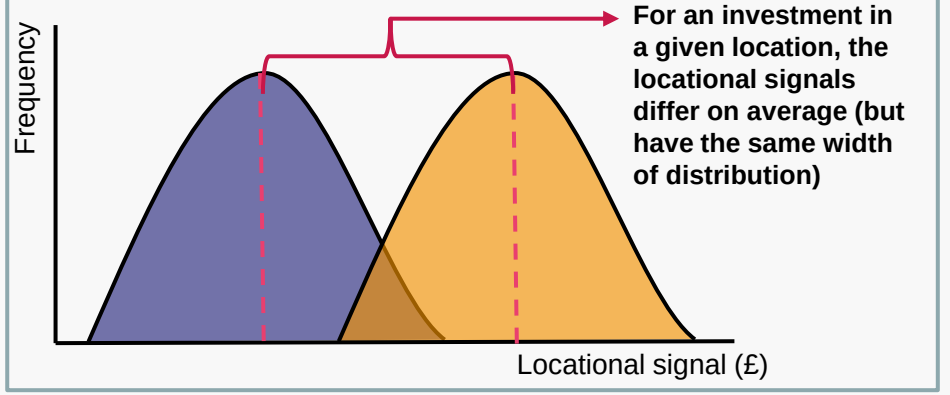
The expected (average) investment return – if the level of the locational signal over the investment horizon differs between national and zonal market design i.e. the expected total TNUoS payment made/received by the investor differs from the change in wholesale revenues from participating in a zonal, rather than national market.

The distribution of potential investment returns – if the underlying volatility (and predictability) of the locational signal differs between the national and zonal market design, this may impact the distribution of returns. Changes in the distribution of returns indicate the **riskiness of an investment,** which in turn will influence the **cost of capital required by investors** (and therefore the support payments required).

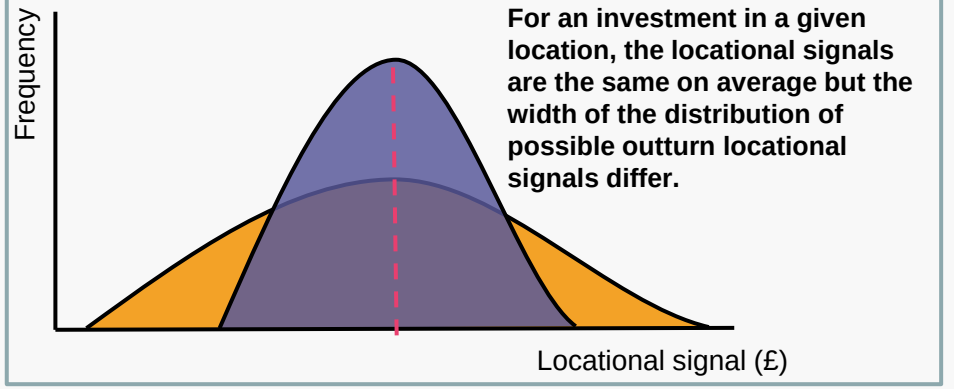
For a supported plant, a reduction in the expected level of return or an increase in the cost of capital are likely to result in an increase in the level of support required to achieve a target level of return, with a given level of certainty.

Illustrative

Difference in the *level* of the locational signal



Difference in the *distribution* of the locational signal



National Zonal

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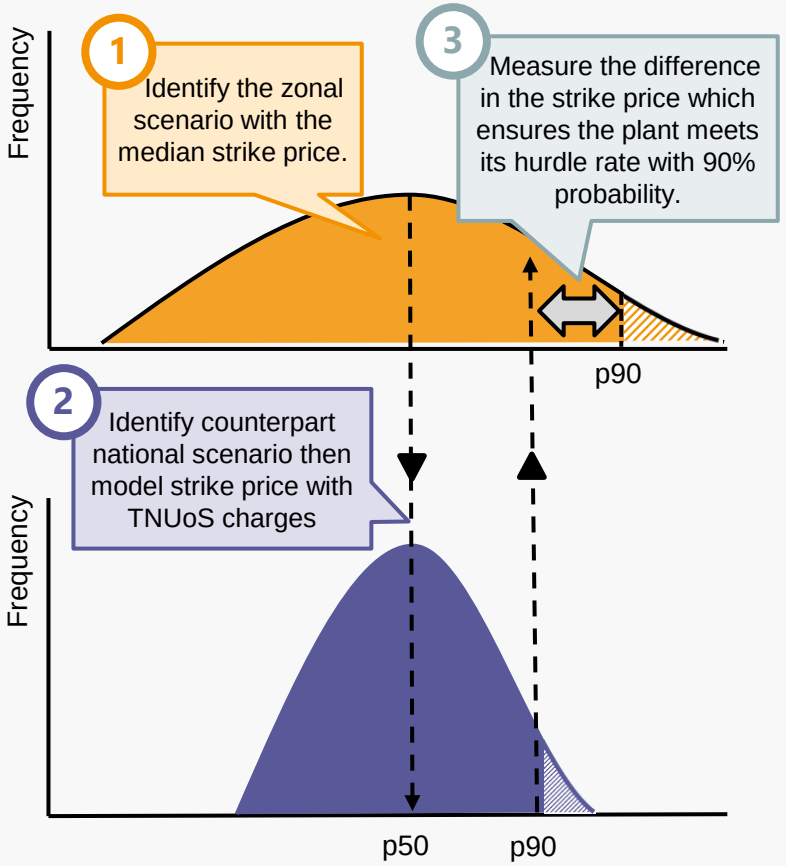
Our approach to illustrate the impact of zonal pricing on the CfD strike price for an offshore windfarm in Northern Scotland

In principle, we expect the distribution of earnings for an archetypal Scottish offshore wind plant connected to a zone in N. Scotland to be wider in a zonal market than in a national market, leading to an increase in the CfD strike price required to achieve a given rate of return with sufficient confidence.



Note: In reality the p50s in the national and zonal market will not be perfectly in line. We align here for illustrative purposes.

1 Strike prices in a zonal market

Our cashflow model calculates the strike price required to achieve the target rate of return based on an estimate of the wholesale zonal market revenue for an offshore windfarm connected to a zone in Northern Scotland.* A strike price can be calculated for each of the modelled scenarios (see slide 10) to produce a distribution of potential strike prices under a zonal market design. Note that we assume full exposure of the wind farm to the zonal locational signal i.e. a CfD based on a system average reference price (as opposed to a zonal reference price).

