Study to support the setting of an indicative asset beta for Sizewell C in the operational phase

Ofgem

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CONFIDENTIAL

FINAL REPORT

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EXECUTIVE SUMMARY

Context

The development of new large-scale nuclear generation assets will play an important role in Britain's transition to net zero emissions. To facilitate this outcome, the Nuclear Energy (Financing) Act 2022 (the NEFA) established the legislative basis for a regulated asset base (RAB) model to support new nuclear projects.

The RAB model provides a framework for nuclear licensees to receive regulated revenues over the life of their project. In November 2022, the Secretary of State (SoS) for the Department of Energy Security and Net Zero (DESNZ) designated NNB Generation Company (Sizewell C) as the first company that is licensed to develop a nuclear project under the RAB model.

Ofgem's responsibilities under these arrangements include the post construction review (PCR), which marks the start of the first five-year price control for the project's operating period. At the PCR, Ofgem will make a series of determinations, including the regulated weighted average cost of capital (RWACC) for Sizewell C. Ofgem is currently developing economic guidance on the way it will approach the regulation of the nuclear licensee during the project's operational period. This includes providing additional transparency around the approach it will take in future decisions on the RWACC, including the allowed cost of equity.

Terms of reference

In this context, Ofgem engaged CEPA to assist it in further developing its economic guidance. Specifically, we were asked to develop a report to support how Ofgem might approach future determinations **on the asset beta for Sizewell C, through the lens of a capital asset pricing model (CAPM) framework.**

The CAPM is an asset pricing model widely used by UK regulators to set the allowed return on equity in RAB-regulated industries. It relates the cost of equity to a 'risk-free rate', the expected return on a market-wide portfolio of investments, and the equity beta. The beta term captures investors' exposure to risk which cannot be eliminated through diversification (systematic risk), measured as the covariance of changes in an asset's value and changes in the value of the market index. The asset beta is the equity beta of the firm removing the effect of gearing, which allows for more precise comparisons of systematic risk across firms with different capital structures.

The CAPM framework rests on several assumptions regarding the nature of risk and investors. For example, the CAPM assumes a normal and symmetrical distribution of returns around the mean. Further, the CAPM assumes that investors hold diversified portfolios to minimise risk. Within this framework, only systematic risk is relevant for determining an investor's required return on equity. There are a range of views on how regulatory determinations should account for these assumptions. Assessing the merits and limitations of CAPM, including issues related to asymmetric or skewed distributions of returns, is outside the scope of this report, and we have not commented on alternative approaches to setting the allowed return on equity.

This report is intended to help inform Ofgem's economic guidance for Sizewell C and provides an indicative asset beta range relative to current empirical evidence. However, this should not be regarded as the ultimate value of the asset beta that will feed into the RWACC for Sizewell C. While CEPA has undertaken some limited empirical analysis to inform this report, developing a precise estimate of the asset beta for Sizewell C would require more extensive analysis and research, using contemporary evidence available to Ofgem at the time of the PCR.

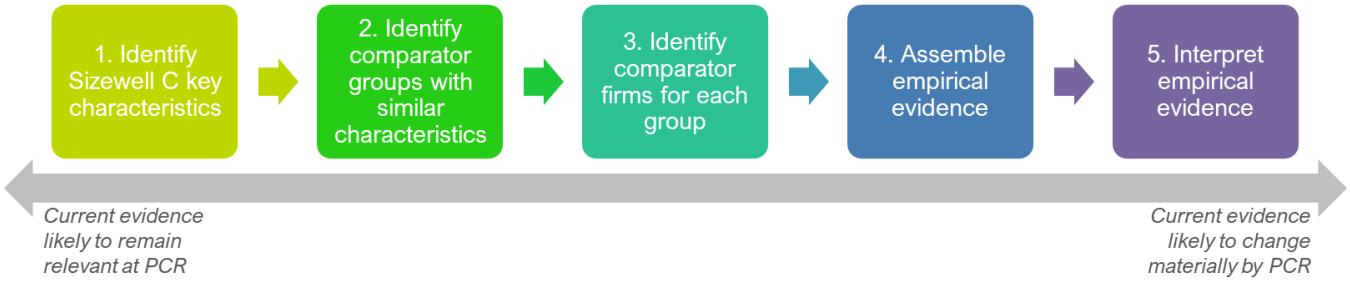
Approach

In this report, we develop a step-based approach to serve as early guidance on how Ofgem might consider Sizewell C's allowed asset beta during the operational phase of the project.

As illustrated in the figure below, while some steps can be addressed with more confidence based on current evidence (e.g., identifying the characteristics of Sizewell C that matter most for beta), for other steps the available evidence could change materially between now and the PCR (e.g., empirical beta evidence from listed comparators). Although we anticipate more stability in judgements on Sizewell C's characteristics and their

implications for beta, these still have the potential to evolve over time. This is because the project's risk will be affected by the specific choices Ofgem makes when implementing the regulatory framework – for example, in relation to the calibration of incentive mechanisms.

Figure E.1: Step-based approach to setting asset beta



Source: CEPA.

Our proposed approach is underpinned by a set of principles. Specifically, that the approach Ofgem uses to determine Sizewell C's asset beta should **take an investor perspective**, with reference to comparable investment opportunities. The approach should also be **consistent**, **reasoned** and **evidence driven**. **Section 2** of this report sets out what these principles mean in practice for Ofgem's approach to the asset beta.

In **Section 3** of this report, we illustrate – based on current market evidence – how Ofgem could apply this approach in determining the asset beta during Sizewell C's operating phase. To do this we:

- Set out the distinctive characteristics of Sizewell C and consider which are most relevant for beta.
- Consider what categories of listed comparators could best capture these characteristics.
- Establish an illustrative sample of appropriate comparators within these categories.
- Estimate empirical betas for this sample.
- Illustrate how this evidence could be brought together to form a transparent judgement.

Illustrating the proposed approach

Distinctive characteristics of Sizewell C

Fundamentally, asset beta is determined by how Sizewell C's value can be expected to change, relative to changes in the value of the market index. The question is what features of Sizewell C affect this.

Sizewell C is a single asset company. It will own and operate a previously constructed nuclear plant until the end of its technical life, and subsequently decommission that plant. There are expected to be limited growth opportunities (save for potential end of life extensions) and there is no construction risk. Sizewell C's RAB value will decline to zero over time as the asset depreciates.[1]

Funding in the operating period will come from a combination of energy market revenues and difference payments from the 'Revenue Collection Counterparty'. The difference payments will provide for recovery of a regulated allowed revenue. Allowed revenue will be calculated based on building blocks assessed over a five-year period.[2]

[1] In addition, there will be a Government Support Package (GSP) for, among other things, high magnitude, low probability risks. The GSP primarily address risks that are not directly relevant for a CAPM-based beta methodology, and so is not considered in detail in this report.

[2] Allowed revenues include: expenditure allowances, cost of capital allowances (that are periodically updated to reflect actual changes in interest rates and equity market returns) and RAB indexation; incentives linked to market prices, capacity, availability and operating phase costs; and funding decommissioning plan (FDP) obligations, which Ofgem advises are met entirely by consumers. While five-yearly determinations are the expectation today, Ofgem may determine a different regulatory period.

Sizewell C's value will be affected by expected out- or under-performance relative to these allowances, and differences between expected determinations of the allowed return and investors' required return.

In this context, the asset beta comparator sample would ideally capture the following characteristics:

- **Long-term security over asset value.** Sizewell C's value is underpinned by a RAB-based framework covering the asset's entire operating life.[3] As outlined below, the features of this framework (e.g., with respect to wholesale market risk, outperformance and the discount rate) impact Sizewell C's systematic risk. When considering comparators, it is relevant to consider not only whether they are similar to Sizewell C with respect to these factors, but also the duration over which this applies.
- **Low exposure to wholesale market risk.** Sizewell C is largely, although not entirely, insulated from risk related to price volatility in the wholesale market. It has capped exposure to basis risk through the market price incentive [Confidential: the combined impact of the market price and totex (see below) incentives is capped at 150 basis points of Return on Regulated Equity (RORE)]. It is also exposed to buy-back risk, if unplanned outages require the purchase of electricity in the spot market to back out of its forward contract position. These 'wholesale market risks' may be systematic to an extent, although this is not clearly the case for buy-back risk.
- **Scope to outperform allowances.** The scope for Sizewell C to out- or under-perform relative to allowances will depend on both how these are set, and how the plant's operations evolve (linked to nuclear-specific operating costs, such as fuel, and technology trends). Scope to outperform agreed annual operating cost allowances are given effect via the totex incentive which will apply during the operational phase of the project according to a specified share of any overspend or underspend compared to the allowance. Outperformance is relevant to systematic risk when it is driven by factors linked to broader economic conditions (e.g., interest rates in relation to cost of debt outperformance, or productivity trends in relation to opex outperformance).
- **Allowed returns reflect changes in discount rates.** Movements in interest rates and market returns impact discount rates. If discount rates rise, asset values generally fall. However, Ofgem's determinations may reflect such movements in Sizewell C's allowed returns – reducing the sensitivity of its value to changes in discount rates, relative to the broader stock market.
- **Limited growth opportunities.** We would expect a declining stream of cash flows to have a lower beta relative to a growing stream of cash flows (all else equal), in particular when future investments are correlated to economic growth. Similarly, exposure to development/construction-phase risks would be associated with higher betas relative to an operating asset (all else equal). [4]

We note that while Sizewell C is a single asset, the ultimate investors in Sizewell C will (or should) be holding this as part of a well-diversified portfolio and the approach to estimating beta should reflect this. This is the approach UK regulators take to other privately owned unlisted assets.

[3] A through-life capacity incentive means that the RAB could increase or decrease if the plant's capacity falls above or below the target – meaning that the asset base is not entirely secured by the regulatory framework. [Confidential: capacity incentive adjustments are restricted to circa -/+9% in aggregate.] However, we would not expect changes in the plant's capacity to be a systematic risk.

[4] As its RAB depreciates, Sizewell C's allowed revenues will reflect a progressively greater share of expenditure relative to the return of and on capital. The impact of expenditure to RAB ratios on the cost of equity is a topic that has been given attention by regulators and the Competition and Markets Authority (CMA). However, the importance of this factor to Sizewell C, compared to other drivers of systematic risk, is unclear. For example, variations in costs relative to revenue allowances may be limited to the short term and addressed at each price control reset. It is also unclear to what extent this characteristic would already be reflected in the beta range and comparator cohort. Ofgem will need to consider this issue amongst a range of factors as part of its future determinations.

As we have been asked to consider beta through a CAPM lens, the discussion above focusses on characteristics that appear most relevant to systematic risk. In line with our terms of reference, we have not considered issues related to asymmetric risk. If there is evidence that Sizewell C faces material asymmetric risks, this would need to be assessed by Ofgem outside the beta methodology described in this report. We would not expect asymmetric risk to be reflected in the empirical betas of the comparator sample.

Relevance of potential comparator groups

We identify four comparator groups that could, to differing extents, capture some of Sizewell C's key features:

- **Regulated integrated utilities** – particularly those with nuclear operations and long-term security over returns through the regulatory arrangements.
- **Contracted generators** – companies with a large proportion of generation assets secured through long-term contracts, providing a relatively high degree of security over their asset value.
- **Regulated networks** – including, but not limited to, the comparator sample relied on by Ofgem to set the asset beta for the energy networks under its regulatory jurisdiction.
- **Market-exposed generators** – companies with generation assets that are largely merchant (including short-term hedging contracts).

Table E.1 below provides a high-level comparison of Sizewell C and the four comparator groups, focussing on the characteristics that we believe matter most for the asset beta. While the characterisation of each group is broadly reasonable, it may not apply to all individual companies included within each sample.

Based on this high-level comparison, **regulated integrated utilities** and **contracted generators** could provide the most relevant evidence. This reflects the higher degree of similarity of these comparators to Sizewell C in terms of both their underlying operations and long-term assurance around their asset value.

Nonetheless, there are some important differences to weigh up in considering evidence from these two 'primary' comparator samples:

- The **regulated integrated utility** sample may reflect a regulatory regime that provides a greater degree of surety over long-term asset values compared to Sizewell C, and broadly similar mechanisms to reflect changes in discount rates and costs in allowed returns. This reflects Sizewell C's exposure to capacity investment mechanism adjustments to its RAB, the operation of other incentive mechanisms, and the presence of some wholesale market exposure.
- The **contracted** sample may reflect less long-term assurance of returns compared to Sizewell C, assuming that contracting arrangements do not cover the full asset life or output, nor allow all efficient changes in costs to flow through to revenues. Similarly, changes in discount rates may not flow through to contract prices (and revenues) in a similar way to Sizewell C. Contracting arrangements could drive higher or lower betas than Sizewell C depending on the volume, fuel price and other risks they impose.
- Companies in each group have additional activities other than nuclear operation. However, the evidence presented in this report does not point to a premium associated with nuclear and/or generation activities, when these are undertaken in the context of a supportive regulatory framework. For example, this can be seen from a comparison of the asset beta ranges for regulated US integrated utilities (0.25-0.40) and EU/UK regulated networks (0.20-0.50). Further analysis would help to test this observation.
- For both groups, there will also be differences in their development pipeline and growth opportunities, which contrasts to Sizewell C's declining asset base. If future growth expectations are material in the

comparator groups[5], all else equal this could point to a *lower* beta for Sizewell C: reflecting the presence of construction risk, and the sensitivity of a growing asset base to changes in discount rates driven by macroeconomic conditions.

The **regulated network** sample could provide a helpful cross check due to similarities with Sizewell C's regulatory framework – although these assets are clearly different from a nuclear generator, and we would not expect Ofgem to focus on these companies as a primary comparator group. The nature of the risks faced by **market-exposed generators** means their asset beta is likely to be above Sizewell C's operational phase beta – in many cases far above. These 'secondary' comparator samples nonetheless provide relevant evidence:

- Of these two groups, we consider that regulated networks provide a more relevant comparison, because their regulatory framework shares certain features with Sizewell C. In particular, the way that interest rates and the equity risk premium may be reflected in allowed returns is similar, meaning that exposure to systematic changes in the discount rate may also be similar.
- We consider that evidence from wholesale-exposed generators is less relevant than the other comparators. This is because Sizewell C's regulatory framework offers considerably greater certainty of revenues and returns, relative to this group. While evidence from this group can still inform Ofgem's decision, we suggest that the beta range implied from this cohort, when considered in the round, should primarily be viewed as a threshold that Sizewell C's asset beta should fall below.

[5] As noted above, substantial further research would be required to establish the specific composition of each comparator group's generation portfolio and the terms of their generation contracts (if even available).

Table E.1: Characteristics of Sizewell C and comparator samples

Characteristics	Regulated integrated utilities	Contracted generators	Regulated networks	Market-exposed generators
Security over long-term asset value	✓	✓	✓	✗
	More security than SZC.	Less security than SZC.	More security than SZC.	Much less security than SZC.
Wholesale market exposure	~	✓	✗	✗
	Less than SZC.	More or less than SZC.	Less than SZC.	Much more than SZC.
Scope to outperform allowances	~	~	✗	✗
	Some similar cost drivers for comparators with nuclear assets, although sample reflects other activities. Similar mechanism to reflect cost changes in revenues. Unclear if comparators face equivalent incentive mechanisms.	Some similar cost drivers for comparators with nuclear assets, although the sample largely reflects renewables/gas. Unclear if contracts allow limited cost pass-through (e.g., fuel). Contracts may include availability incentives, but not cost incentives.	Similar mechanism to reflect cost changes in revenues and similar incentive mechanisms – but may have different drivers of costs and performance.	Some similar cost drivers for comparators with nuclear assets, although sample reflects other technologies. No guaranteed mechanism to reflect cost changes in revenues (depends on market dynamics). No similar incentive mechanisms; generator bears full impact of availability and cost changes.
Limited growth opportunities	✗	✗	✗	✗
	Most comparators appear to have some level of planned construction activity and expected growth (therefore flat or increasing asset value), pointing to higher beta risk.			
Allowed returns reflect changes in discount rates	✓	✗	✓	✗
	Similar mechanism to pass through rate movements.	No mechanism to pass through rate movements.	Similar mechanism to pass through rate movements.	No mechanism to pass through rate movements.