2 Strike prices in a national market

We calculate an equivalent strike price for the same plant operating in a national market in the following steps:

- We select the national scenario with the same core demand, supply and network investment assumptions, thus ensuring the difference in revenue represents the different allocation of price and volume risks alone.
- Calculate a strike price assuming a TNUoS charge based on the most recent five-year forecasts for the relevant zone.
- Using the average TNUoS charge, we then apply the variation in historical TNUoS charges to simulate future TNUoS uncertainty.

3 Illustration of impact of risk on strike price

A wider distribution of strike prices necessary to achieve a target rate of return means investors face increased uncertainty which would increase the cost of capital, and hence the target rate of return. We illustrate the impact by comparing the strike price that would be required to achieve the target rate of return in 90% of scenarios (i.e. p90 value) in a zonal and national market.

** For each modelling scenario, the wholesale revenues reflect those of a plant that faces an average level of curtailment across all offshore wind plants located in Northern Scotland. In reality, some plants may be exposed to much greater curtailment and hence volume risk than shown in this analysis.*

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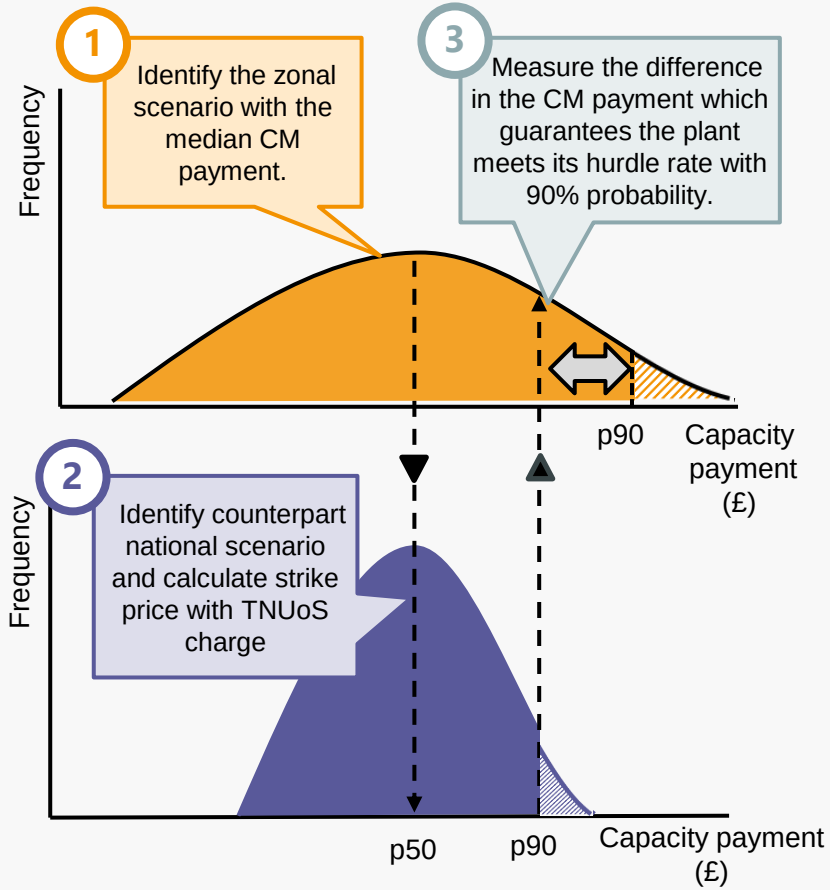
Our approach to illustrate the impact of zonal pricing on the capacity payment of a dispatchable gas plant

We illustrate the potential impact on CM payments of the change in risk under a zonal market by comparing the distributions of possible CM payments for an archetypal CCGT in a zonal and national market. The CCGT earns a mix of wholesale and BM revenues in the national market



Note: In reality the P50s in the national and zonal market will not be perfectly in line. We align here for illustrative purposes.

1 CM payment in a zonal market

Our cashflow model calculates the 15-year capacity payment required by a CCGT to achieve the target rate of return across a range of modelled scenarios to produce a distribution of potential CM payments under a zonal market design.

2 Capacity payment in a national market

We calculate an equivalent CM payment for the same plant operating in a national market, capturing volatility due to TNUoS and BM revenues in the following steps:

- We select the national scenario with the same core demand, supply and network investment assumptions, thus ensuring the difference in revenue represents the different allocation of price and volume risks alone.
- Calculate a CM payment assuming a TNUoS charge based on the most recent five-year forecasts for the relevant zone.
- Using the average TNUoS charge, we then apply the variation in historical TNUoS charges to simulate future TNUoS uncertainty.
- In addition, we apply the volatility in BM revenues earned across the range of modelled scenarios.

3 Illustration of impact of risk on CM bid

A wider distribution of CM bids necessary to achieve a target rate of return means investors face increased uncertainty which would increase the cost of capital, and hence the target rate of return. We illustrate the impact by comparing the CM bid that would be required to achieve the target rate of return in 90% of scenarios (i.e. P90 value) in a zonal and national market.

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Our analysis is focused on a range of scenarios with different levels of network capacity

We have used the national and zonal modelling scenarios from LCP's analysis, 'Zonal Pricing in Great Britain – Assessing the impacts of the 'Beyond 2030' network plans', as well as other scenarios provided to SSE, as the basis for the distributions of CfD strike prices and CM prices

	Modelling run	Description
Five scenarios included from LCP's published analysis of system impacts	**NOA7 Refresh network plans**	Zonal pricing assessed under, now outdated, NOA7 Refresh network build-out (using ETYS 2023 assumptions).
	'Beyond 2030' network plans with fixed offshore wind locations	Zonal pricing assessed with 'Beyond 2030' network plans and fixed offshore wind locations that align with seabed leasing round results.
	Addressing Southern (SC1) Constraint	Based on 'Beyond 2030' network plans, this sensitivity increases the boundary capacity on SC1, using NESO data, to understand the impact of increased network upgrades in this area.
	3-year network acceleration	A 'what-if' scenario to test the impacts of accelerated investments and upgrades in network infrastructure where all 'Beyond 2030' network plans are brought forward by 3-years.
	Alternative demand and capacity mix	An alternative market background scenario with lower demand based on the DESNZ Net Zero Lower Demand scenario, with Beyond 2030 network plans.
In this analysis we have also included three additional scenarios carried out by LCP to broaden this analysis	**NOA7 Refresh network plans with fixed offshore wind locations**	Zonal pricing assessed with NOA7 Refresh network build-out and fixed offshore wind locations that align with seabed leasing round results.
	Beyond 2030 network plans	Zonal pricing assessed with 'Beyond 2030' network plans (without fixed offshore wind locations).
	3-year network delay	A delay of 3-years in all boundary capacity increases under the 'Beyond 2030' plans.

- We adopt cost assumptions and a target rate of return for this plant from DESNZ's Electricity Generation Report 2023.
- In contrast to TNUoS where we have historic data on which to base a distribution of locational risk in a national market, the distribution of revenues in a zonal market is ultimately constrained by the future scenarios available. Variations in the number/type of scenario or their assumed probability (we assume the same probability for each) could affect the results.

Note: The focus of this analysis is on the impact of changes in locational risk on zonal and national strike prices. Therefore, we focus on scenarios with constant demand and capacity mix with variations in network capacity (and hence congestion), which leads to a distribution of locational risk in the zonal market. This can then be compared to the locational risk driven by TNUoS in the national market. However, we have included the single scenario modelled by LCP which varies demand and capacity. The impact of its inclusion on the results is negligible.

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Impact of zonal pricing on CfD strike prices

Fundamentally, a zonal market changes the extent of price and volume risks that investors in wind plants face…

Risk category	National market	Zonal market
Wholesale price risk	▪ Plant exposed to risk of changes in wholesale market prices at the national level. National prices are impacted by the overall balance of national demand and supply and plant marginal costs (in particular, fuel and carbon costs).	***Increase in price risk*** ▪ Plant is exposed to the risk of changes in its local zonal wholesale price. Therefore, in addition to uncertainty due to drivers of national price risk, a plant faces the risk that its zonal price diverges from the national price due to limited network capacity. ▪ The impact of congestion on prices is difficult to predict over the life of a plant given it relies on forecasts of the relative balance of future demand, supply and network build, all of which are subject to significant uncertainty and beyond the control of investors and generators.
Wholesale volume risk	▪ Plants can sell all available output in wholesale market when in merit nationally. ▪ Plant is compensated for curtailed volumes in the Balancing Market due to congestion.	***Increase in volume risk*** ▪ Volume risk is increased due to the additional uncertainty that the impact of limited network capacity could have on the ability of the market to accommodate the plant's output. ▪ The impact of congestion on plant output is difficult to predict over the life of a plant given it relies on forecasts of the relative balance of future demand, supply and network build, all of which are subject to significant uncertainty and beyond the control of investors and generators.
Locational TNUoS risk	▪ Locational Transmission Network Use of System (TNUoS) risk refers to the volatility and unpredictability of future locational network charges that are updated annually.	***Removal or reduction in TNUoS risk*** ▪ With a relatively high number of zones (e.g. 8-12), it is reasonable to assume that locational TNUoS (and hence a source of investor risk) would be removed, mitigating in part the increase in price and volume risks.*

**We note that charges reflecting intra-zonal congestion are still possible*

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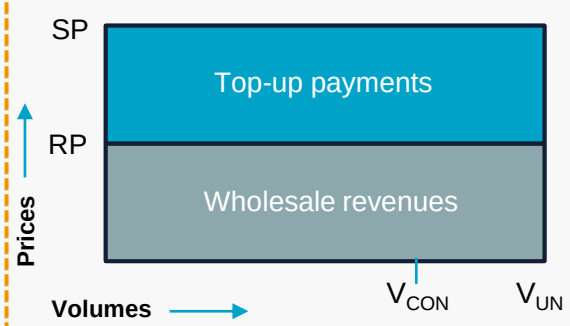
...though the extent to which CfD investors are exposed to these changes in risk will depend on the particular CfD design

Zonal market

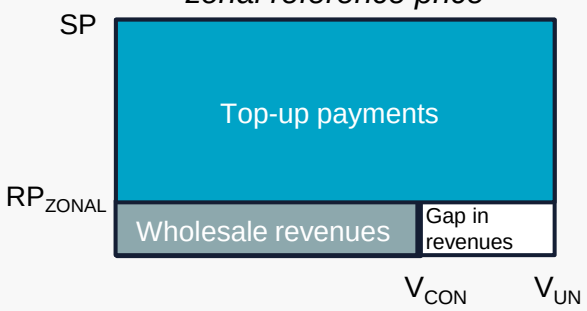
CfD design assumed in national analysis

Current CfD



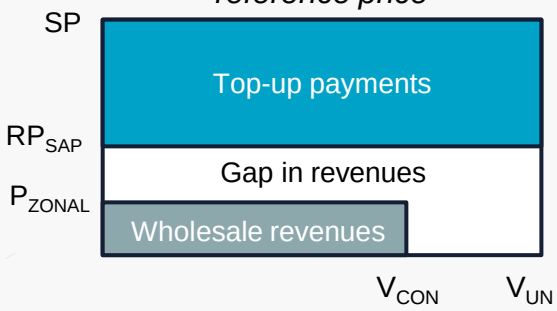
- Wind plant makes sales into reference market on unconstrained volumes (V_{UN}).
- Wind plant achieves reference price (RP) on wholesale sales and is compensated for constrained off volumes at value of lost top-up, so overall meets its strike price (SP).

Deemed Volume CfD with zonal reference price*



- Wind plant earns lower wholesale price on actual volumes. This is reflected in the RP, so overall plant achieves SP on actual production.
- Wind plant sales volumes lower due to congestion, but deeming ensures top-ups paid out on unconstrained volumes, so risk only on wholesale revenue.
- In reality, zonal prices in periods of wind plant curtailment would be zero, so gap in revenues would also be zero. Contract period revenue risk low.