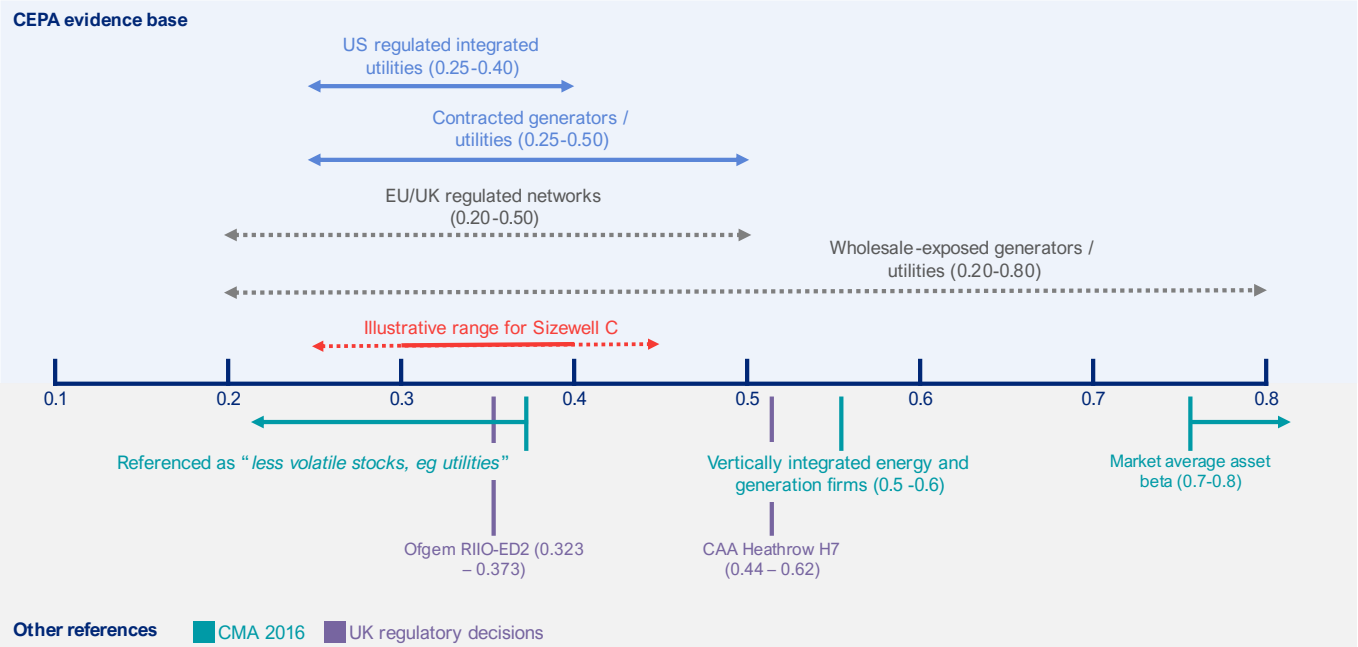
Legend: ✓ = broadly similar to Sizewell C, ~ = partly similar to Sizewell C, ✗ = not similar to Sizewell C. A more detailed analysis of the comparators may identify other relevant differences – e.g., remuneration for inflation.

Empirical comparator evidence

We have used a standard methodology to estimate the comparator firms' betas, using a 2-year data specification to illustrate the approach. Figure E.2 below provides a summary of the empirical beta estimates for the primary regulated integrated utility and contracted generator samples, which we consider likely to provide the most relevant evidence (i.e., primary comparator evidence). The figure compares this evidence to other reference points, including the secondary comparator samples (regulated networks and market-exposed generators) and other regulated sector determinations. We also present the ranges that the Competition and Markets Authority (CMA) used for generation and vertically integrated generators as part of the 2016 Energy Market Investigation. This includes firms that were generally comparable to our comparator set of market-exposed generators.[6]

We would expect Ofgem to consider a similar range of reference points and cross-checks in making its PCR determination of the asset beta for Sizewell C – noting that the evidence base that will be available to Ofgem at that time will be different from that presented here. In the following section, we explain the reasoning behind the indicative range indicated for Sizewell C, which reflects the primary comparator evidence.

Figure E.2: Asset beta spectrum



Source: CEPA analysis. Adapted from CMA (2016) – Energy Market Investigation.

Implications and conclusions from the analysis

The empirical analysis undertaken for this report has been exploratory. However, it is instructive to consider how this evidence can help us to think about the *process* Ofgem could follow in interpreting and weighting the comparator evidence that is available to it in future when it comes to set the RWACC.

With this objective in mind, the following discussion sets out how the evidence we have assembled could be used to establish a range for Sizewell C's asset beta. We emphasise that this does not reflect CEPA's definitive view of what the range actually is. For the reasons we set out in **Section 4** of the report we consider that additional research and analysis could, and should, be undertaken to refine the samples of comparators and to help draw firmer conclusions from the data.

[6] Our illustrative sample provides a much wider range than the CMA reference, reflecting differences in the firms that are included. This could change with further investigation of the sample.

Primary comparator evidence

The evidence outlined above, combined with our illustrative characterisation of Sizewell C and the comparator groups, **may point to a beta range for Sizewell C in the order of 0.3 to 0.4**.

- The lower end of the range reflects the mid-point of evidence from the regulated integrated utility comparators (and overlaps with the bottom end of the range for the contracted sample). Starting from the mid-point of this sample recognises that, based on our initial research, the regulatory framework for Sizewell C appears to leave more scope for variability around long-term value (e.g., some exposure to cost performance and basis risk).
- The upper end of the range reflects the mid-point of the contracted sample. Given the assumptions noted above, the upper end of the contracted sample range may be less relevant for Sizewell C, if it reflected shorter contract durations, greater exposure to wholesale market risks, and differences in the way that changes in costs and discount rates flow through to revenues.

Our evidence base indicates that **the asset beta for Sizewell C could potentially fall outside of the 0.3-0.4 range**. For example, the lower bound of the regulated utility sample extends to approximately 0.25, while the contracted generation sample extends up to 0.50. A more detailed assessment of the comparator's similarities and differences to Sizewell C could therefore shift or widen the illustrative range of 0.3-0.4.

Subject to further investigation of the comparator evidence, we suggest that Ofgem consider the following issues when determining where to position Sizewell C within such a range.

Factors that could point towards the lower end of the range

- **The very long-term nature of the revenue protections provided by Sizewell C's regulatory framework.** In particular, and distinct from our assumptions regarding the contracted generator group, the regulatory framework for Sizewell C covers the entire life of the asset, and allows efficient changes in costs to be passed through to consumers. Similarly, Ofgem may calibrate the strength of incentives over time, depending on the plant's actual operating performance. We would not expect the contractual arrangements for the generation comparators to reflect this degree of flexibility, making it more likely that costs and revenues could diverge more materially over time for this group relative to Sizewell C.
- **Sizewell C's declining asset value and absence of construction activity.** As we discuss in the body of the report, this may reduce exposure to construction risk and the sensitivity of value to changes in discount rates. This depends on the materiality of future construction plans, and growth opportunities, for the firms represented in the comparator samples. Indeed, if Sizewell C's operating period beta is based on comparator evidence that reflects construction phase risk, then the asset beta implied by Sizewell C's **combined** IWACC/RWACC is likely to be overall higher than the comparator evidence.

Factors that could point towards the upper end of the range

- **Sizewell C's exposure to operating and wholesale market risks.** As noted above, Sizewell C's returns have varying levels of exposure to capacity, availability, basis risk and buy-back risk. With the exception of basis risk, these are not clearly relevant for beta determined under a CAPM framework. In practice however, it is challenging to classify any source of risk as strictly systematic or non-systematic. To the extent that these factors are systematic, they would be reflected in the measured betas of the contracted generator sample. If further investigation indicates that Sizewell C's exposure to these risks is similar to that sample, it may be appropriate to recognise this by placing more weight on this evidence.
- **Uncertainty around how Sizewell C's regulatory regime will apply in practice.** CEPA understands that the regulatory model for Sizewell C is intended to provide a supportive and relatively low risk framework for investment. For example, Ofgem retains flexibility to calibrate incentive mechanisms and allowances in light of the asset's actual operating performance. However, the process is untested, and it remains to be seen how Ofgem will, in practice, respond to risks as they emerge. Over time, experience with the regime will

indicate whether Sizewell C's risks are more consistent with the beta range implied by the regulated utility sample or the contracted generation sample. Initially, the regime's relative immaturity could point to placing more weight on the latter – although this reflects a judgement on the appropriate remuneration of risk in a context of uncertainty, rather than differences in systematic risk.

The point estimate would ultimately depend on Ofgem's assessment of the relative importance of these factors for the asset beta.

Secondary comparator evidence

As discussed above, we consider that the secondary comparator samples (regulated network and market-exposed generators) provide a helpful cross check of the conclusions that might be drawn from the primary groups:

- A range of 0.3-0.4 would sit below the range of long-term average beta estimates drawn from our wholesale exposed generators/utilities, consistent with the CMA's positioning of asset beta values for generation/vertically integrated utilities with wholesale risk in its Energy Market Investigation (2016).
- Many of the comparators in the network comparator group operate under regimes that share key characteristics with Sizewell C, although clearly the underlying activities are very different. An asset beta range of 0.3-0.4 for Sizewell is not inconsistent with network comparator observations.

We note that Ofgem's allowed asset beta for RIIO-ED2 – its most recent onshore energy network cost of capital determination – falls within the 0.3-0.4 range. As outlined above, this does not reflect a view that the asset beta for Sizewell C should be set based on similar evidence to Ofgem's network decisions. Rather, for the reasons we set out above, we suggest an entirely different asset beta evidence base. Therefore, if Ofgem follows a similar methodology to that outlined in this report, we would expect to see divergence between Ofgem's asset beta decisions for regulated networks and Sizewell C over time.

Further analysis

While this report is intended to help inform Ofgem's economic guidance for Sizewell C and provides an indicative asset beta range relative to current empirical evidence, this should not be regarded as the ultimate value of the asset beta that will feed into the RWACC for Sizewell C. We would expect that, in the first stages of the PCR, Ofgem would undertake similar analysis to that presented in this report using contemporary data and evidence, before undertaking any further steps required to reach a determination on the RWACC.

In addition, it is important to note that Ofgem's current economic guidance does not constitute a final regulatory decision, and the approach set out in this report to gathering and assessing empirical beta estimates does not necessarily encompass the entire range of evidence and considerations that Ofgem may have regard to at the PCR. In line with good regulatory practice, we would expect that Ofgem's final decision on Sizewell C's RWACC would follow consultations with relevant stakeholders, and consideration of relevant information that could supplement the sources of empirical evidence included in this report.

We anticipate that when it comes to determine the asset beta for Sizewell C, Ofgem will considerably expand the scope of analysis and research contained in this report. In particular, we recommend that Ofgem:

- Undertake a more detailed review of comparators, including evidence from countries not currently captured in the sample in this report. More detailed research on the following issues for each comparator would assist in interpreting the evidence: breakdown of revenue / EBITDA by activity; analysis of growth opportunities; regulatory arrangements; contractual arrangements; and exposure to decommissioning risk (for companies with nuclear assets).
- To the extent that more information is available on how Ofgem intends to apply the regulatory regime, consider how this impacts Sizewell C's position relative to the sample.
- Test a wider range of empirical estimates of asset beta.

- Identify possible cross-checks that could be used to test a CAPM derived cost of equity. This has been the practice in the most recent set of onshore network price controls, RIIO-2, and is consistent with UK Regulators Network (UKRN) guidance.

1. INTRODUCTION

1.1. CONTEXT

The development of new large-scale nuclear generation assets will play an important role in Britain's transition to net zero emissions. To facilitate this outcome, the Nuclear Energy (Financing) Act 2022 (the NEFA) established the legislative basis for a regulated asset base (RAB) model to support new nuclear projects.

The RAB model provides a framework for nuclear licensees to receive regulated revenues over the life of their project. In November 2022, the Secretary of State (SoS) for the Department of Energy Security and Net Zero (DESNZ) designated NNB Generation Company (Sizewell C) as the first company that is licensed to develop a nuclear project under the RAB model.

Ofgem's responsibilities under these arrangements include the post construction review (PCR), which marks the start of the first five-year price control for the project's operating period. At the PCR, Ofgem will make a series of determinations, including the regulated weighted average cost of capital (RWACC) for Sizewell C.[7] Ofgem is currently developing economic guidance on the way it will approach the regulation of the nuclear licensee during the project's operational period. This includes providing additional transparency around the approach it will take in future decisions on the RWACC, including the allowed cost of equity.

In this context, Ofgem engaged CEPA to assist in developing its economic guidance on its approach to setting the cost of equity in the operational phase of the project. Specifically, we have been asked to develop how Ofgem might approach future determinations on the asset beta for Sizewell C, through the lens of a capital asset pricing model (CAPM) framework. The purpose of this report is to provide a preliminary study on asset beta, similar to how regulators would typically approach the task of forming an initial position on cost of capital parameters in the opening phases of a price control review. This type of study is designed to provide early guidance and evidence on how the regulator could consider these parameters in their upcoming determinations, to inform stakeholders of the possible 'direction of travel' in future price controls decisions – e.g., in this case, with respect to considerations around systematic risk and relevant comparator evidence on asset beta.

Ofgem's economic guidance for Sizewell C seeks to build on the regulatory precedent for Thames Tideway Tunnel (TTT) in 2015, where Ofwat provided a worked example and supporting narrative of the TTT Infrastructure Provider's (IP's) post construction cost of capital.[8] Ofwat's 2015 guidance on approach to the post construction cost of capital for TTT indicated that analysis supported the beta range for the water sector used by Ofwat in its cost of capital determination in PR14[9] and that a number of factors would be relevant to Ofwat in future when estimating the IP's asset beta. On this basis, Ofwat provided an indicative worked example of TTT's post construction cost of capital, including an assumption of the IP's asset beta.

In contrast to TTT, in the case of Sizewell C Ofgem will not be able to rely on an asset beta range from a previous price control. The PCR will be the first determination of Sizewell C's RWACC, and as detailed in this report, given the differences in the characteristics of Sizewell C compared to energy network assets, it would not be appropriate to conclude that Ofgem's most recent energy network sector cost of capital decisions provide an appropriate evidence base for estimating the asset beta for Sizewell C.

[7] Sizewell C's returns during the pre-PCR phase will be determined by the initial weighted average cost of capital (IWACC), which is set by the SoS rather than Ofgem.

[8] Ofwat (2015), *Ofwat guidance on approach to the economic regulation of the Infrastructure Provider for the Thames Tideway Tunnel*.

[9] The most recent price controls set for other water and sewage companies at the time of Ofwat's publication of the TTT guidance.

This report aims to address this challenge by considering the distinctive characteristics of Sizewell C that are most relevant for beta; considering what categories of listed comparators could best capture these characteristics; and providing a framework where consideration of relevant similarities and differences between comparators and Sizewell C can help to guide the decision of how to weigh up empirical beta estimates.

This analysis is intended to help inform Ofgem's development of economic guidance for Sizewell C and provide an indicative asset beta range based on current empirical evidence. However, this should not be regarded as the ultimate value of the asset beta that will feed into the RWACC for Sizewell C. The PCR will take place a number of years from now, and we expect that Ofgem would undertake similar analysis to that presented in this report, using contemporary data in the first stages of PCR to refresh the empirical evidence, before undertaking any further steps required to reach a determination on RWACC.[10]

In addition, it is important to note that Ofgem's current economic guidance does not constitute the final regulatory decision on RWACC, and the approach set out in this report to gathering and assessing empirical beta estimates does not necessarily encompass the entire range of evidence and considerations that Ofgem may have regard to at the PCR. In line with good regulatory practice, we would expect that Ofgem's final decision on Sizewell C's asset beta would follow consultations with relevant stakeholders, and consideration of relevant information that could supplement the sources of empirical evidence included in this study.

1.2. TERMS OF REFERENCE

Our terms of reference are as follows:

- Provide independent expert advice on the approach that Ofgem could take in determining the asset beta for Sizewell C during the operational phase of the project, in a manner consistent with Ofgem's duties. While we have considered Ofgem's economic guidance on the RWACC, our advice reflects CEPA's own view of the relevant issues and appropriate methodology.
- Provide qualitative and quantitative analysis to help inform Ofgem's guidance and future judgements on Sizewell C's asset beta during the operational phase, including to:
    - Comment on how Ofgem might identify a set of benchmark comparators to Sizewell C that can be used to inform an evidence base for future determinations on asset beta, and the types of firms CEPA would expect to be included in this benchmarking cohort.
    - Undertake limited empirical analysis of the asset betas of these benchmark comparators, that will allow Ofgem to expand on the quantitative material in the economic guidance with respect to asset beta in the operational phase of the project.
    - Based on this analysis, provide a qualitative discussion of the factors that may be relevant for Ofgem when weighing the empirical evidence in future determinations on Sizewell C's asset beta, including how the nuclear licensee might compare to other regulated sectors.

The scope of our work does not include:

- Assessing the merits and limitations of CAPM, or alternative approaches to setting the allowed return on equity.

[10] Similarly, the range and point estimate presented in Ofwat's 2015 guidance for TTT may have changed by the time Ofwat undertakes TTT's First Periodic Review in 2029, given any updates to Ofwat's beta analysis in more recent price control reviews. However, these changes do not undermine the usefulness of Ofwat's guidance in 2015.

- Considering Ofgem's approach to the economy-wide parameters of the CAPM (the risk-free rate and market-wide return).
- Developing a precise estimate of the asset beta for Sizewell C during the operational phase, based on current market evidence.
- Estimating or advising on the development of Ofgem's economic guidance on debt beta or notional gearing in deriving Sizewell C's equity beta. We understand that Ofgem expect to comment separately on these parameters of the CAPM as part of its economic guidance.

1.3. Document structure

The rest of this document is structured as follows:

- Section 2 sets out the approach we have taken in developing our advice to Ofgem.
- In Section 3 we illustrate – based on current market evidence – how Ofgem could approach its determination of the asset beta for Sizewell C.
- Section 4 provides our conclusions and discusses factors that may be relevant to Ofgem's future determinations on Sizewell C's asset beta and areas for potential further analysis.

2. APPROACH

This section sets out the approach we have taken in developing our advice to Ofgem.

2.1. OBJECTIVES

As outlined above, while Ofgem will not make its first RWACC decision until the PCR, potential equity providers will form judgements on future Ofgem cost of equity determinations when deciding whether to invest in Sizewell C.

In this context, we consider that guidance on the asset beta should aim to provide potential investors with:

- visibility of the asset beta they might expect Ofgem to determine in the operations phase, particularly relative to approaches used to estimate beta for other regulated assets; and
- further comfort on Ofgem's intention to adopt best-practice in determining the asset beta for the nuclear licensee, underpinned by a stable, transparent, predictable and evidenced-based regulatory approach.