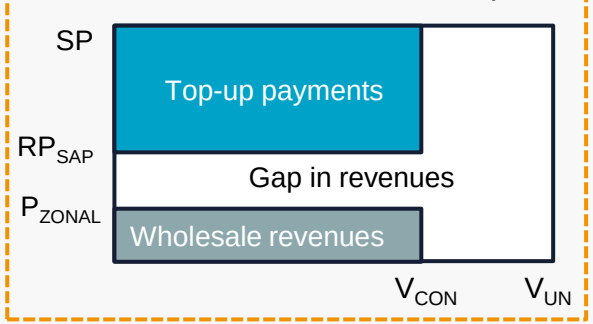
Deemed Volume CfD with SAP reference price



- Additional gap in revenues as RP set at system average price (SAP).
- Plant cannot achieve RP on actual production when zonal price and SAP diverge (i.e. "basis risk").
- For volume lost due to congestion, top-ups paid on deemed rather than actual volumes, so risk on wholesale revenue

CfD design assumed in zonal analysis

Current CfD with SAP reference price



- Additional gap in revenues introduced as top-ups only paid on actual volumes. Therefore, wind plant cannot earn any revenues on volumes which are curtailed due to congestion.

Depending on significance of congestion, revenue gap can increase required SP. Gap is also volatile and difficult to predict, potentially increasing cost of capital, and hence strike price

Increasing exposure to price and volume risks in a zonal market during contract period

Note: The illustrations assume that day ahead price >0 and that strike price > reference price

** There are a wide range of potential approaches to a deemed CfD model. We are assuming that the deeming methodology ensures top-ups are paid on all unconstrained volumes. Alternatively, deemed volumes could be fixed further in advance (e.g. yearly or monthly) with different implications for risk.*

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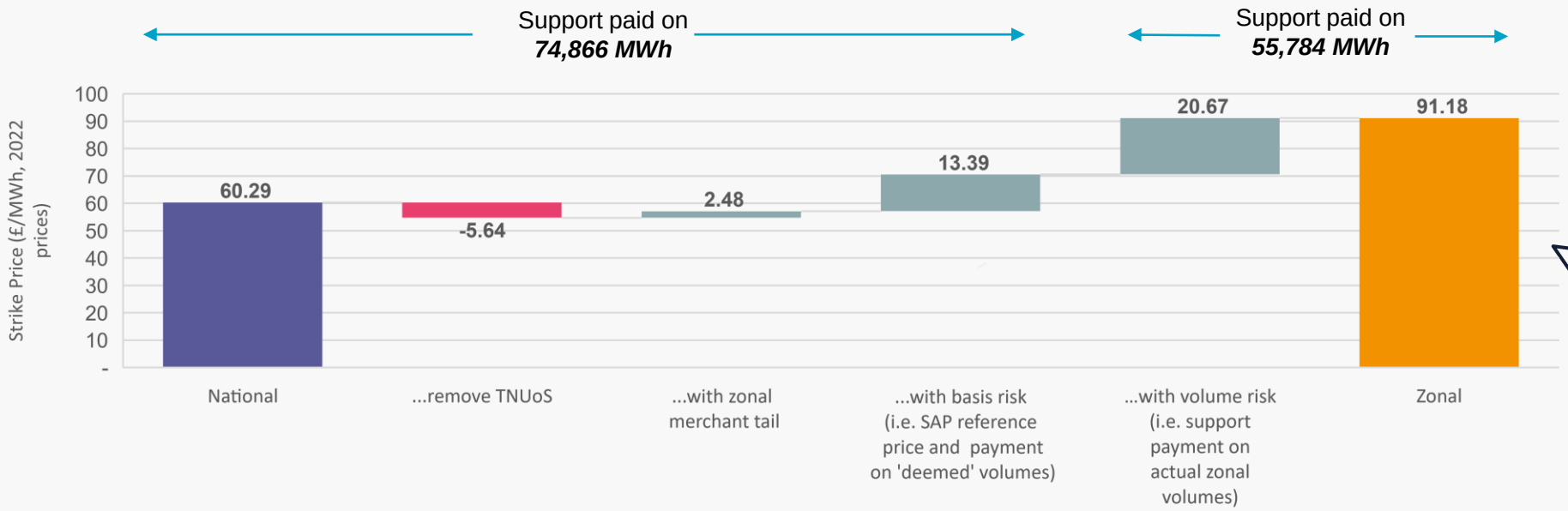
A move to a zonal market is likely to result in significantly higher CfD strike prices

We compare the offshore wind strike price in a national market with the strike price in a zonal for a CfD with an SAP reference price, and decompose the drivers of the increase.



Although the increase in strike price is paid out on reduced MWhs, there is an overall increase in the total subsidy paid:

- £4.5m in the national market
- £5.1m in the zonal market

A change to a zonal market is likely to lead to an increase in strike prices and there are several drivers for this. In this example, the strike price increases from £60/MWh to £91/MWh.

- In a zonal market, locational TNUoS is removed (though it is possible an intra-zonal TNUoS remains).
- The increase in the SP under the zonal market is driven by:
  - Reduced wholesale revenues in the merchant tail* compared to the national market – this is independent of the CfD design.
  - Reduced revenues on unconstrained volumes due to divergence between zonal price (i.e. plant's capture price) and CfD reference price (SAP).
  - Reduced revenues due to top-ups and wholesale revenue only being paid out on actual (constrained) volumes in a zonal market.

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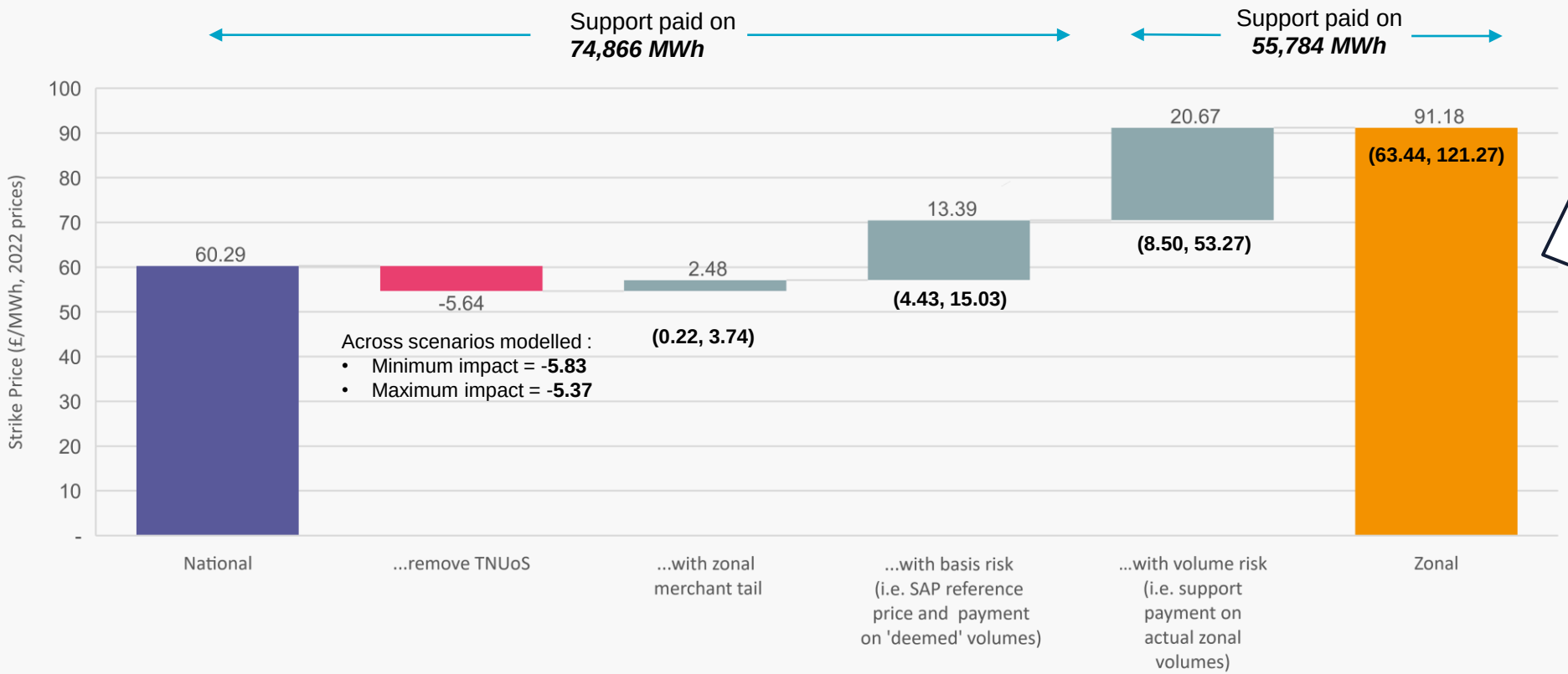
There is also significant uncertainty as to the precise impact of the different drivers on the zonal strike price…

In reality, there is a lot of uncertainty as to the impact on future revenues of operating in a zonal market. This uncertainty is particularly driven by different levels of network investment, that lead to variations in the required strike price



- Values in parentheses show the degree of uncertainty around each of the drivers of the strike prices (i.e. the minimum and maximum impacts across the scenarios modelled). The values in parentheses presented for the "Zonal" bar show the range of strike prices modelled.
- For example, the expected impact of the volume risk associated with a zonal market is an increase in the strike price of £20.67, however across the scenarios we have looked at, the increase could be in the range of £8.50 to £53.27.

Note: In this analysis, the impact of a zonal market on the value of the merchant tail appears relatively small compared to the impact of no longer paying TNUoS. However, we have conservatively assumed a relatively short tail of 10 years for offshore wind, and the variability (and hence uncertainty) in its value is wider than for TNUoS across the scenarios modelled.

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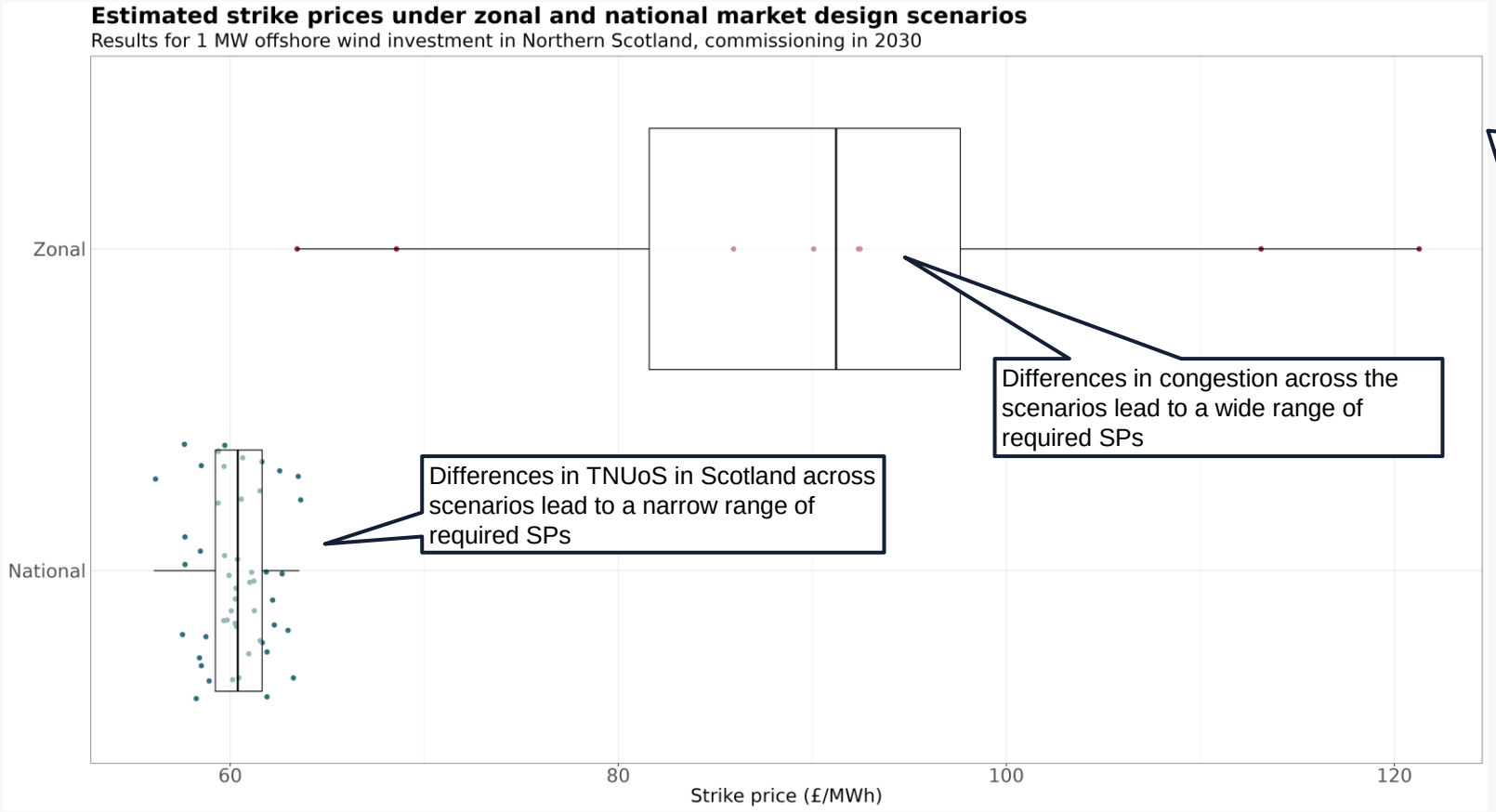
...which reflects the increased risk that investors have to take into account in their CfD strike prices in a zonal market