The above objectives should be balanced against the reality that:

- there is considerable uncertainty around how the market evidence base that is relevant and available today will evolve over time; and
- that members of the Gas and Electricity Market Authority (GEMA) today cannot unreasonably fetter the discretion of GEMA's members in the future.

2.2. PRINCIPLES

The considerations outlined above suggest the following principles, on which we have based our advice:

1. **Investor perspective.** The approach to estimating the asset beta should reflect the views of an investor seeking to assess the risk of a prospective investment in the nuclear licensee, with reference to comparable investment opportunities. The approach should therefore aim to capture a potential diversity of opinions and reference points across different investors. For example, investors may be expected to consider Sizewell as part of a global set of investment opportunities, and in this context may have regard to comparators outside the United Kingdom and/or Europe.

2. **Consistent.** Investors will seek to understand how Ofgem arrives at its view and how that view may evolve or react to changes in other sectors. The methodology should therefore rationalise Ofgem's judgements relative to other regulated assets under its jurisdiction. That is, where Ofgem takes a different approach to its other regulatory decisions, the reasons should be transparent and logical. Further, the guidance should be transparent on which elements of the approach are more certain, and which are more likely to evolve over time.

3. **Reasoned.** The selection of relevant evidence should reflect the characteristics of Sizewell C, and an assessment of the relative importance of these characteristics for determining the asset beta. This approach provides visibility around how Ofgem is likely to form future views on relevant evidence, without inappropriately constraining its judgement in a context where the available evidence base is likely to change. At the same time, the approach should recognise the limitations of hypothesising on what drives beta – and that in practice, perceptions of what risks are important can also evolve over time.

4. **Evidence driven.** Given the current lack of close 'pure play' comparators for Sizewell C, the approach should draw on a wide evidence base and avoid anchoring judgements on one sector. Careful consideration of empirical evidence can help to inform judgements on what certain characteristics may mean for beta, helping to address some of the challenges noted under Principle 3. Evidently, the empirical analysis that the asset beta estimate relies on should be complete and robust.

2.3. IMPLICATIONS OF DECISION MAKING USING CAPM

Our terms of reference ask us to consider how Ofgem could approach setting the asset beta for Sizewell C during the operational period of the project, through the lens of a CAPM framework. This is consistent with the UK Regulators Network (UKRN) 2023 guidance that notes CAPM remains in use by a wide cross-section of financial practitioners and benefits from requiring only three inputs, the data for which can be transparently derived with relative ease. A UKRN-commissioned report in 2018 recommended that regulators should continue to use the CAPM to estimate the cost of equity – a conclusion that is reflected in the UKRN's 2023 cost of capital guidance.[11] We note that the CAPM has also been used extensively by the Competition and Markets Authority (CMA) in its assessment of the cost of capital, including its estimation of generation cost of capital for its 2016 Energy Market Investigation.[12]

The CAPM relates the cost of equity to a 'risk-free rate', the expected return on a market-wide portfolio of investments and the equity beta:

$$rE = rf + \beta E * (TMR - rf)$$

- rf is the **risk-free rate,** which is the theoretical return an investor would expect to earn on a riskless investment.
- βE or **equity beta** is a business-specific measure of an investor's exposure to systematic risk that cannot be reduced by holding a diversified portfolio of investments.
- TMR is the **total market return,** representing the expected return on a market-wide portfolio of investments.

The **asset beta** – the focus of this report – is the equity beta of the firm removing the effect of gearing.[13] Asset betas allow for more precise comparisons of risk across firms with different levels of gearing.

Within the CAPM framework, only risk which cannot be eliminated through diversification – systematic risk – is relevant for determining an investor's required return on equity. This definition of risk is captured by the beta term, which measures the covariance of changes in an asset's value and changes in the value of the market index.[14]

The CAPM framework as a result distinguishes between:

- **Business-specific risks**, which are unique to a particular investment. Equity investors can eliminate their exposure to such risks by holding a diversified portfolio. In a sufficiently diversified portfolio, on average, business-specific risks that cause lower returns for one investment will be offset by different business-specific risks that create higher returns for another investment.
- **Systematic risk**, which is the variability in returns that cannot be removed through diversification. Systematic risk is associated with factors that impact all investments in the portfolio. A diversified investor requires an overall return that is commensurate with the risk of its portfolio as a whole.

[11] UK Regulators Network (2023), *UKRN guidance for regulators on the methodology for setting the cost of capital,* 23rd March 2023

[12] CMA (2016), *Energy Market Investigation, Final Report – Appendix 9.12: Cost of capital*, 24th June 2016

[13] The asset beta is calculated as: *(βe x (1 – gearing)) + (gearing x debt beta)*. In contrast, an 'unlevered beta' assumes that the debt beta is zero. This report focusses on asset beta, as this is consistent with Ofgem's current practice of assuming a non-zero debt beta.

[14] Defined more formally, the beta of security i is calculated as the ratio of the covariance of security i's return and the market portfolio return, and the variance of the market portfolio return over a specified period. The beta therefore measures the contribution of a security to portfolio risk.

Although non-systematic risk does not affect the cost of equity in the CAPM framework, this does not mean that it is irrelevant to investment decisions. When considering a project, investors will require that expected returns are at least equal to the cost of equity. Even if it does not affect the cost of equity, a business-specific risk might be reflected in the investors' decision-making as a change in the forecast cash flows and therefore in the expected returns of the asset.

In addition to a focus on systematic risk, the CAPM framework rests on several other assumptions, including a normal and symmetrical distribution of returns around the mean. There are a range of views on how regulatory determinations should account for these assumptions.

The treatment of non-systematic and asymmetric risk is outside the scope of this report. If there is evidence that Sizewell C faces material asymmetric risks, this would need to be assessed by Ofgem outside the beta methodology described in this report. We would not expect asymmetric risk to be reflected in the empirical betas of the comparator sample.

2.4. Approach

In light of Ofgem's objectives and the considerations outlined above, we consider that the approach to setting the asset beta should consist of the following steps. For each step, we comment on how stable judgements made today are likely to be, considering that Ofgem will ultimately make future decisions in line with the evidence available to it at the time of those decisions, consistent with its duties. This provides an indication of whether, at this point in time, prospective investors could reasonably place more weight on guidance related to some steps than others.

1. **Identify Sizewell C's key characteristics.** These will be driven by the nature of the underlying operating asset, the regulatory regime, and the Government Support Package (GSP) for the project. Not all characteristics will be relevant for determining beta under a CAPM-based cost of equity framework.[15]

   Although it is possible that these arrangements could evolve between now and the operational phase (e.g., through licence modifications). Further, risks will be affected by Ofgem's decisions in implementing the regulatory framework. However, judgements made in relation to this step today are likely to be more stable than for other steps.

2. **Identify groups of comparators that share these characteristics.** Consistent with the principles outlined above, we expect that it will be appropriate to consider multiple groups of comparators – given that in practice no one group is likely to capture all relevant characteristics of Sizewell C. While the focus should be on identifying the most relevant groups, it is also helpful to consider groups that can place 'boundaries' around the asset beta range (i.e., groups that we would expect to clearly sit above, or below, the beta for Sizewell C).

   While it is plausible that many of the groups that we can identify today could still be relevant evidence at the time of the PCR, it is also possible that new groups could be identified.

3. **Identify and assess the most relevant comparators under each group.** This step involves assembling a representative sample of listed companies that fall into each grouping, based on an examination of their characteristics. Consistent with Principle 1 (see Section 2.2), we suggest that the evidence base should include a wide range of comparators that are not restricted to the United Kingdom or Europe.[16]

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[15] As discussed above, our terms of reference require us to assume that Ofgem will adopt the CAPM to calculate Sizewell C's allowed equity returns and so we do not consider the treatment of risks that are not relevant under a CAPM framework.

[16] From a theoretical perspective, considering beta evidence from international comparators poses challenges. As discussed above, implementing the CAPM requires us to define a diversified market portfolio for the investor in the firm of interest. The most common approach, at least in regulatory contexts, is to assume a domestic portfolio – i.e., an UK portfolio in the context of Sizewell C. This creates a challenge when relying on evidence from international comparators, whose betas are commonly

It is likely that by the PCR, the set of comparators that could be considered under each group will have changed. Current comparators may be delisted, or materially alter the nature of their operations. New listed comparators may also emerge.

4. **Assemble the empirical evidence.** This step involves obtaining beta measurements from the comparator sample. We have not identified reasons why the estimation methodology for Sizewell C comparators – i.e., the regression period, frequency of observations, debt beta, and so forth – should be different from Ofgem's prevailing approach at the time. This may be different from Ofgem's approach as of today. Indeed, the estimation methodology that Ofgem adopts for the first RWACC decision may continue to change over the course of Sizewell C's operational period.

   While it is not possible to be too precise at this point in time, we recommend that when estimating empirical betas, Ofgem:

   a. has regard to regulatory best practice (e.g., as indicated by UKRN guidance); and

   b. considers a range of estimation approaches – noting that in some cases, estimation choices can materially change the beta for certain comparators.

   It is highly likely that empirical estimates derived for comparator groups today will be different at the time of the PCR. This is due to potential evolutions in the sample of comparators and the estimation approach, in addition to underlying changes in empirical betas (which do move over time, even if the methodology and comparator sample does not change).

5. **Interpret the empirical evidence.** This step involves weighing up estimates from the different comparator groups, with a view to determining an asset beta for Sizewell C that reflects the available evidence. This step is the most difficult to describe in advance, as we do not know today what the nature and limitations of the evidence available to Ofgem in the post-PCR period will be. However, we suggest that the following factors will be relevant to weighting the evidence:

   a. Reasoning around which characteristics of Sizewell C are likely to be most relevant for beta (consistent with the CAPM's focus on systematic risk) and which comparator groups best capture these characteristics. This may point to placing more weight on some comparator groups than others – while noting the inherent limitations in making such judgements.

   b. The relevance of the comparator evidence. For example, while certain comparator groups could be relevant to Sizewell C in principle, in practice the available comparators may capture a range of other, irrelevant, characteristics.

   c. The quality of the comparator evidence. Some empirical estimates may be considered more robust than others – for example, due to the underlying liquidity of the listed stocks, recent market developments, or the number of comparators in each group.

   As we note above, Ofgem should place most weight on evidence from comparators that best capture the relevant characteristics of Sizewell C. Ofgem should also consider evidence from groups of comparators that may be viewed as less comparable to Sizewell C, but that can help Ofgem to judge what may be appropriate 'boundaries' around its appropriate asset beta, including other regulated sectors. We consider this consistent with how the CMA has reached overall judgements on beta in other regulated sector contexts.

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measured against a local stock market index in their own country (or region) of listing. This may not be representative of the risk faced by an investor in Sizewell C, if they are assumed to hold a domestic portfolio.

However, in practice there are few suitable UK comparators for Sizewell C, and those that are available do not capture all relevant characteristics. In this context, we consider that it is appropriate to rely on evidence from international beta comparators. While other approaches could address this issue (e.g., assume that the representative investor has a portfolio with both international and domestic stocks), such questions are beyond the scope of this report.

While Ofgem may establish principles for determining how it will weigh the available evidence, the results that this process would produce today are not likely to be the same at the time of the PCR. For example, the quality of evidence available for certain comparator groups could improve or deteriorate in future, which could in turn affect the relative weight that Ofgem could reasonably place on this evidence. Precedent and reference points in other regulated sectors may also change over time.

We appreciate that this approach does not provide certainty to investors on the value of the asset beta that Ofgem might ultimately determine. However, it does provide transparency on the factors that are likely to be important, what type of evidence might be considered relevant, and how the evidence could be weighted.

We also recognise that fundamentally our approach is empirically driven, which relies on collecting a sample of firms that represent the closest available comparators to Sizewell C. As we discuss in the next section, many companies involved in energy generation are vertically integrated (i.e., they produce, transport and supply energy). Each of these segments has different risks, which cannot be easily separated from aggregated company data. Further, even pure play generation comparators are likely to hold several projects at any given point in time. These projects may use different technologies, be at different levels of development, or even in different countries (i.e., subject to different regulation, cost of development, exchange rate risk, etc.). While this makes interpreting the comparator data challenging, we consider that grounding the beta estimation in the available empirical evidence is the most robust approach.

Finally, there is a risk of statistical or measurement error inherent in any empirical exercise. As we note above, this points to considering a range of beta estimates and checking that results are robust to different estimation approaches.

In the next section of this report, we provide an illustration of how this approach could be applied in practice.

3. ILLUSTRATION OF OUR APPROACH

In this section, we illustrate – based on current market evidence – how Ofgem could approach its determination of the asset beta for Sizewell C. To do this we:

- Set out the distinctive characteristics of Sizewell C and consider which are most relevant for beta.
- Consider what categories of listed comparators could best capture these characteristics.
- Establish an illustrative sample of appropriate comparators within these categories.
- Estimate empirical betas for this sample.
- Interpret what conclusions the empirical data suggest.

Section 4 then illustrates how this evidence could be brought together to form a transparent judgement.

It is important to emphasise that the empirical analysis presented in this section is preliminary and designed to illustrate the approach we propose, rather than provide a definitive view. This is consistent with our terms of reference, that do not require us to estimate the asset beta for Sizewell C. In particular, given our scope and the time available to prepare this report, we have:

- Relied on pre-existing analysis and knowledge to identify a selection of relevant firms, rather than following a systematic process to narrow down from the full range of possible international comparators that may be available to inform Ofgem's future decision making. In particular, the geographic scope of the comparators we have considered is currently limited to the UK, Western Europe and North America. In principle, it is possible that relevant comparators could be drawn from other markets – for example, to capture evidence from nuclear operators and contracted generation in Japan and Korea.
- Undertaken a high-level review of the comparators. More detailed analysis (for example, of their contractual and/or regulatory arrangements) could reveal that some are more relevant than others, or suggest a different classification.[17]
- Applied one approach to estimate observed betas from the comparators, rather than testing a range of estimation approaches. It is possible that other estimation approaches could change the results of our analysis.[18] This could affect both relative comparisons between firms, and a view on the appropriate absolute value for Sizewell C's asset beta.

We encourage Ofgem to consider a more detailed study of comparator evidence, with a view to testing the impact of the factors outlined above on our conclusions.

3.1. CHARACTERISING SIZEWELL C

In this section, we consider the relevant characteristics of Sizewell C for estimating asset beta. We first set out a theoretical framework for thinking about what factors are important, and then apply this.

[17] For example, we identified that for a number of US entities, assets that are covered under long term contracts were still sometimes described as 'merchant' in company disclosures. Accordingly, additional research may identify additional comparators for the 'contracted generator' sample than were identified in our initial scan. Similarly, it is often challenging to precisely identify what proportion of comparator revenues is under long-term contracts. Therefore, additional research could result in some movement between the 'contracted' and 'market exposed' categories.

[18] We highlight some examples in the discussion below.

3.1.1. What matters for beta?

As discussed in Section 2, in the CAPM, the beta term is intended to cover systematic risk; that is, risk that investors cannot mitigate through diversifying into a broader portfolio of assets.

Data from equity markets is often used to estimate historic betas with reference to a stock market index, to inform judgements on the forward-looking value. When a regulated entity such as Sizewell C is not listed, an estimate of their asset beta must rely on data from listed companies which may be considered comparators; that is, they are considered by investors to be investment substitutes and have similar systematic risk. By similar systematic risk, we mean that the relationship between the comparator's future value and the chosen stock market index is similar to what we would expect for Sizewell C.

Fundamentally then, asset beta is determined by how Sizewell C's value can be expected to change, relative to changes in the value of the market index. Changes in Sizewell C's value relate to the interaction of two factors:[19,20]

- Changes in expected **future cash flows**. For a regulated asset such as Sizewell C, value is determined by expectations of outperformance relative to regulatory allowances. Broadly speaking, for Sizewell C future regulated revenues are determined by the building blocks allowance[21] and the application of incentive mechanisms. Value will depend on whether the company is expected to perform better than assumed in the regulatory determination, in terms of both costs (including the cost of capital) and plant performance (availability and capacity).
- Changes in the **discount rate** used to convert these future cash flows to a present value. Systematic variation in the discount rate will be driven by changes in the interest rates and equity market returns. If discount rates rise, asset values generally fall. For regulated assets such as Sizewell C, there is an additional effect associated with how movements in the RfR and TMR flow through to the allowed rate of return.

Accordingly, we consider that it is relevant to consider both factors, their interactions, and the extent to which they are a source of systematic risk, when thinking about what matters for Sizewell C's asset beta.

The UKRN's 2023 guidance on cost of capital references two specific factors that regulators may wish to consider when determining the asset beta for regulated firms:

- **Systematic demand risk.** Demand characteristics affect the sensitivity of returns to economic shocks that affect broader market returns. Returns are typically considered more sensitive to economic shocks if they relate to services with higher income elasticity. If the firm is subject to economic regulation, this may change how this factor affects returns and beta. For example, exposure to demand risk can be mitigated by whether under-recovery of allowed revenues can be recouped in future periods, as is the case for Sizewell C under its revenue cap.
- **Operating leverage.** Operating leverage represents the ratio of fixed costs to variable costs – the higher the proportion of fixed costs, the higher the operating leverage. All else equal, a firm with lower operating

[19] Similar 'decompositions' of beta have been discussed in the context of past Ofgem determinations. For example, in RIIO-1 academic work from Campbell and Mei (1993): *Where do Betas Come From? Price Dynamics and the Sources of Systematic Risk, The Review of Financial Studies, Vol 6 No. 3* was cited who decompose beta into components: market beta of news about the asset's future cash flows; market beta of news about future real interest rates (i.e., the RfR); and market beta of news about the asset's future excess returns (i.e., the ERP). More examples can be found in the literature.