Across the modelled scenarios, we observe a wider distribution of required strike prices that ensure a plant's target rate of return under a zonal market relative to a national market, which is likely to result in strike price bids with a higher cost of capital in recognition of the additional uncertainty



- To indicate the potential strike price impact implied by the difference in distribution we calculate the SP bid which ensures the plant meets its target rate of return with 90% probability and compare this to the SP which ensures the plant meets its target rate of return with 50% probability.
- This shows greater variation in strike prices in the zonal market:
  - In the national market, the p90 strike price of £62.71/MWh is **4%** higher than the median strike price of £60.29/MWh.*
  - In the zonal market, the p90 strike price of £115.58/MWh is **27%** higher than the median strike price of £91.22/MWh.

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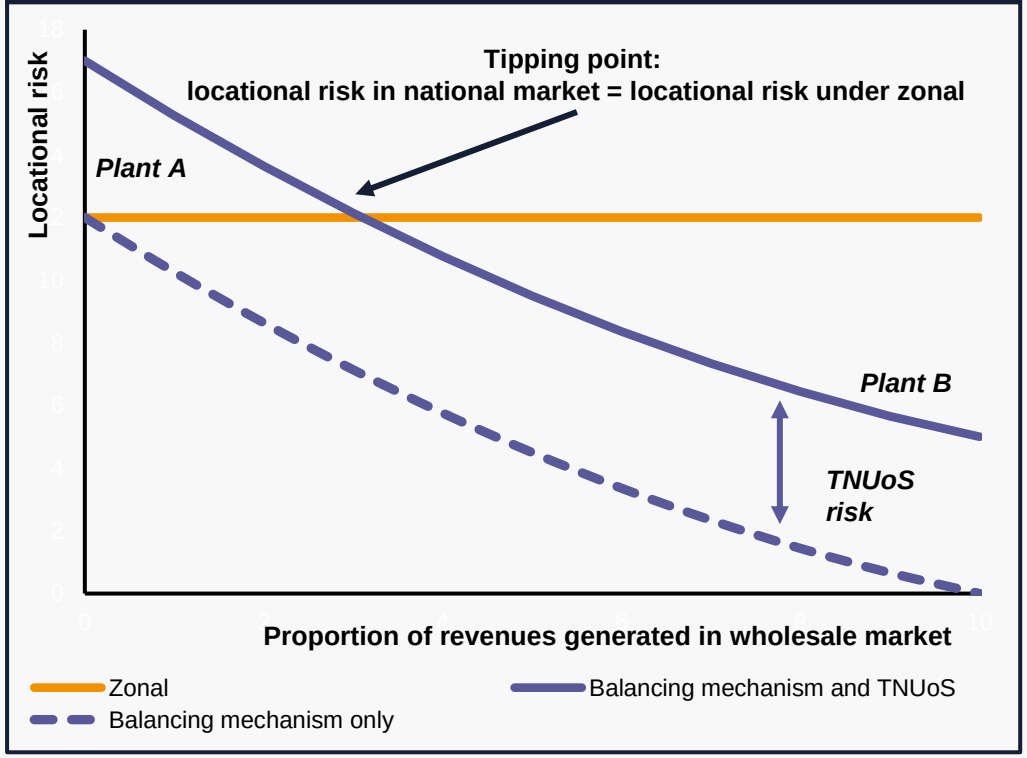
Impact of zonal pricing on Capacity Market payments

Implementing a zonal market may result in an increase to Capacity Market payments

The extent of any increase is likely to depend on the degree to which a dispatchable plant is already exposed to locational risk in its BM revenues in the national market

Implications of balancing mechanism revenues for locational risk exposure



'Stylised' plant	National wholesale market	Zonal wholesale market	Likely impact of move to zonal
Plant A **(all output sold through BM)**	Locational risk embedded in clearing locational price in Balancing Mechanism and in TNUoS charges.	Locational risk embedded in zonal price (and equal to locational risk in BM). No TNUoS locational risk.	Reduction in locational risk.
Plant B **(all output sold through day ahead market)**	Locational risk embedded in TNUoS charges.	Locational risk embedded in zonal price. No TNUoS locational risk.	Increase in locational risk.