[20] Expected inflation impacts both future cash flows and the discount rate, but could potentially be thought about as a separate third factor.

[21] Including allowances for operating costs, return of capital, return on capital, and pass-through costs such as the funded decommissioning plan.

leverage may be able to reduce profit volatility (and beta) by adjusting variable costs as economic conditions change, to a greater extent than a firm with a higher proportion of fixed costs.

Consistent reporting of costs as fixed or variable is generally not available. Assessments of operating leverage therefore tend to rely on proxy measures, which all suffer from limitations. This creates challenges for precisely controlling for this factor in practice. However, it may be a reason for selecting comparator firms that are likely to have a similar cost structure as Sizewell C.

3.1.2. What characteristics of Sizewell C are most relevant?

Sizewell C is a single asset company. It will involve owning and operating a previously constructed nuclear plant until the end of its technical life, and subsequently decommissioning that plant. There are expected to be limited growth opportunities (save for potential end of life extensions) and there is no construction risk. Sizewell C's RAB will decline to zero over time as the asset depreciates. There will be a GSP for, among other things, high magnitude, low probability risks.[22]

Funding in the operating period will come from a combination of energy market revenues and difference payments from the 'Revenue Collection Counterparty'. The difference payments will provide for recovery of a regulated allowed revenue. Allowed revenue will be calculated based on building blocks assessed over a five-year period, including:[23]

- Expenditure allowances, cost of capital allowances (that are periodically updated to reflect actual changes in interest rates and equity market returns, via the RfR and ERP) and RAB indexation.
- Incentives linked to market prices, capacity, availability, and operating phase costs.
- Funded decommissioning plan (FDP) obligations. Ofgem has advised us that there will be no (unfunded) gap between the end of the operational period and decommissioning.

Accordingly, Sizewell C's value will be affected by expected out- or under-performance relative to these allowances, and differences between expected determinations of the allowed return and investors' required return.

Relevant characteristics for a CAPM asset beta

In this context, the table below outlines the characteristics that the comparator sample for Sizewell C would ideally capture.

Table 3.1: Key characteristics and relevance for comparator selection

Characteristic	Description
Long-term security over asset value	Sizewell C's value is underpinned by a RAB-based incentive regulation framework covering the asset's entire operating life.[24] Provisions within the framework limit the overall impact of incentive mechanisms on Sizewell C's cash flows. [Confidential: Specifically, a 75% allowed revenue floor, and caps on certain incentives (see below).] In addition, Ofgem retains flexibility to adjust the strength of incentive mechanisms over time, based on the asset's operational performance. As outlined below, the features of this framework (e.g., with respect to wholesale market risk, outperformance and the discount rate) impact Sizewell C's systematic risk. When considering

[22] The GSP primarily address risks that are not directly relevant for a CAPM-based beta methodology, and so is not considered in detail in this report.

[23] While five-yearly determinations are the expectation today, Ofgem may determine a different regulatory period.

[24] A through-life capacity incentive means that the RAB could increase or decrease if the plant's capacity falls above or below the target, a cap and floor apply to such adjustments. [Confidential: capacity incentive adjustments are restricted to circa -/+9% in aggregate.] However, we would not expect changes in the plant's capacity to be a systematic risk.

Characteristic	Description
	comparators, it is relevant to consider not only whether they are similar to Sizewell C with respect to these factors, but also the duration over which this applies. **Relevant comparators may include companies with similar RAB-based regulatory frameworks, or with a high proportion of revenues secured under long-term contracts. The degree of similarity depends on the nature and duration of the regulatory / contractual arrangements.**
Low exposure to wholesale market risk	For some regulated infrastructure assets, price and demand risk may be substantial contributors to systematic risk (e.g., airports). In contrast, Sizewell C is largely, although not entirely, insulated from risk related to trading in the wholesale market. In particular, it faces basis risk and buy-back risk. *Basis risk* Sizewell C's regime includes obligations on the licensee to sell its electricity for a competitive price and to adopt a trading strategy comparable to an efficient commercial baseload generator trading in the electricity market. These obligations are reinforced through the Market Price Incentive (MPI) – a financial incentive applied each year based on the variance between the nuclear licensee's actual trading income and that which may be expected for a 'baseload' plant, i.e., what could have been achieved had the licensee sold each unit of electricity at the relevant reference price. The risks that Sizewell C faces under this incentive, however, are more akin to basis risk than wholesale electricity market price volatility and risk. The combined impact of the market price and totex incentives (see below) is capped [Confidential: at 150 basis points on Return on Regulated Equity (RORE)]. Basis risk has been cited in other studies as a possible source of systematic risk, although in practice it is difficult to determine the extent.[25] *Buy-back risk* As outlined above, the MPI creates incentives for Sizewell C to sell its output forward to manage basis risk. In this context, an unplanned outage would likely require Sizewell C to purchase ('buy-back') replacement electricity in the spot market, creating a potential mismatch between the price of forward contract sales and spot purchases. This 'buy-back' risk is a standard forward trading risk for generators. As outages are not correlated with broader market returns, buy-back risk is unlikely to be systematic in nature. **Comparators may be relevant if they operate under arrangements that provide a similarly low level of exposure to demand and price risk, whether through their regulatory or contractual arrangements.[26]**
Allowed returns reflect changes in discount rates	As outlined above, if discount rates rise, asset values in general – for Sizewell C and the broader stock market – will fall. However, Ofgem's determinations may reflect such movements in Sizewell C's allowed returns – reducing the sensitivity of its value to changes in discount rates, relative to the broader stock market. This feature creates a dynamic between macroeconomic conditions and allowed returns that may be different to unregulated assets (or regulated assets that operate under a very different framework).

[25] See for example NERA (2015), *Electricity Generation Costs and Hurdle Rate – Lot 1: Hurdle Rates update for Generation Technologies*, a report for the Department of Energy and Climate Change (DECC), July 2015, p. 20.

[26] For example, these arrangements may differ in terms of the trading obligations / incentives that they place on generators, which could drive differences in risk compared to Sizewell C.

Characteristic	Description
	Comparators may be relevant if they operate under an economic regulation framework with a similar approach to setting the allowed rate of return.
Scope to outperform allowances	In practice, regulatory allowances will not perfectly track actual costs. There are likely to be expectations of over- or under-performance relative to operating phase cost allowances, which will affect Sizewell C's value. There may be a systematic element to this, although the materiality and directional impacts are difficult to discern. For example, cost shocks that impact wider corporate profitability may also affect Sizewell C, but these may be offset to some extent by the indexation framework that applies to Sizewell C. To the extent that this is a source of systematic risk, it may be captured in the observed asset beta of comparators with (i) similar drivers of operating costs (e.g., future expectations with regard to productivity and innovation, exposure to particular supply chains) and (ii) in the case of regulated assets, similar drivers of information asymmetry between the regulator and regulated company (e.g., related to the complexity and/or bespoke nature of cost drivers). **Comparators may be relevant if they face similar operating cost drivers (for example, if their activities include the operation of nuclear generations assets) and/or if there are similar arrangements to reflect changes in costs and revenues.**
Limited growth opportunities	From a theoretical perspective, we would expect a declining stream of cash flows to have a lower beta relative to a growing stream of cash flows (all else equal), in particular when future investments are correlated to economic growth. This is because any factor that affects the valuation of future cash flows (e.g., a change in the discount rate) will have a correspondingly smaller effect on an asset with shorter cash flows.[27] For example, we can compare two hypothetical projects with the same net present value (NPV) of cash flows based on an initial discount rate, but where cashflows for the first project are spread over a shorter time period than the second. Under these conditions, a change in the discount will have a proportionally higher impact on the NPV of the project with the longer stream of cash flows. [28] Further, we expect that (all else equal) comparators with exposure to construction-phase risks would have a higher beta relative to an operating asset.[29] These characteristics particularly differentiate Sizewell C from a number of other sectors. For example: • In contrast with a regulated electricity network, which based on current investment plans we might expect to have a growing present value over time, Sizewell C will have a declining present value (see figure below). • In contrast with an airport, which may have opportunities for expansion in future linked to economic growth and other macroeconomic trends (e.g., consumption and business

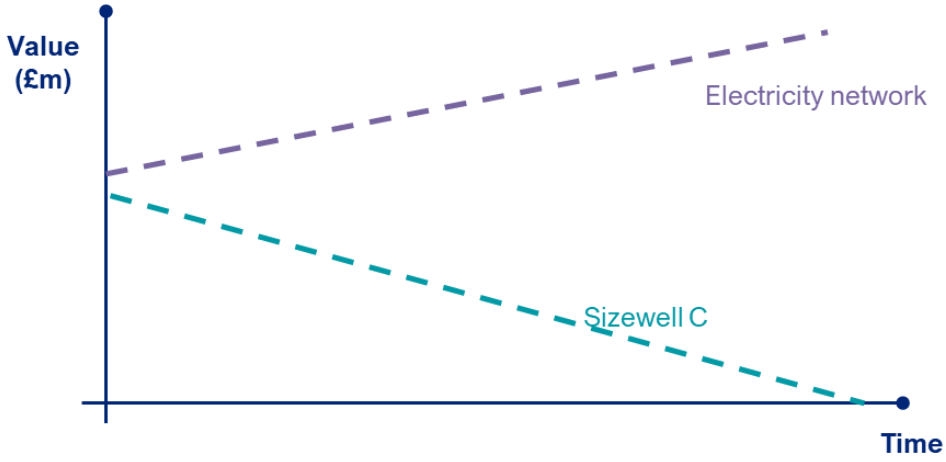
[27] This effect has been raised in other regulatory WACC contexts. For example, in a telecommunications context, see Brattle (2016), *Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization*, p.99.

[28] As its RAB depreciates, Sizewell C will have a progressively greater share of operating expenditure relative to RAB. The impact of operating expenditure to RAB ratios on the cost of equity is a topic that has been given attention by regulators and the CMA. However, the importance of this factor to Sizewell C, compared to other drivers of systematic risk, is unclear. For example, variations in costs relative to revenue allowances may be limited to the short term, and addressed at each price control reset. It is also unclear to what extent this characteristic would already be reflected in the beta range and comparator cohort. Ofgem will need to consider this issue amongst a range of factors as part of its future determinations.

[29] For example, CEPA's 2018 report for Ofgem on cost of capital ranges for new energy network assets commented on differences in risk between the construction and operation phases – see CEPA (2018), *Review of cost of capital ranges for new assets for Ofgem's networks division*, 23 January 2018, p. 28. Another example can be found in the US National Renewable Energy Laboratory's (NERL) financial assumptions for energy projects, which assume a 2% cost of equity differential between the construction and operational phases. See NERL (2020), *Current and Future Costs of Renewable Energy Project Finance Across Technologies*, July 2020, p.11.

Characteristic	Description
	practices, transport innovation, etc.), Sizewell C will have limited growth opportunities and, therefore, a declining asset value.

Figure 3.1: Value proposition – Sizewell C vs. electricity network



Source: CEPA

Comparators may be relevant if, like Sizewell C, their growth opportunities and exposure to construction risk are limited.

This characteristic may be difficult to capture perfectly within a comparator set that is used to estimate beta empirically – because listed companies would be expected to have a range of ongoing projects and activities. Investigation of potential comparators may indicate whether some have this characteristic.

Less relevant characteristics for a CAPM asset beta

Sizewell C has some distinctive features that we have *not* listed as key drivers of asset beta, including: Sizewell C's status as a single **undiversified asset**; the **importance of (il)liquidity** to asset beta; Sizewell C's **nuclear decommissioning liabilities**; and the presence of **high-impact low probability risks** associated with the operation of a nuclear power plant. For the reasons outlined below, we do not consider that these features are highly relevant for estimating Sizewell C's beta under a CAPM-based framework.

Undiversified asset

We do not consider that the characteristic of being a single, geographically undiversified asset is highly relevant to asset beta under a CAPM framework. This reflects an assumption that the regulatory regime ensures that the combined package of allowances and incentives provide a 'fair bet' to investors – that is, in expectation, allowed returns will provide an NPV equal to zero. In this context, the expected value for Sizewell C should not be affected by the fact that it is a single asset.

It is possible that the *volatility* around expected returns could be higher for a single asset as compared to a portfolio of assets. For example, the occurrence of unsystematic asset-specific risks – for example, a crack in a reactor vessel leading to an extended shut down – may have a proportionally larger effect on a single asset compared to a portfolio (which benefits from diversification). However, this would be taking a narrow view. In practice, even though Sizewell C is a single asset, this does not prevent its investors from holding, overall, a diversified portfolio that reduces their exposure to asset specific risks.[30]

[30] In this particular example, it is also possible that the asset might have recourse to the EPC contractor (i.e., via warranties with respect to construction defects).

Investment entities – strategic corporate investors, limited partnerships, or other fund management structures – often invest in individual assets or private market companies with single assets. Individual assets may be large in the context of the vehicle or entity that invests. However, these investment entities are not the ultimate investor. The ultimate investor can, and usually does, invest in a wide range of such entities, and will be diversified. Therefore, it is appropriate to treat the required returns for an individual asset from the perspective of a diversified investor. Although Sizewell C is a significant asset, it is not large in the context of the total value of UK listed companies.

Illiquidity

We have been asked if, when determining the asset beta under a CAPM framework, Ofgem should give consideration to Sizewell C potentially being a less liquid investment, compared to a scenario in which the company was publicly listed (i.e., as is the case with the comparators). We consider that:

- It is a feature of listed markets that returns from less liquid companies tend be higher than those of more liquidly traded companies. This is reasonably well established in the financial literature.[31] There has also been some regulatory precedent in the past of 'small company premiums' being granted (e.g., in the water sector), although this has in recent price determinations been in relation to allowed debt, not the asset beta.
- However, companies are entitled to use publicly listed or private capital. For assets of Sizewell C's size, we would suggest that the liquidity of the investment is therefore a choice of the company.
- Ofgem's standard approach to economic regulation has been to assume a benchmark efficient (notional) entity, including the capital structure and approach to financing. Choices that a company and its investors choose to make – e.g., on capital structure or private vs. public listing – are, as a result, for the company and its investors to manage.

For these reasons, we do not consider it would be appropriate for Ofgem to allow a liquidity premium in Sizewell C's asset beta.

Decommissioning liabilities

The relevance of decommissioning arrangements to beta depends on:

- Whether the licensee is exposed if decommissioning turns out to be costlier than provided for in the FDP, or whether they fully discharge their liability by contributing in line with the FDP.
- If there is a residual risk, this may have a systematic component (to the extent that the value of the fund varies with interest rates and/or excess market returns) and also be a source of asymmetric risk (i.e., if there is not a symmetric probability that the fund will be greater / less than the actual cost of decommissioning).

However, Ofgem has advised us that consumers will bear any shortfall associated with the FDP for Sizewell C. Accordingly, we do not consider that this risk is a driver of Sizewell C's beta. It is possible that this may be a source of difference to comparators with nuclear operations – although our preliminary investigations suggest many of the comparators may operate under broadly similar regimes.

High-impact low-probability risks

By this, we mean specific risks associated with the operation of a nuclear asset, such as a nuclear disaster, or political risk. Although CEPA has not undertaken a legal review of the GSP, our understanding is that it provides substantial protections for investors in Sizewell C in relation to such risks. In any event, the GSP primarily addresses asymmetric and/or non-systematic risks that are not directly relevant for a CAPM-based beta methodology – and therefore we do not consider these issues further in this report.

[31] See, for example, Fama & French (1992): *Common risk factors in the returns on stocks and bonds – Journal of Financial Economics 33, 3 – 56*, September 1992. Other literature is available.

3.2. COMPARATOR GROUPS

We are not aware of a listed, pure-play, regulated nuclear power plant operator. If we were, given the propensity of empirical betas to vary over time and cross-sectionally, it would still be prudent to bring in wider evidence.

At the time of writing, we have identified the following groups of comparators which could – to varying degrees – provide relevant evidence for assessing Sizewell C's asset beta:

- regulated integrated utilities;
- contracted generators;
- regulated networks;
- market-exposed generators;
- airports; and
- offshore transmission operators (OFTOs).

We discuss each group in turn below.

3.2.1. Regulated integrated utilities

This group includes firms that have generation assets with long-term security over returns provided through their regulatory arrangements. In the US, there are several examples of integrated utilities with nuclear generation assets that operate under cost-of-service regulation,[32] often in combination with network, other generation, and retail activities.

These entities share several features with Sizewell C, including:

- Security over long-term asset value and limited exposure of long-term returns to wholesale market risk, as a result of cost-of-service regulation that aims to allow the operator to receive a fair return on capital over the life of the assets. There are differences between US cost of service regulation and the RAB model that will apply to Sizewell C, which mean that while the comparison is relevant, it is not exact. For example, Sizewell C, as discussed above, is exposed to a range of incentive mechanisms and certain trading risks from operating as a baseload power plant in wholesale electricity markets. The comparators may not be exposed to these risks and/or may face different risks.[33]
- Exposure to a regulatory framework that may flow changes in discount rates through to allowed revenues in a somewhat similar way – although as noted above, this may not be identical to Sizewell.[34] The US approach to cost-of-service regulation does have differences to the approach typically applied in the UK, although the differences may sometimes be overstated.
- A similar mechanism to reflect efficient changes in costs in revenues, through regulatory review.

[32] See for example: https://www.nei.org/resources/statistics/old/nuclear-plants-in-cos-regulation-merchant-markets. Accessed February 2024.

[33] Developing a precise characterisation of the risks faced by the US regulated integrated utilities would be a valuable, albeit complex exercise – given the need to consider the overall impact of overlapping federal and state-based regulatory arrangements on regulated rates, alongside geographical variations in wholesale market arrangements.

[34] For example, there may be differences in the timing of revisions to the allowed cost of capital, given that regulated rates for US utilities are (typically) updated through periodic rate cases submitted by the utility, rather than the more regular cycle of reviews that is a feature of UK regulatory models.

- Exposure to factors that drive expected future costs and outperformance, to the extent that the comparators operate nuclear assets – which in practice may form only part of their portfolio of activities.

In addition to the other sources of potential difference noted above, unlike Sizewell C, many of these entities also appear to have a development pipeline (growth opportunities), and associated exposure to construction risk.

3.2.2. Contracted generators

Companies for which a high proportion of their assets are generators with a relatively high degree of security over their asset value and market position, provided through long-term contracts, provide another point of reference.

- Like Sizewell C, these assets may be relatively insulated from wholesale market price risk – although this will depend on the coverage and duration of their contracting arrangements, including the underlying allocation of risk (e.g., in relation to curtailment or congestion).
- As noted in Section 3.1.2, Sizewell C has some exposure to basis risk and buy-back risk. These are standard forward trading risks that many other generators also face – albeit depending on the precise nature of their contracting arrangements and the market trading obligations/incentives that these create. Subject to a more detailed review, contracted generation comparators may allow these risks to be captured in the estimated asset beta for Sizewell C, to the extent that they are systematic and reflected in empirical betas.[35]
- These assets may also face availability-based contracts that share similar characteristics to Sizewell C's plant performance incentives. Again, to the extent that these are in fact a source of systematic risk, the effect would be captured in the observed betas for this sample.

There are also likely to be some important differences between Sizewell C and this group:

- They will include different generation technologies to Sizewell C (e.g., renewables or gas fired generation).
- Unlike Sizewell C, contract prices (and therefore revenues) are not typically able to adjust to changes in inputs cost, including the cost of capital. A partial exception may be contracts that are linked to inflation or fuel prices, although the precise approach is likely to vary across the comparators. Contracts may include availability incentives, but in our experience, incentives related to costs are not typical.
- Further, in practice pure play contracted generation companies may be scarce, with listed companies actually reflecting companies with a diverse range of corporate activities, in addition to both construction and operation of generation plant.

3.2.3. Regulated networks

This group includes, but is not limited to, the comparator sample relied on by Ofgem to set the asset beta for the energy networks under its regulatory jurisdiction. We have identified a wider sample of European and UK comparators with substantial regulated network activities (energy and water), whose cash flows are underpinned by a building blocks regime rather than market prices.

However, we would not expect Ofgem to focus on these companies as a primary comparator set, as these assets are clearly different from a nuclear generator. In particular, the underlying activities of this asset class mean that they are not similar to Sizewell C in terms of the factors that may drive future costs and performance relative to regulatory allowances.

Nonetheless, these comparators provide a helpful cross check due to similarities with Sizewell C's regulatory framework in terms of:

[35] As noted above, we would not expect measured betas to capture asymmetric or non-systematic risks.

- Exposure to macroeconomic conditions. Changes in discount rates and inflation are an important systematic driver of investor value. Sizewell C shares a common feature with regulated networks in that changes in the RfR and TMR may, to a degree, over time feed into allowed returns, reducing the sensitivity of their value to changes in discount rates relative to the broader stock market.
- Long-term revenue security. Like regulated networks, Sizewell C will operate under a RAB-based regime covering the entire life of the plant. Further, the regulatory regime means that changes in costs are expected to be predominantly (although not perfectly) reflected in the allowed revenues of the company over time, with revenues exposed to limited demand or price risk.

3.2.4. Market exposed generators

This group includes companies with generation assets that have a higher degree of merchant exposure. The nature of the risks for these companies means their asset beta is likely to sit above Sizewell C's operational phase beta – in many cases far above. Nonetheless, this group may be helpful as a cross check to other evidence – for example, to establish whether long-term contracted cash flows do in practice tend to be associated with lower beta assets.

3.2.5. Airports

A priori, some listed airport comparators may share one feature with Sizewell C, in the sense that they operate a large single asset. However, with further scrutiny the comparison is less relevant:

- While the airport may be viewed as a single asset, in practice it is still likely to have scope for significant growth – for example, through the expansion of terminal capacity, the addition of new runways, or growth in non-aeronautical services (retail, etc).
- These growth opportunities mean that future cash flows are exposed to systematic variation, given the linkages between demand for air travel and economic growth.

Given these features, we would expect measured airport betas to sit above that of Sizewell C. How far above would depend on the degree of exposure to systematic demand risk (among other factors, including growth). For this reason, we have not explored this group in detail in this report.

3.2.6. OFTOs

OFTOs are operational assets with long-term inflation linked, albeit fixed, regulated revenue streams, with some (albeit limited) potential changes in value (linked to changes in wind farm use) over the technical life of the asset. However:

- The evidence on required equity returns for OFTOs is for radial – i.e., sole use – network assets based on a relatively well-established technology. This comparator group may not, therefore, capture some of the distinctive operating features of Sizewell C.
- From a practical perspective, we cannot directly observe the asset beta of OFTOs. This might only be inferred by 'backing out' an asset beta from the total equity returns implied in OFTO bids, which requires assumptions of the RfR and TMR. Accordingly, while Ofgem may wish to consider OFTO evidence as a cross check to its overall cost of equity determination, it is unlikely to be a useful point of reference for a beta study.

3.2.7. Summary of the potential comparator groups

The relevance of the comparator groups discussed needs to be interpreted in light of their similarities and differences to Sizewell C. A generic assessment of each group, relative to Sizewell C, is summarised in the table below. For the reasons stated above, we have not sought to rank airports and OFTOs (and do not consider these groups further in this report).

Table 3.2: Relevant comparator groups for Sizewell C

Characteristics	Regulated integrated utilities	Contracted generators	Regulated networks	Market-exposed generators
Security over long-term asset value	✓	✓	✓	✗
Wholesale market exposure	~	✓	✗	✗
Scope to outperform allowances	~	~	✗	✗
Limited growth opportunities	✗	✗	✗	✗
Allowed returns reflect changes in discount rates	✓	✗	✓	✗

Legend: ✓ = broadly similar to Sizewell C, ~ = partly similar to Sizewell C, ✗ = not similar to Sizewell C. A more detailed analysis of the comparators may identify other relevant differences – e.g., remuneration for inflation.

Based on this high-level comparison:

- **Regulated integrated utilities** and **contracted generators** could provide the most relevant evidence. This reflects the higher degree of similarity of these comparators to Sizewell C in terms of both their underlying operations and long-term assurance around their asset value. We therefore consider that these could be treated as primary comparator groups for Sizewell C.
- The **regulated network** and **market-exposed** samples could provide a helpful cross check as secondary comparators.

3.3. COMPARATOR SAMPLE

We have reviewed a range of potential comparators that could inform estimates for the groups noted above. The table below lists the comparators that we have included in each group. Further details on the comparators, and this classification, is provided in Appendix A.

Table 3.3: List of comparators by group

US regulated integrated utilities	Contracted generators / utilities	EU / UK regulated networks	Wholesale-exposed generators / utilities
• Ameren*	• AES Corporation	• A2A	• BKW*
• American Electric Power*	• Atlantica Sustainable Infrastructure	Enegas	• CEZ AS*
• Avangrid	• Clearway Energy	• Hera	• Drax Group
• CMS	Encavis	• National Grid	• DTE Energy*
• Consolidated Edison	Ibedrola*	• Pennon	• EnBW
• Dominion Energy*	Innergex Renewable Energy	• Red Electrica	Endesa*
• Duke Energy*	• NextEra Energy*	• REN	• Enel*
Edision*	• Polaris Renewable Energy	• Severn Trent	• Engie*
• Entergy*		Snam	• Fortum Oyj*
Evergy*		• Terna	• NRG Energy*
• First Energy Corp		• United Utilities	• Public Service Enterprise Group*
• Pacific Gas & Electric*			• RWE
• Pinnacle West*			• SSE
• PNM Resources*			• TransAlta Renewables
• Sempra			Vistra Corp*
• Southern Company*			
• Xcel Energy*			
• WEC			

Notes: (*) indicates the comparator has operating nuclear assets.

3.4. EMPIRICAL BETA EVIDENCE

3.4.1. Estimation approach

The estimation methodology we have applied in this report is a relatively standard approach in a UK regulatory context. However, it differs from Ofgem's RIIO-2 methodology, which considered evidence based on a wider range of estimation approaches. We would encourage Ofgem to consider a similar breadth of evidence in its decisions on the asset beta for Sizewell C.

While we consider that the analysis contained in this report is helpful for exploring the asset beta methodology that Ofgem could adopt, in line with our terms of reference, it is possible that a different estimation could change some of our conclusions. For example, it is possible that other estimation approaches could change the results of relative comparisons between Sizewell C and the comparator groups. In addition, it would be prudent to consider a wider range of estimates to determine the appropriate absolute values for Sizewell C's asset beta.

Our estimation approach is to:

- Estimate equity betas for the comparator sample based on a regression period of two years. We have calculated 2-year betas for each day over the period starting 11 January 2014 and ending 11 January 2024.
- The equity betas are converted to asset betas using:

- A debt beta assumption of 0.075, consistent with Ofgem's RIIO-2 methodology.[36]
- Gearing that is calculated as net debt over net debt plus market capitalisation. The gearing value used to convert equity betas to asset betas is the average of daily gearing values over the same 2-year period as used for the equity beta regression. In cases where gearing is negative, we exclude the negative values from the average.

- We have considered 2-year asset beta estimates over several periods: spot (i.e., the 2-year asset beta as at 11 January 2024); 1-year average (i.e., 11 January 2023 to 11 January 2024); 2-year average; 5-year average; and 10-year average.

We have undertaken a basic check of average bid-ask spreads to ensure that comparators are based on liquid traded shares. Generally, the comparators have bid-asks spreads that are in acceptable ranges – save for a handful of comparators, for which bid-asks spreads fall within a range of roughly 1 to 2% (see Appendix B). We have not investigated this issue further, as values for the comparator sample are likely to have changed materially by the time of Ofgem's PCR determination. We would encourage Ofgem to consider liquidity as part of its assessment of the comparator evidence, which may include consideration of other indicators (e.g., percentage of free float).

Finally, we note that several of the comparators (e.g., AES) appear to have substantial operations outside the country of the main stock market in which they are listed. This may have implications for the observed asset betas, as we might expect these comparators to have lower systematic risk as measured with respect to the stock index in their home markets. This feature would also merit further investigation by Ofgem, if it is present in the evidence base at the time of the PCR determination.

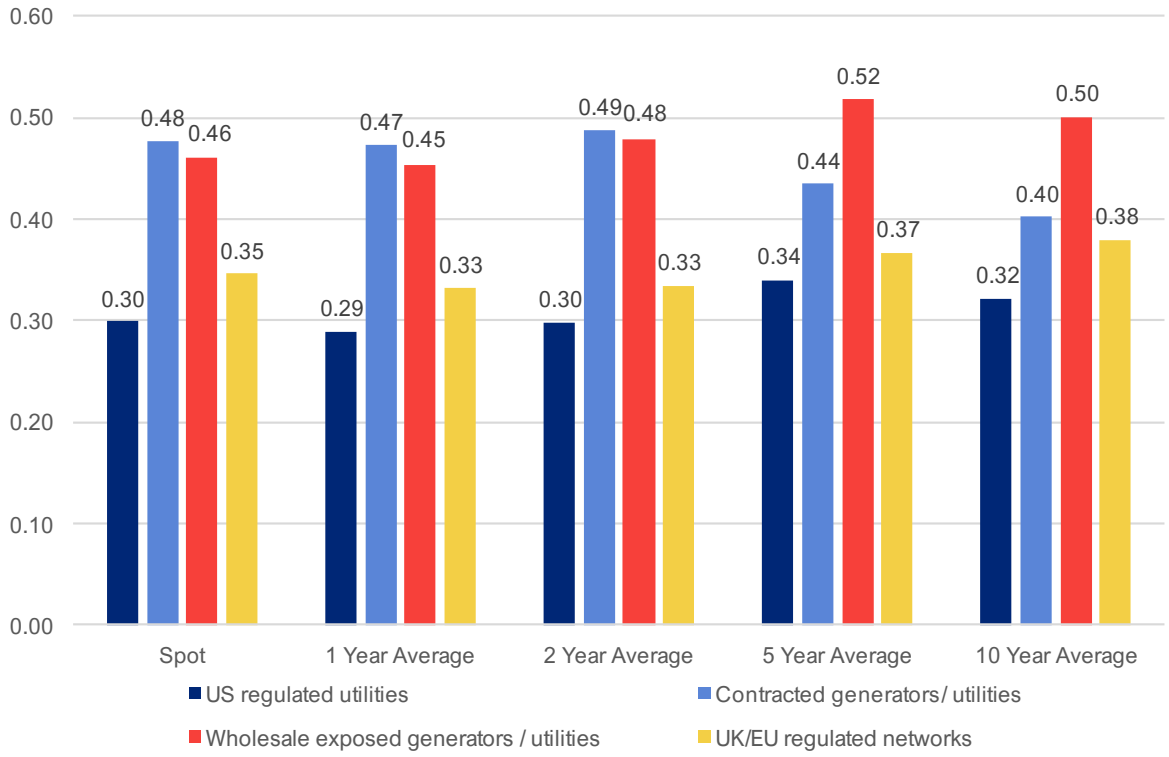
3.4.2. Estimation results

This section presents a summary of the empirical beta estimates for the comparator sample. More detail is included in Appendix B. Within this section we present a range of asset beta observations for different periods, ranging from spot to longer-term averages. It is important to note that we would expect Ofgem to give the greatest weight to the long-term averages, as opposed to the more recent data, when forming judgements of the appropriate asset beta value for Sizewell C. This is consistent with the approach that Ofgem took for its RIIO-2 determinations on asset beta. At the same time, if shorter- and longer-term estimates differ markedly, it would be appropriate to investigate the reasons for this.

Figure 3.2 below illustrates that, when an average is taken across all comparators, there are clear differences between the estimates for each group. In particular, and regardless of the period over which the 2-year betas are averaged, the US regulated utility group (including some with nuclear operations) has the lowest measured beta, followed by the regulated network comparators. On average, the group of generators / utilities with a higher proportion of revenues exposed to wholesale market dynamics has a markedly higher beta than the other groups – although it is slightly below the contracted generator / utility group when shorter-term evidence is considered.

[36] Ofgem (2021), *RIIO-2 Final Determinations – Finance Annex (REVISED)*, 3 February 2021, p.150.

Figure 3.2: Asset beta results - Average beta by estimation period and comparator group

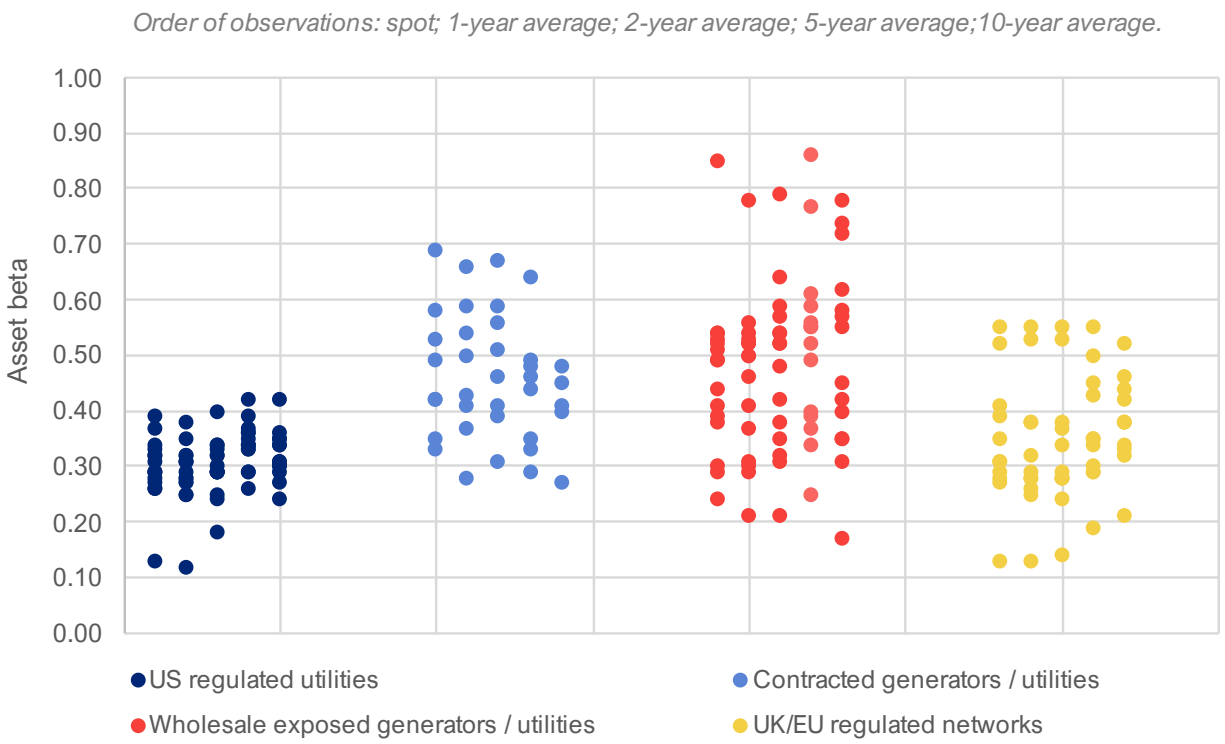


Source: CEPA analysis.