- From these two extremes, it is evident that the extent to which zonal increases or decreases volatility in returns depends on how much of a plant's revenues comes from constrained-on payments through the balancing mechanism. As the balance shifts away from constrained-on revenues towards wholesale (national price) revenues, any move to zonal is more likely to increase risk.
- **Our focus in this analysis is on a CCGT located between these extremes i.e. it earns the majority of its revenues through the wholesale market, with limited BM revenues. More so than with the wind farm analysis, the results of this analysis are likely to be sensitive to the type of plant and its running pattern.**

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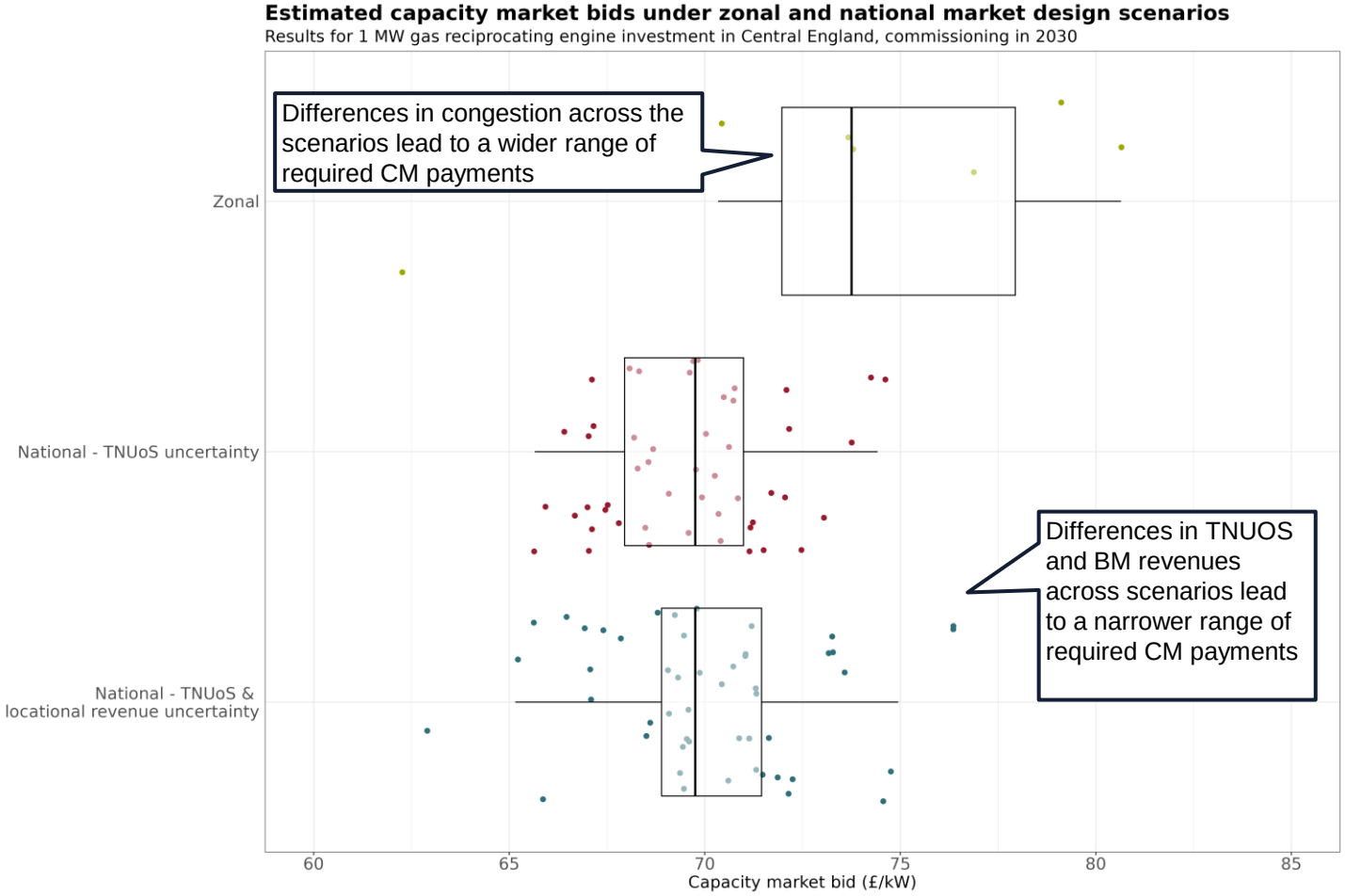
For the CCGT modelled, we find that an increase in locational risk would need to be reflected in a higher CM payment

We observe a broader range of possible CM payments that guarantee the target rate of return under a zonal market, when compared to the range driven by the combined volatility of BM revenues and TNUoS charges



- To indicate the potential CM bid impact implied by the difference in distribution, we calculate the CM bid which ensures the plant meets its target rate of return with 90% probability and compare this to the CM bid which ensures the plant meets its target rate of return with 50% probability.
- This shows greater variation in CM bids in the zonal market:
  - In the national market, if the plant only faces locational risk through its TNUoS charge, the p90 CM bid of £72.22/MWh is **3.5%** higher than the median CM bid of £69.76/MWh.
  - In the national market, if we also consider the additional locational risk transmitted through revenue uncertainty in the BM, the p90 increases to £73.31/MWh which is **5%** higher than the median CM bid of £69.76/MWh.
  - In the zonal market, the p90 CM bid of £79.64/MWh is **8%** higher than the median of £73.68/MWh.
- Our finding that volatility is greater in the zonal market is a result of our modelled CCGT having only a limited degree of exposure to locational risk through the BM. I.e., the proportion of the plants' revenues made through the BM are sufficiently low that it is positioned to the right of the tipping point described in slide 19.

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Annex

Overview of approach to modelling the distribution of strike prices under a zonal and national market

1) Calculate strike price (SP) in each of the modelled zonal scenarios

- For each zonal modelled scenario we calculate wholesale zonal revenues for our archetypal wind plant
- From this we calculate the strike price bid required in each scenario to achieve the target rate of return.
- Plant revenues taken from LCP's modelling scenarios. Costs and hurdle rates informed by DESNZ Electricity Generation Report 2023.
- Plant assumed to be connected to a zone in Northern Scotland

2) Identify zonal scenario at median SP

- From the distribution of strike prices produced in 1), we identify the zonal scenario at the median.
- We then select the counterpart national scenario as the basis for our national market modelling.
- NB, where we have an even number of scenarios, we assume wholesale revenues are the midpoint of the two scenarios closest to the median.

3) Calculate SP in equivalent national scenario

- Using the national wholesale revenues at the median and applying a TNUoS charge based on the NESO's latest 5-year forecast, we calculate the strike price required to meet the target rate of return in the national market.

4) Simulate TNUoS to create SP distribution

- We proxy future TNUoS volatility by considering how historical TNUoS charges in each charging zone varied (relative to the long-term average) over the period 2005-2024.
- We draw randomly from this historical volatility and apply to the NESO's 5 year forecast to simulate future TNUoS charges.
- We apply the simulated TNUoS charges to the median national scenario cashflows to calculate a distribution of strike prices in the national market (centred around the strike price calculated in 3).