The average results presented above mask that there is a considerable range within each group of comparators. The spread of values for each group is illustrated in Figure 3.3 below. With a focus on the longer-term (**10-year average**) evidence, and rounding to the nearest 0.05, this indicates the following ranges for each group:

- For the US regulated utility sample, an asset beta range of 0.25-0.40.
- For the contracted generator / utility sample, an asset beta range of 0.25-0.50.
- For the EU / GB regulated network sample, an asset beta range of 0.20-0.50.
- For the wholesale-exposed sample, a wide asset beta range of 0.20-0.80.

Figure 3.3: Range of comparator estimates by averaging period



Source: CEPA analysis. Notes: the figure presents 2-year beta estimates for each comparator, over each averaging period. For some comparators, 5-year and 10-year averages are not available.

The variation highlighted by the figure above is unsurprising, considering the diversity of activities undertaken by the comparators. For example:

- Within the US regulated utilities category are companies with varying proportions of generation (across a range of technologies, including nuclear), network and retail activities. These activities sit under different regulatory arrangements (e.g., the Federal Energy Regulatory Commission (FERC) in the context of transmission networks, state-based regulators in the context of distribution networks, generation, and retail). Some comparators provide both regulated *and* unregulated services.
- Within the contracted generator group are some companies that include network and other services in addition to generation, although in most cases in much smaller proportions.[37] Importantly, the level and duration of contracts that underpin long-term revenues varies across the group. Specific contractual provisions – for example, indexation of contracted prices – are also likely to vary and may contribute to the variation that we observe in the beta estimates.
- Within all comparator groups, there are likely to be differences in the development pipeline and growth opportunities for each firm. Future prospects are also important for value, and beta.

The figure also highlights that the beta averaging period can make a significant difference for several comparators. For example, for one of the contracted generator/utility comparators (Polaris) the 10-year average estimate is 0.45, while the 5-year average estimate in 0.64 – reflecting a shift in the beta of this comparator over time. This data point contributes to the narrowing of the contracted sample range between the 5-year and 10-year averages, as seen in the figure above. The US regulated utility and UK/EU network samples also narrow when moving from shorter-term to longer-term evidence – again, reflecting changes in the measured betas of some comparators over time. If such

[37] One exception is Iberdrola, which has a more substantial share of network activities.

features are present in the evidence base when Ofgem comes to make its future decisions, it would be prudent to investigate these further, in order to assess how to appropriately weight the evidence.

These complexities highlight the need for careful interpretation of the evidence base that we have established for this report. Below, we draw out some conclusions that the data may support – and note some assumptions that should be tested before relying on the results.

- **Firstly, a comparison of the US regulated utility and EU/UK network samples does not point to nuclear operations having a strong impact on beta.**

  The US sample includes companies with regulated generation *and* network assets, with the generation assets including some nuclear operations in most cases. However, the top end of the range is well below that of the EU/UK network comparators. To strengthen confidence in this observation, it would be helpful to obtain more detailed information on the contribution of nuclear operations to the US comparators (noting that their activities are in practice rather broad) and explore the potential contribution of differences in the regulatory frameworks that apply to both sets of comparators.

- **Secondly, a comparison of the US regulated utility sample and contracted generator / utility sample indicates that contracted entities, may, in some cases have betas that are as low or lower than regulated entities.** To firm up this conclusion, it would be helpful to further explore (and potentially extend) the contracted generation sample – noting that it reflects a diversity of contractual arrangements and generation technologies. It may also be valuable to identify whether any of the contracted sample reflect a key characteristic of Sizewell C – namely its declining asset value, which might be expected to reduce beta (all else equal).[38]

- **Finally, a comparison of the contracted and wholesale-exposed samples indicates that there is overlap between these groups – notably at the lower end.** However, on average the contracted sample has a lower beta when considered over longer estimation windows (e.g., 10 years) – potentially reflecting the impact of greater long-term assurance of achieving a reasonable return. Again, further investigation (and potentially extension) of the contracted sample would better support this conclusion.

In Section 4, we comment on how this evidence impacts our conclusions on the appropriate methodology for Ofgem to apply in determining Sizewell C's asset beta.

[38] This will depend on whether the comparators included in the sample have a development pipeline, which is not clear from our initial research.

4. CONCLUSIONS

In this section, we synthesise observations on Sizewell C's risk profile and the comparator evidence, and comment on the implications for Ofgem's asset beta methodology. We also briefly discuss areas of further work that we would recommend Ofgem undertake to further inform its future determinations on Sizewell's asset beta (for example, further research on comparators) and the allowed cost of equity more generally.

4.1. ASSET BETA

As noted in Section 3, it is important to recognise that the empirical analysis undertaken for this report is exploratory. However, it is instructive to consider how this evidence can help us to think about the *process* Ofgem could follow in interpreting and weighting the comparator evidence that is available to it in future when it comes to set the RWACC. With this objective in mind, the following discussion sets out how the evidence we have assembled could be used to establish a range for Sizewell C's asset beta.

We emphasise that this does not reflect CEPA's definitive view of what the range actually is, based on current evidence. For the reasons we set out below we consider there is a range of additional work and research that could, and should, be undertaken to refine the samples of comparators and to help draw firmer conclusions from the data.

4.1.1. Relevance of comparator groups to Sizewell C's asset beta

Based on the characteristics of the comparator groups and Sizewell, we consider it may be appropriate for Ofgem to draw *primarily* on evidence from **(a)** the **US regulated utility sample** (asset beta range of 0.25-0.40, based on the 10-year evidence in this report) and **(b)** the **contracted generation sample** (asset beta range of 0.25-0.50, based on 10-year evidence in this report).

Interpreting evidence from the US regulated utility sample

We consider that the following considerations are relevant in determining where the asset beta for Sizewell C could sit relative to evidence from the sample with US integrated utilities under cost-of-service regulation:

- This group shares with Sizewell C a regulatory framework that provides long-term assurance over returns and limited exposure to wholesale market risk, supporting a reasonable expectation of the asset's ability to earn a return on equity. At the same time, this sample may reflect a regulatory regime that provides a greater degree of surety over long-term asset values compared to Sizewell C. This reflects Sizewell C's exposure to capacity incentive mechanism adjustments to its RAB, the operation of other incentive mechanisms, and the presence of some wholesale market exposure.
- These comparators undertake a range of activities other than nuclear operation. However, as noted above, the evidence in this report does not point to a premium associated with nuclear and/or generation activities, when these are undertaken in the context of a supportive regulatory framework (see comparison of regulated US integrated utilities and EU/UK regulated networks). Accordingly, the evidence does not suggest that the beta for Sizewell C should sit above the observed evidence for this group of comparators on account of systematic risk differences related to nuclear technology. Further analysis would help to test this observation.
- There appears to be differences in the growth opportunities and development pipeline for the regulated integrated utility sample, which contrasts with Sizewell C's declining asset base. If future growth expectations for this sample are material, all else equal our view is that this could point to a *lower* beta for Sizewell C.

Interpreting evidence from the contracted generator / utility sample

We see the following issues as being relevant for assessing where Sizewell C's asset beta could be positioned in relation to the contracted generator / utility sample:

- The contracting arrangements of these assets provide a degree of certainty around long-term returns that may be similar to Sizewell C, although this will depend on how much of the comparator's portfolio is covered, for how long, and with what other conditions attached. Other features of their contracting arrangements could drive a higher or lower beta than for Sizewell C, depending on the volume, fuel price and wholesale market trading risks these comparators are subject to. Our expectation (subject to further analysis) is that Sizewell C would have greater assurance of long-term returns relative to many of the comparators in this group. This is because:
    - The regulatory arrangements for Sizewell C extend over the entire operating life of the asset. In contrast, contracted generators may have exposure to a 'merchant tail' in the later years of operation.
    - The regulatory framework for Sizewell C is able to accommodate efficient changes in costs and Ofgem may calibrate the strength of incentives over time, depending on Sizewell C's actual operating performance. In contrast, contractual arrangements for the comparators would not typically have this degree of flexibility, making it more likely that costs and revenues could diverge more materially over time for this group relative to Sizewell C.
- As noted above for the regulated utility group, contracted generation assets may not share Sizewell C's characteristic of declining asset value – all things equal, a factor we consider *lowers* rather increases beta. The presence of growth opportunities for the contracted comparators could point to Sizewell C's beta sitting more to the lower end of the range for this sample.[39]
- Long-term contracted generation revenues may also be more sensitive to changes in discount rates than Sizewell C. As outlined in Section 3.1.2, under Sizewell C's regulatory framework, changes in interest rates and market returns may, to a degree, over time feed into allowed returns, reducing the sensitivity of their value to changes in discount rates relative to the broader stock market. We do not expect this to be the case for the contracted generation comparators – whose value may therefore be more sensitive to changes in the macroeconomic environment than Sizewell C.

Interpreting evidence from the other samples

Although we would not expect Ofgem to focus on the regulated networks (asset beta range of 0.2-0.5, based on 10-year evidence) and wholesale-exposed (asset beta range of 0.2-0.8, based on the 10-year evidence) samples, these 'secondary' comparator samples nonetheless provide relevant evidence.

Of these two groups, we consider that regulated networks provide a more relevant comparison, because their regulatory framework shares certain features with Sizewell C. In particular, the way that interest rates and the equity risk premium may be reflected in allowed returns is similar, meaning that exposure to systematic changes in the discount rate may also be similar. There may also be reasons to consider that some features of Sizewell C could (all else equal) *reduce* beta relative to the network comparators, as the latter reflect both growth expectations and construction risk.

We consider that evidence from wholesale-exposed generators is less relevant than the other comparators. This is because Sizewell C's regulatory framework offers considerably greater certainty of revenues and returns, relative to

[39] As noted above, substantial further research would be required to establish the specific terms of each comparator group's generation portfolio, the terms of those generation contracts (if even available) and each comparator's development pipeline / growth opportunities.

this group. While evidence from this group can still inform Ofgem's decision, we suggest that the beta range implied from this cohort, when considered in the round, should primarily be viewed as a threshold that Sizewell C's asset beta should fall below.

4.1.2. Potential implications for the range of Sizewell C's asset beta

This section sets out how Ofgem could bring the evidence base together to determine a range for Sizewell C's asset beta and select a point estimate within that range.

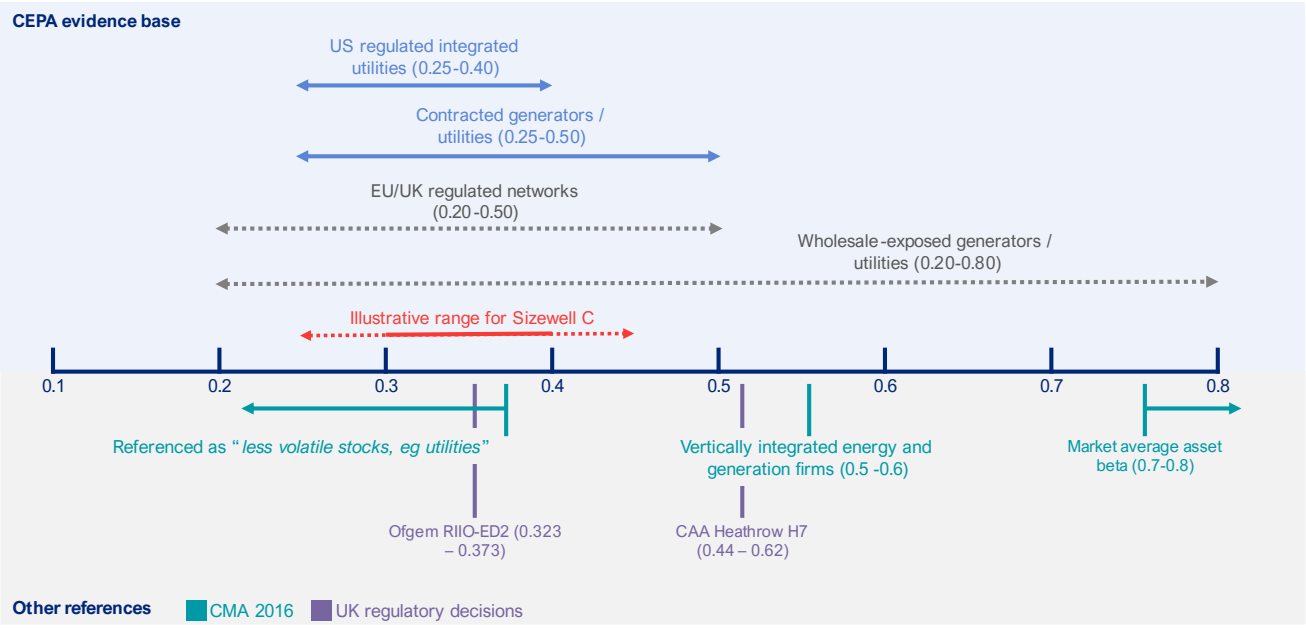
Beta spectrum

Consistent with how some UK regulators and the CMA have sought to form judgements on beta in previous determinations, we have placed the empirical beta observations from the primary (blue) and secondary (grey) comparator samples for Sizewell C alongside a broader set of reference points drawn from regulatory precedent. The latter includes:

- The range that the CMA used for its CAPM derived cost of equity estimates for generation and vertically integrated energy companies in the context of its final report for the Energy Market Investigation.
- Ofgem's RIIO-ED2 – electricity distribution – determination on asset beta, which reflected a relatively narrow set of UK comparators.
- The CAA's H7 decision for Heathrow Airport – we present the asset beta range that the CAA used, as its final decision reflected a series of steps and adjustments to get to a final value of 0.53 that was used to determine the allowed revenues for the price control period.[40]

The resulting beta spectrum is illustrated in Figure 4.1 below. In the following section, we explain the reasoning behind the indicative range indicated for Sizewell C, which reflects the primary comparator evidence.

Figure 4.1: Illustrative spectrum of beta evidence for Sizewell C



Source: CEPA analysis. Adapted from CMA (2016) – Energy Market Investigation.

[40] CAA (2023), *Economic regulation of Heathrow Airport Limited: H7 Final Decision, Section 3: Financial issues and implementation, CAP2524D*, March 2023. See paragraph 9.90 (asset beta range of 0.44-0.62) and paragraph 9.193 (decision to adopt the mid-point of the cost of capital range, implying an asset beta of 0.53).

We would expect Ofgem to consider a similar range of reference points and cross-checks in making its PCR determination of the asset beta for Sizewell C – noting that the evidence base that will be available to Ofgem at that time will be different from that presented above.

Primary comparator evidence

The evidence outlined above, combined with our illustrative characterisation of Sizewell C and the comparator groups, **may point to a beta range for Sizewell C in the order of 0.3 to 0.4**.

- The lower end of the range reflects the mid-point of evidence from the regulated integrated utility comparators (and overlaps with the bottom end of the range for the contracted sample). Starting from the mid-point of this sample recognises that, based on our initial research, the regulatory framework for Sizewell C appears to leave more scope for variability around long-term value (e.g., some exposure to cost performance and basis risk).
- The upper end of the range reflects the mid-point of the contracted sample. Given the assumptions noted above, the upper end of the contracted sample range may be less relevant for Sizewell C, if it reflected shorter contract durations, greater exposure to wholesale market risks, and differences in the way that changes in costs and discount rates flow through to revenues.

Our evidence base indicates that **the asset beta for Sizewell C could potentially fall outside of the 0.3-0.4 range**. For example, the lower bound of the regulated utility sample extends to approximately 0.25, while the contracted generation sample extends up to 0.50. A more detailed assessment of the comparator's similarities and differences to Sizewell C could therefore shift or widen the illustrative range of 0.3-0.4.

Subject to further investigation of the comparator evidence, we suggest that Ofgem consider the following issues when determining where to position Sizewell C within such a range.

Factors that could point towards the lower end of the range

- **The very long-term nature of the revenue protections provided by Sizewell C's regulatory framework.** In particular, and distinct from our assumptions regarding the contracted generator group, the regulatory framework for Sizewell C covers the entire life of the asset, allowing efficient changes in costs to be passed through to consumers. Similarly, Ofgem may calibrate the strength of incentives over time, depending on the plant's actual operating performance. We would not expect the contractual arrangements for the generation comparators to reflect this degree of flexibility, making it more likely that costs and revenues could diverge more materially over time for this group relative to Sizewell C.
- **Sizewell C's declining asset value and absence of construction activity.** As we discuss in the body of the report, this may reduce exposure to construction risk and the sensitivity of value to changes in discount rates. This depends on the materiality of future construction plans, and growth opportunities, for the firms represented in the comparator samples. Indeed, if Sizewell C's operating period beta is based on comparator evidence that reflects construction phase risk, then the asset beta implied by Sizewell C's **combined** IWACC/RWACC is likely to be overall higher than the comparator evidence.

Factors that could point towards the upper end of the range

- **Sizewell C's exposure to operating and wholesale market risks.** As noted above, Sizewell C's returns have varying levels of exposure to capacity, availability, basis risk and buy-back risk. With the exception of basis risk, these are not clearly relevant for beta determined under a CAPM framework. In practice however, it is challenging to classify any source of risk as strictly systematic or non-systematic. To the extent that these factors are systematic, they would be reflected to a degree in the measured betas of the contracted generator sample. If further investigation indicates that Sizewell C's exposure to these risks is similar to that sample, it may be appropriate to recognise this by placing more weight on this evidence.
- **Uncertainty around how Sizewell C's regulatory regime will apply in practice.** CEPA understands that the regulatory model for Sizewell C is intended to provide a supportive and relatively low risk framework for

investment. For example, Ofgem retains flexibility to calibrate incentive mechanisms and allowances in light of the asset's actual operating performance. However, the process is untested, and it remains to be seen how Ofgem will, in practice, respond to risks as they emerge. Over time, experience with the regime will indicate whether Sizewell C's risks are more consistent with the regulated utility sample or the contracted generation sample. Initially, the regime's relative immaturity could point to placing more weight on the latter – although this reflects a judgement on the appropriate remuneration of risk in a context of uncertainty, rather than differences in systematic risk.

The point estimate would ultimately depend on Ofgem's assessment of the relative importance of these factors for the asset beta.

Secondary comparator evidence

As discussed above, we consider that the secondary comparator samples (regulated network and market-exposed generators) provide a helpful cross check of the conclusions that might be drawn from the primary groups:

- A range of 0.3-0.4 would sit below the range of long-term average beta estimates drawn from our wholesale exposed generators/utilities, consistent with the CMA's positioning of asset beta values for generation/vertically integrated utilities with wholesale risk in its Energy Market Investigation (2016).
- Many of the comparators in the network comparator group operate under regimes that share key characteristics with Sizewell C, although clearly the underlying activities are very different. An asset beta range of 0.3-0.4 for Sizewell is not inconsistent with network comparator observations.

We note that Ofgem's allowed asset beta for RIIO-ED2 – its most recent onshore energy network cost of capital determination – falls within the 0.3-0.4 range. As outlined above, this does not reflect a view that the asset beta for Sizewell C should be set based on similar evidence to Ofgem's network decisions. Rather, for the reasons we set out above, we suggest an entirely different asset beta evidence base. Therefore, if Ofgem follows a similar methodology to that outlined in this report, we would expect to see divergence between Ofgem's asset beta decisions for regulated networks and Sizewell C over time.

4.2. FURTHER WORK

While this report is intended to help inform Ofgem's economic guidance for Sizewell C and provides an indicative asset beta range relative to current empirical evidence, this should not be regarded as the ultimate value of the asset beta that will feed into the RWACC for Sizewell C. We would expect that, in the first stages of the PCR, Ofgem would undertake similar analysis to that presented in this report using contemporary data and evidence, before undertaking any further steps required to reach a determination on the RWACC.

In addition, it is important to note that Ofgem's current economic guidance does not constitute a final regulatory decision, and the approach set out in this report to gathering and assessing empirical beta estimates does not necessarily encompass the entire range of evidence and considerations that Ofgem may have regard to at the PCR. In line with good regulatory practice, we would expect that Ofgem's final decision on Sizewell C's RWACC would follow consultations with relevant stakeholders, and consideration of relevant information that could supplement the sources of empirical evidence included in this report.

We anticipate that when it comes to determine the asset beta for Sizewell C, Ofgem will considerably expand the scope of analysis and research contained in this report. In particular, we recommend that Ofgem:

- Undertake a more detailed review of comparators, including evidence from countries not currently captured in the sample in this report. More detailed research on the following issues for each comparator would assist in interpreting the evidence: breakdown of revenue / EBITDA by activity; analysis of growth

opportunities; regulatory arrangements; contractual arrangements; and exposure to decommissioning risk (for companies with nuclear assets).[41]

- To the extent that more information is available on how Ofgem intends to apply the regulatory regime, consider how this impacts Sizewell C's position relative to the sample.
- Test a wider range of empirical estimates of asset beta.
- Identify possible cross-checks that could be used to test a CAPM derived cost of equity. This has been the practice in the most recent set of onshore network price controls, RIIO-2, and is consistent with UKRN guidance.

[41] As an illustration of the need for additional research, we identified that for a number of US entities, assets that were covered under long term contracts were still sometimes described as 'merchant' in company disclosures. Accordingly, additional research may identify additional comparators for the 'contracted generator' sample than were identified in our initial scan. Similarly, it is often challenging to precisely identify what proportion of comparator revenues is under long-term contracts. Therefore, additional research could result in some movement between the 'contracted' and 'market exposed' categories.

Appendix A COMPARATOR CHARACTERISTICS

This appendix provides a high-level description of the comparators we have considered in the empirical analysis, in relation to the samples of US regulated utilities, contracted generators / utilities, and market-exposed generators/utilities. To categorise each comparator, we have considered the factors outlined in the table below. It is important to highlight that thresholds used to derive the rankings reflect a degree of judgement.

Factor	Description	Ranking
Exposure to nuclear operation	We have considered each comparator's mix of activities, including generation (and what type), networks, or other.	Green = nuclear accounts for >30% of generation output. Amber = nuclear accounts for 1-30% of generation output. Red = no nuclear generation assets. The use of generation output as the basis for the ranking has been chosen because it is readily available for most comparators. For selecting a beta comparator sample, it would be preferable to consider contribution to returns – e.g., EBITDA (although even this would not be perfect, as it ignores future returns). However, most companies do not report profit by generation type.
Exposure to generation operation		Green = generation accounts for >80% of revenues. Amber = generation accounts for 20-80% of revenues. Red = generation accounts for <20% of revenues. The use of revenue as the basis for the ranking has been chosen because it is readily available for most comparators. For selecting a beta comparator sample, it would be preferable to consider contribution to returns – e.g., EBITDA (although even this would not be perfect, as it ignores future returns). However, many companies do not provide a breakdown of EBITDA by activity.
Exposure to wholesale market risk	Their degree of exposure to wholesale electricity market dynamics (e.g., whether a large proportion of revenues appears to be secured through a regulatory or private contract).	Green = revenues appear to be mostly or entirely regulated. Amber = a high proportion of revenues appears to be secured through long-term contracts. Red = appears to be largely exposed to wholesale market dynamics. Typically, information on contracting arrangements is difficult to obtain and may present only a partial picture (for example, reports may note that a company has "most" of its generation output secured through "long-term" contracts, without actually stating the level or duration of contract coverage). Accordingly, these rankings provide only approximate indications.

All websites and linked documents referred to below were accessed in February 2024.

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Atlantica				Contracted generators / utilities
Profile: "*We are a clean energy transition company focused on renewable energy with a portfolio of 2.2 GW operating assets. We complement our renewable assets portfolio with storage, efficient natural gas, and transmission infrastructure assets, as enablers of the transition towards a clean energy mix. We also hold water assets, a relevant sector for sustainable development*."[42] **Generation / nuclear:** Cash Available for Distributions (CAFD) breakdown by sector: 70% renewable generation, 15% gas and heat, 12% transmission, 3% water. **Wholesale exposure:** Most of the portfolio appears to be on long-dated contracts, with a 14-year weighted average remaining contract life (using CAFD for weighting). ***Note – this comparator has international operations, which may impact beta estimates measured with respect to a US stock exchange.***				
AvanGrid				Contracted generators / utilities
Profile: "*Avangrid, Inc. (NYSE: AGR) aspires to be the leading sustainable energy company in the United States. Headquartered in Orange, CT with approximately $41 billion in assets and operations in 24 U.S. states, Avangrid has two primary lines of business: Avangrid Networks and Avangrid Renewables. Avangrid Networks owns and operates eight electric and natural gas utilities, serving more than 3.3 million customers in New York and New England. Avangrid Renewables owns and operates a portfolio of renewable energy generation facilities across the United States.*"[43] Avangrid is a subsidiary of Iberdrola (listed separately in the US). **Generation / nuclear:** The company's net income appears to be almost entirely driven by its network business.[44] Generation production is 90% renewable. Therefore there is a question of whether this comparator is potentially more appropriately classed as a regulated network. **Wholesale exposure:** ~68% of wind and solar installed capacity under long-term contract. Nine-year average remaining PPA life. Target 85-95% capacity under contract and/or hedged.[45] Overall, this comparator sits in between 'green' and 'amber' on this factor, as its network business is regulated, and generation appears to be largely contracted				
AEP				US regulated utilities
Profile: AEP is one of the largest investor-owned electric public utility holding companies in the United States. AEP's electric utility operating companies provide generation, transmission and distribution services to more than five million retail customers in Arkansas, Indiana, Kentucky, Louisiana, Michigan, Ohio, Oklahoma, Tennessee, Texas, Virginia and West Virginia. AEP's public utility subsidiaries are involved in rate and regulatory proceedings at the FERC and their state commissions.[46] **Generation / nuclear:** 45% of earnings directly attributable to transmission and distribution, 45% to vertically integrated utilities businesses (which include generation, network, and supply activities), 10% to pure-play generation subsidiaries (p. 26). Generation capacity is 68% coal and gas, 7% nuclear, 23% hydro, wind, solar, and storage.[47]				

[42] https://www.atlantica.com/wp-content/uploads/documents/Factsheet-Atlantica-March-2023.pdf

[43] https://s24.q4cdn.com/489945429/files/doc_financials/2023/q3/final-nov-23-earnings-factbook.pdf

[44] https://d18rn0p25nwr6d.cloudfront.net/CIK-0001634997/d8735fa8-246c-4c78-aa68-bce251391a12.pdf, p. 64

[45] https://s24.q4cdn.com/489945429/files/doc_financials/2023/q3/final-nov-23-earnings-factbook.pdf, p.78.

[46] https://www.aep.com/assets/docs/investors/AnnualReportsProxies/docs/22annrep/2023ProxyAppendixA.pdf

[47] https://www.aep.com/assets/docs/investors/filings/docs/AEP_10K_2022.pdf, p. 8.

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Wholesale exposure: Wholesale market exposure from generation assets appears to be limited. In the vertically integrated utility segment, retail rates are subject to traditional cost-based regulation by the state utility commissions, which is designed to allow a utility an opportunity to recover its cost of providing service and to earn a reasonable return on its investment used in providing that service. AEP's vertically integrated utilities are also subject to regulation by the FERC under the Federal Power Act with respect to certain wholesale power sales – and for some of these have received authority from FERC to sell at market based rates.[48] However, only 15% of their electricity output is sold on wholesale markets.[49] Network assets in vertically integrated subsidiaries form part of the same rate base and are subject to cost of service regulation. Pure-network subsidiaries are also generally subject to cost of service regulation.				
Clearway				Contracted generators
Profile: *"Clearway Energy, Inc. is one of the largest renewable energy owners in the US with over 5,500 net MW of installed wind and solar generation projects. The Company's over 8,000 net MW of assets also include approximately 2,500 net MW of environmentally-sound, highly efficient natural gas generation facilities."*[50] **Generation / nuclear:** 59% of revenues are from renewables, the remainder from gas-fired generation (p.9). **Wholesale exposure:** The majority of the company's revenues are derived from long-term contractual arrangements for the output or capacity from these assets. The weighted average remaining contract life (based on CAFD) is 11 years as of the end of 2022 (see p. 6).				
AES				Contracted generators
Profile: AES is a global energy company. In addition to vertically integrated utility businesses (generation and networks) in Indiana and El Salvador, AES owns an electricity network business in Ohio and substantial generation capacity outside of the US, mainly in Central and South America. [51] We note that non-US operations (mainly Central and South America) contribute over 70% to operating margins (see p. 10). Further investigation would be prudent to confirm the suitability of this comparator. **Generation / nuclear:** AES earns over 70% of its margins in geographies outside the US, where it operates primarily as a generation business. Around 54% of the company's overall generation capacity is from fossil fuels, the rest is from renewables (p.5). **Wholesale exposure:** Most existing generation capacity is subject to long-dated (10+ years) contracts. The company has a substantial pipeline of future generation investments under long-term power purchase agreements.				
Dominion				US regulated utilities
Profile: Dominion Energy, headquartered in Richmond, Virginia and incorporated in Virginia in 1983, is one of the nation's largest producers and distributors of energy. Key business segments include vertically integrated electric utility operations in Virginia and South Carolina, gas distribution, and contracted generation assets.[52] **Generation / nuclear:** 20% of revenue is attributable to the gas distribution business. The remainder largely to vertically integrated electric utility operations which include both generation/supply and network activities. Output is 28% nuclear, 36% gas, 8% coal, 5% hydro and renewables, 23% purchased power. Nuclear is above 30% when considered on an owned-generation basis (i.e., excluding purchased power).				

[48] Ibid p. 20.

[49] Ibid. p. 85. Also note (p. 21), that certain "wholesale sales" (e.g., to municipal and cooperative utilities) are approved by FERC at cost-based rates.

[50] https://investor.clearwayenergy.com/static-files/cf45e789-75b2-42e0-85ae-63b06fd87c3a

[51] https://s202.q4cdn.com/986265382/files/doc_financials/2022/ar/2023-annual-report-wrap-10K_FINAL.pdf

[52] https://s2.q4cdn.com/510812146/files/doc_financials/2022/ar/2022-Form-10-K-typeset-ADA-compliant.pdf

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Wholesale exposure: The vast majority of Dominion's revenues are subject to rate regulation by the relevant state utility commissions.				
DTE				Market-exposed generators / utilities
Profile: *"DTE Energy is a Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric company serving 2.3 million customers in Southeast Michigan and a natural gas company serving 1.3 million customers in Michigan. The DTE portfolio includes energy businesses focused on custom energy solutions, renewable energy generation, and energy marketing and trading."*[53] **Generation / nuclear:** Only 23% of electricity generation capacity is from hydro and renewables, the remainder is largely fossil fuel, but also includes 10% that is nuclear. **Wholesale exposure:** Approximately one-third of revenues are from the energy trading segment. Significant portions of the Energy Trading portfolio are economically hedged (see p.14). However, it is not clear whether this is through long-term contracts. However, approximately 60% of revenue is from utility operations (generation, distribution and sale of electricity and gas, mainly electricity) which are under cost-of-service regulation.				
Duke Energy				US regulated utilities
Profile: *"Duke Energy, a Fortune 150 company headquartered in Charlotte, N.C., is one of America's largest energy holding companies. Our electric utilities serve 8.2 million customers in North Carolina, South Carolina, Florida, Indiana, Ohio and Kentucky, and collectively own 50,000 megawatts of energy capacity." "Electric Utilities and Infrastructure conducts operations primarily through the regulated public utilities of Duke Energy Carolinas, Duke Energy Progress, Duke Energy Florida, Duke Energy Indiana, Duke Energy Ohio and Duke Energy Kentucky."*[54] **Generation / nuclear:** Duke's main business is electricity (vertically integrated utility), making up over 80% of revenues), with the remainder mainly gas. Of its own generated output, 35% is nuclear, 63% fossil fuel, plus 2% hydro and renewable (p. 17). **Wholesale exposure:** 81% of billed GWh sales are to residential, commercial and industrial customers. For these retail sales, services are generally priced by state commission-approved rates designed to include the costs of providing these services and a reasonable return on invested capital. Only 19% are sales to wholesale or other customers, where FERC regulation applies and arguably there is not guarantee of cost recovery.				
Edison				US regulated utilities
Profile: Edison International is the ultimate parent holding company of SCE and Edison Energy. SCE is an investor-owned public utility primarily engaged in the business of supplying and delivering electricity to an approximately 50,000 square mile area of southern California.[55] **Generation / nuclear:** It appears that of the total energy requirements of its retail base, SCE meets 20% with owned generation, and the rest with purchased power. 43% of this is nuclear, 34% is fossil fuel, and the remainder largely hydro.[56] The red rating for generation reflects the small proportion of own generation (relative to retail sales).				