5) Compare the strike prices at the p90

- We identify the strike prices required to meet the target rate of return with 90% probability by taking the p90 of the strike price distributions.
- We then compare the p90 of the two strike price distributions to consider the impact of zonal on strike prices

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Overview of approach to modelling the distribution of capacity market bids under a zonal and national market

1) Calculate capacity market bid in each of the modelled zonal scenarios

- For each zonal modelled scenario we calculate wholesale zonal revenues for our archetypal CCGT
- From this we calculate the CM bid required in each scenario to achieve the target rate of return.
- Plant revenues taken from LCP's modelling scenarios. Costs and hurdle rates informed by DESNZ Electricity Generation Report 2023.
- Plant assumed to be located in Central England

2) Identify zonal scenario at median CM bid

- From the distribution of CM bids produced in 1), we identify the zonal scenario at the median.
- We then select the counterpart national scenario as the basis for our national market modelling.
- NB, where we have an even number of scenarios, we assume wholesale revenues are the midpoint of the two scenarios closest to the median.

3) Calculate CM bid in equivalent national scenario

- Using the national wholesale revenues at the median and applying a TNUoS charge based on the NESO's latest 5-year forecasts, we calculate the CM bid required to meet the target rate of return in the national market.

4) Simulate TNUoS to create CM bid distribution

- We proxy future TNUoS volatility by considering how historical TNUoS charges in each charging zone varied (relative to the long-term average) over the period 2005-2024.
- We draw randomly from this historical volatility and apply to the NESO's 5 year forecast to simulate future TNUoS charges.
- We apply the simulated TNUoS charges to the median national scenario cashflows to calculate a distribution of CM bids in the national market (centred around the CM bid calculated in 3).

5) Compare the CM bid at the p90

- We identify the CM bid required to meet the target rate of return with 90% probability by taking the p90 of the CM bid distributions.
- We then compare the p90 of the two CM bid distributions to consider the impact of zonal on CM bids.

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Modelling TNUoS uncertainty under a national market design

Step 1: Measure historical volatility of TNUoS charges

- We measure the variation in historical TNUoS charges for a CCGT and offshore wind plant as follows:
  - Calculate TNUoS charges in every zone in every time period between 2005 and 2024.
  - Calculate the average charge within each zone over that time period.
  - Measure the deviation of the annual TNUoS charge in any given year from the average charge between 2005 and 2024. This gives a distribution of TNUoS volatility (i.e.deviations from the average TNUoS charge) that an investor may expect to face in any given year– see diagram across.

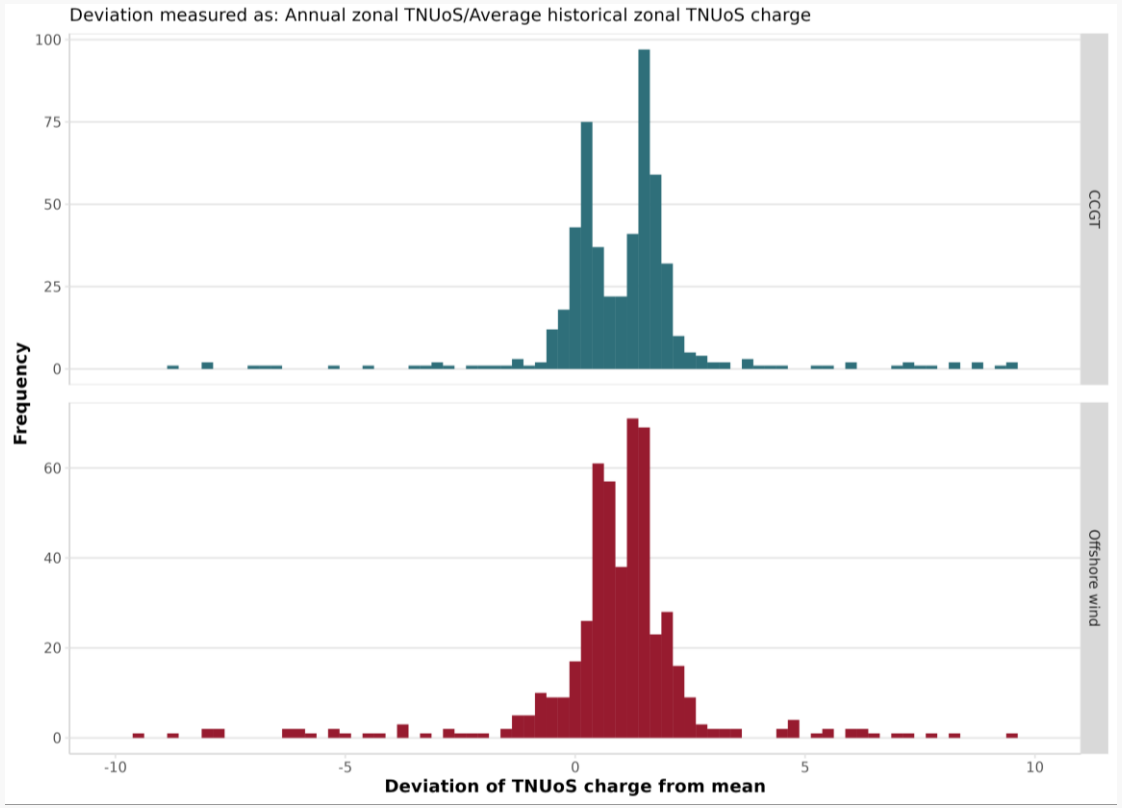
Step 2: Simulate future TNUoS charges using historical volatility

- We then simulate the future TNUoS charge in any given year by:
  - Calculating the average NESO 5 year TNUoS forecast over the period (2025-2030) for the zone in which the plant is sited.
  - Multiplying the average forecast TNUoS charge by a random draw from our distribution of TNUoS volatility (produced in step 1).

Step 3: Use simulated TNUoS charges in cashflow modelling to calculate strike prices

- We can then enter our simulated series of future TNUoS charges into the cashflow modelling for a plant operating in a national market and calculate the strike price. Running this simulation exercise repeatedly will produce a distribution of strike prices.

Distribution of historical TNUoS volatility across all zones



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