[53] https://d18rn0p25nwr6d.cloudfront.net/CIK-0000936340/28477a4e-8214-40c5-a20a-a5f8c4fbe3d8.pdf

[54] https://s201.q4cdn.com/583395453/files/doc_financials/2023/ar/2022-Annual-Report.pdf

[55] https://download.edison.com/406/files/20232/2022-eix-sce-annual-report.pdf?Signature=2O6lS0fLN3M6HGNy89wAuNrqfrA%3D&Expires=1707942128&AWSAccessKeyId=AKIAJX7XEOOELCYGIVDQ&versionId=bpeN_aiySep67UMc7RtP511pq9M5I127&response-content-disposition=attachment

[56] https://download.edison.com/406/files/20232/2022-financial-statistical-report.pdf?Signature=ddkfqmz2U7QrWrxRj19DxHdsgLM%3D&Expires=1707199556&AWSAccessKeyId=AKIAJX7XEOOELCYGIVDQ&versionId=WIE.fj3tqCmnBxbzkTOJjwEJoO8OlEaX&response-content-disposition=atta

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Wholesale exposure: SCE is subject to cost of service regulation – like other Californian vertically integrated utilities (see p. 81).				
First Energy				US regulated utilities
Profile: FE and its subsidiaries are principally involved in the transmission, distribution, and generation of electricity. FirstEnergy's utility operating companies comprise one of the nation's largest investor-owned electric systems, serving over six million customers in the Midwest and Mid-Atlantic regions. FirstEnergy's transmission operations include more than 24,000 miles of transmission lines and two regional transmission operation centers. AGC and MP control 3,580 MWs of total capacity. **Generation / nuclear:** The relative contributions of generation and network activities for this comparator require further investigation. Our current impression is that most of the subsidiaries are pure play networks, and just one in West Virginia has generation assets (mostly coal).[57] This is the reason for the red rating. **Wholesale exposure:** All subsidiaries appear to be subject to cost of service regulation (see p.3.).				
Evergy				US regulated utilities
Profile: Evergy, through its operating subsidiaries Evergy Kansas Central, Evergy Metro, and Evergy Missouri West, provides clean, safe and reliable energy to 1.7 million customers in Kansas and Missouri. We have classified this company as an integrated utility with an interest in a nuclear plant.[58] **Generation / nuclear:** 64% of capacity is from fossil fuels, 7% from nuclear, and 28% renewables (possibly less on an output basis) (p.10). **Wholesale exposure:** Revenue is largely derived from retail electricity sales, as opposed to wholesale electricity and transmission revenue (p. 8) – retail sales are subject to cost of service regulation.				
Vistra				Market-exposed generators / utilities
Profile: Vistra is a leading, Fortune 500 integrated retail electricity and power generation company based in Irving, Texas. **Generation / nuclear:** Over half of group revenues are from retail business in Texas, which is competitive.[59] **Wholesale exposure:** *"Our commercial team is focused on effectively and efficiently managing risk, through opportunistic hedging, and optimizing our assets and business positions. We proactively manage our exposure to wholesale electricity prices and fuel costs in markets in which we operate, on an integrated basis, through contracts for physical delivery of electricity, exchange-traded and over-the-counter financial contracts, term, day-ahead and real-time market transactions, and bilateral contracts with other wholesale market participants, including other power generators and end-user electricity customers."*[60]				
Southern Co				US regulated utilities
Profile:[61] Southern Company is a holding company that owns all of the outstanding common stock of three traditional electric operating companies, Southern Power, and Southern Company Gas. **Generation / nuclear:** Overall generation mix is 10% nuclear, 70% gas and coal, the rest hydro and renewables.				

[57] https://d18rn0p25nwr6d.cloudfront.net/CIK-0001031296/d2ab3d4f-0d3a-4619-b95e-79c003b96d45.pdf

[58] https://investors.evergy.com/index.php/index.php/static-files/ed9d8b7d-75d5-47cb-b30e-356e9d763a6e

[59] https://app.quotemedia.com/data/downloadFiling?webmasterId=101533&ref=117298855&type=PDF&symbol=VST&companyName=Vistra+Corp.&formType=10-K&dateFiled=2023-03-01&CK=1692819, p. 108

[60] https://filecache.investorroom.com/mr5ir_vistracorp_ir/300/415768%20Vistra%202022%20AR%20BMK1.pdf

[61] https://d18rn0p25nwr6d.cloudfront.net/CIK-0000092122/9619ee32-4e60-409f-8df9-407b49aa0ef1.pdf

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Wholesale exposure: The traditional electric operating companies – Alabama Power, Georgia Power, and Mississippi Power – are each operating public utility companies providing electric service to retail customers in three Southeastern states in addition to wholesale customers in the Southeast. Makes up ca 70% of revenue and drives most of the earnings. These appear to be regulated based on cost of service. Southern Power develops, constructs, acquires, owns, and manages power generation assets, including renewable energy projects, and sells electricity at market-based rates in the wholesale market. Makes up less than 10% of revenue. Southern Company Gas is an energy services holding company whose primary business is the distribution of natural gas in four states – Illinois, Georgia, Virginia, and Tennessee. Makes up ~20% of revenue. These appear to be regulated based on cost of service.				
Xcel Energy				US regulated utilities
Profile:[62] *"Xcel Energy is a major U.S. electric and natural gas company with annual revenues of $15.3 billion. Based in Minneapolis, Minnesota, the company operates in eight states and provides a comprehensive portfolio of energy-related products and services to 3.8 million electricity customers and 2.1 million natural gas customers. Electric operations consist of energy supply, generation, transmission and distribution activities across all four operating companies. Xcel Energy had electric sales volume of 116,885 (millions of KWh), 3.8 million customers and electric revenues of $12,123 million for 2022.* *Xcel Energy has two nuclear plants with approximately 1,700 MW of total 2022 net summer dependable capacity that serve the NSP System. Our nuclear fleet has become one of the best performing and dependable in the nation, as rated by both the NRC and INPO. Xcel Energy secures contracts for uranium concentrates, uranium conversion, uranium enrichment and fuel fabrication to operate its nuclear plants. We use varying contract lengths as well as multiple producers for uranium concentrates, conversion services and enrichment services to minimize potential impacts caused by supply interruptions due to geographical and world political issues."* **Generation / nuclear:** The main driver of revenues is the electric utility business, with gas utility accounting for a minority share. Generation breakdown: 47% coal and gas, 13% nuclear, 40% renewables. **Wholesale exposure:** Xcel Energy is subject to rate regulation by state utility regulatory agencies, which have jurisdiction with respect to the rates of electric and natural gas distribution companies in Minnesota, North Dakota, South Dakota, Wisconsin, Michigan, Colorado, New Mexico and Texas. Rates are designed to recover plant investment, operating costs and an allowed return on investment.				
NextEra[63]				Contracted generators / utilities
Profile: NextEra Energy is a leading clean energy company headquartered in Juno Beach, Florida. NextEra Energy owns Florida Power & Light Company (FLP), which is America's largest electric utility that sells more power than any other utility, providing clean, affordable, reliable electricity to approximately 5.9 million customer accounts, or more than 12 million people across Florida. NextEra Energy also owns a competitive clean energy business (NEER). They are involved in nuclear generation. **Generation / nuclear:** Nuclear makes up 21% of the FPL generation mix, the rest is largely gas. Nuclear makes up 23% of the NEER generation mix, the rest is primarily wind and solar. FPL provides 70-80% of revenue in recent years. **Wholesale exposure:** FPL is a rate-regulated electric utility, including two nuclear power plants. NEER combines rate-regulated transmission and competitive renewable energy generation. NEER's renewable assets (the bulk of NEER's power) have an average contract life of 15 years (p.25).[64]				

[62] https://d18rn0p25nwr6d.cloudfront.net/CIK-0000072903/e3289f4f-768c-4d54-b8ec-d48a6088805d.pdf

[63] https://www.investor.nexteraenergy.com/~/media/Files/N/NEE-IR/reports-and-fillings/annual-reports/NEE%202022%20Annual%20Report.pdf

[64] https://www.investor.nexteraenergy.com/~/media/Files/N/NEE-IR/news-and-events/events-and-presentations/2024/01-25-24/4Q%202023%20Slides%20vF.pdf

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Note: The categorisation of this comparator requires further consideration. In particular, while most revenue appears to be from the rate-regulated utility business, competitive generation is largely on long-dated contracts. Further investigation could place this company in the 'US regulated utility' group.				
Pinnacle West				US regulated utilities

Profile:[65] [66] *"Pinnacle West is a holding company that conducts business through its subsidiaries. We derive essentially all of our revenues and earnings from our wholly-owned subsidiary, APS. APS is a vertically integrated electric utility that provides either retail or wholesale electric service to most of the State of Arizona, with the major exceptions of about one-half of the Phoenix metropolitan area, the Tucson metropolitan area and Mohave County in northwestern Arizona.*

APS currently provides electric service to approximately 1.3 million customers. We own or lease 6,340 MW of regulated generation capacity and we hold a mix of both long-term and short-term purchased power agreements for additional capacity, including a variety of agreements for the purchase of renewable energy. During 2022, no single purchaser or user of energy accounted for more than 2.4% of our electric revenues.

APS is also the operator and co-owner of the Palo Verde Generating Station – the largest nuclear plant and the single-largest generator of carbon-free electricity in the U.S."

Generation / nuclear: Energy mix: 45% gas / coal, 24% nuclear, 12% renewable + other.

Wholesale exposure: The ACC regulates APS's retail electric rates and its issuance of securities. APS is subject to varying degrees of competition from other investor-owned electric and gas utilities in Arizona (such as Southwest Gas Corporation), as well as cooperatives, municipalities, electrical districts, and similar types of governmental or non-profit organisations.

FERC regulates rates for wholesale power sales and transmission services. See Note 3 for information regarding APS's transmission rates. During 2022, approximately 11.6% of APS's electric operating revenues resulted from such sales and services. APS's wholesale activity primarily consists of managing fuel and purchased power supplies to serve retail customer energy requirements. APS also sells, in the wholesale market, its generation output that is not needed for APS's Native Load and, in doing so, competes with other utilities, power marketers and independent power producers.

PSEG				Market-exposed generators / utilities

Profile:[67] *"We are an energy company consisting primarily of a regulated electric and gas utility and a nuclear generation business. Our operations are located primarily in the Mid-Atlantic United States."* The company's two principal operating subsidiaries are:

"PSE&G—A New Jersey corporation, incorporated in 1924, which is a franchised public utility in New Jersey. It is also the provider of last resort for gas and electric commodity service for end users in its service territory. PSE&G earns revenues from its regulated rate tariffs under which it provides electric transmission and electric and natural gas distribution to residential, commercial and industrial (C&I) customers in its service territory. It also offers appliance services and repairs to customers throughout its service territory and invests in regulated solar generation projects and regulated energy efficiency (EE) and related programs in New Jersey.

PSEG Power—A Delaware limited liability company formed in 1999 as a result of the deregulation and restructuring of the electric power industry in New Jersey. PSEG Power earns revenues from its nuclear generation and marketing of power and natural gas to hedge business risks and the value of its portfolio of nuclear power plants, other contractual arrangements and gas storage facilities."

Generation / nuclear: PSE&G earns revenues from its regulated rate tariffs under which it provides electric transmission and electric and natural gas distribution to residential, commercial and industrial (C&I) customers in its service territory. This accounts for ~70% of revenue (p. 148). PSEG Power earns revenues from its nuclear

[65] https://s22.q4cdn.com/464697698/files/doc_presentations/2024/January-Investor-Deck.pdf

[66] https://s22.q4cdn.com/464697698/files/doc_financials/2022/q4/PNW-2022.12.31-10-K-[Final].pdf

[67] https://d18rn0p25nwr6d.cloudfront.net/CIK-0000788784/3d15ef5e-bd55-41b8-92ab-ce07926810f7.pdf

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
generation and marketing of power and natural gas to hedge business risks and the value of its portfolio of nuclear power plants. Its hedging strategy is short term (2-3 years). This accounts for ~30% of revenue. **Wholesale exposure:** Although the generation business (PSEG Power) appears to have a high degree of wholesale market exposure, this is counteracted by the regulated nature of PSE&G's revenues. The classification of this comparator requires further investigation.				
PG&E				US regulated utilities
Profile:[68] **"***PG&E Corporation, incorporated in California in 1995, is a holding company whose primary operating subsidiary is Pacific Gas and Electric Company, a public utility operating in Northern and Central California. The Utility generates revenues mainly through the sale and delivery of electricity and natural gas to customers."* **Generation / nuclear:** 69% of revenue is from electricity (appears to include all vertically integrated operations), 31% from gas. Note that, as of 2019, generation made up only 19% of the rate base (distribution 50% and transmission 30%). 65% of electricity generated is from two nuclear units at the same location (38% if electricity procured from third parties is included in the calculation), 24% fossil fuel (mainly gas), 9% hydro, and 3% renewables. **Wholesale exposure:** 77% of electricity is sold to customers, 23% to CAISO in the open market. The CPUC has jurisdiction over the rates and terms and conditions of service for the Utility's electric and natural gas distribution operations, electric generation, and natural gas transmission and storage services. The FERC has jurisdiction over the Utility's electric transmission revenue requirements and rates, the licensing of substantially all of the Utility's hydroelectric generation facilities, and the interstate sale and transportation of natural gas, and the terms and rates of wholesale electricity sales. The Utility operates under a "cost-of-service" ratemaking model, which means that rates for electric and natural gas utility services are generally set at levels that are intended to allow the Utility to recover its costs of providing service and to earn a return on invested capital. In addition, the CPUC authorizes the Utility to recover costs that the Utility is allowed to "pass through" to customers, including its costs to procure electricity and natural gas for customers. The Utility is exposed to commodity price risk as a result of its electricity and natural gas procurement activities. Procurement costs are recovered through rates. The Utility uses both derivative and non-derivative contracts to manage volatility in customer rates due to fluctuating commodity prices. The Utility expects to fully recover through rates all costs related to derivatives under the applicable ratemaking mechanism in place as long as the Utility's price risk management activities are carried out in accordance with CPUC directives. As long as the Utility can conclude that it is probable that its reasonably incurred wholesale electricity procurement costs and natural gas costs are recoverable, fluctuations in electricity and natural gas prices do not affect earnings. Such fluctuations, however, may impact cash flows.				
PNMR				US regulated utilities
Profile:[69] PNMR is an investor-owned holding company with two regulated utilities, PNM and TNMP. PNM engages in the generation, transmission, distribution, and supply of electricity to rate-regulated customers. TNMP provides only electricity transmission and distribution. **Generation / nuclear:** For PNM, generation (GWh) is 35% nuclear, 37% coal, and 24% gas. It is challenging to disentangle generation from other sources of revenue. Wholesale energy sales account for 24% of revenue , but a further 46% is derived from retail sales subject to state regulation, through rates that encompass both generation and distribution services (p. B-41 and B-42). **Wholesale exposure:**				

[68] https://d18rn0p25nwr6d.cloudfront.net/CIK-0001004980/70d15bb3-a51f-494a-bd25-79184a126c4d.pdf

[69] https://otp.tools.investis.com/clients/us/pnm_resources/SEC/sec-show.aspx?FilingId=16442475&Cik=0001108426&Type=PDF&hasPdf=1

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
PNM provides electric generation, transmission, and distribution service to its rate-regulated customers in New Mexico. Customer rates for retail electric service are set by the NMPRC. PNM is required to meet the demand and energy needs of its customers. PNM is exposed to market risk for the needs of its customers not covered under the FPPAC. PNM is exposed to changes in the market prices of electricity and natural gas for the positions in its wholesale portfolio not covered by the FPPAC. PNM engages in activities to optimize its existing jurisdictional assets and long-term power agreements through spot market, hour-ahead, day-ahead, week-ahead, month-ahead, and other sales of excess generation not required to fulfill retail load and contractual commitments. PNM began participating in the EIM in 2021. The EIM is a real-time wholesale energy trading market operated by the CAISO that enables participating electric utilities to buy and sell energy. The NMPRC granted PNM authority to seek recovery of costs associated with joining the EIM, which have been included in the 2024 Rate Change and to pass the benefits of participating in EIM to customers through the FPPAC. TNMP is subject to traditional cost-of-service regulation with respect to rates and service under the jurisdiction of the PUCT and certain municipalities. TNMP's transmission and distribution activities are solely within ERCOT, which is the independent system operator responsible for maintaining reliable operations for the bulk electric power supply system in most of Texas. Therefore, TNMP is not subject to traditional rate regulation by FERC.				
NRG				Market-exposed generators / utilities
Profile:[70] NRG produces and sells energy and related products. **Generation / nuclear:** Generation mix is 19% nuclear, the remainder largely fossil fuel. **Wholesale exposure:** 40% of operating income is driven by Texas generation and supply, which is competitive. It appears that the other business segments also operate in largely competitive environments (see p.10, 14, and 137).				
Ameren				US regulated utilities
Profile:[71] The company's main segments include: Ameren Missouri operates a rate-regulated electric generation, transmission, and distribution business and a rate-regulated natural gas distribution business in Missouri. This makes up ca. 60% of revenue. Ameren Illinois operates rate-regulated electric transmission, electric distribution, and natural gas distribution businesses in Illinois. Ca 30% of revenue. ATXI operates a FERC rate-regulated electric transmission business in the MISO. Ca 10% of revenue. **Generation / nuclear:** GWh output: 22% nuclear, 62% coal, 8% hydro and wind, the remainder is largely purchased power. **Wholesale exposure:** As outlined above, the main operating segments are subject to rate regulation.				
Entergy				US regulated utilities
Profile:[72] "*Entergy operates primarily through two business segments: Utility and Entergy Wholesale Commodities.* *The Utility business segment includes the generation, transmission, distribution, and sale of electric power in portions of Arkansas, Mississippi, Texas, and Louisiana, including the City of New Orleans; and operation of a small natural gas distribution business.* *The Entergy Wholesale Commodities business segment includes the ownership, operation, and decommissioning of nuclear power plants located in the northern United States and the sale of the electric power produced by its operating plants to wholesale customers. Entergy Wholesale Commodities also provides services to other nuclear*				

[70] https://investors.nrg.com/static-files/b31004b2-5945-49da-a395-205ed3166a47

[71] https://d18rn0p25nwr6d.cloudfront.net/CIK-0001002910/65fe34c4-aeb2-4942-90af-17207c3d8f2e.pdf

[72] https://s201.q4cdn.com/714390239/files/doc_financials/2022/ar/4Q22-10K.pdf

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
power plant owners and owns interests in non-nuclear power plants that sell the electric power produced by those plants to wholesale customers. This segment was essentially constituted by Palisades NPP, which sold almost all its output through a long-dated PPA. With the sale of Palisades in June 2022, Entergy completed its multi-year strategy to exit the merchant nuclear power business." ***Note: This extract highlights that in the US, plants with long-term PPAs can often be referred to as 'merchant' – creating some challenges in classifying comparators without extensive research.*** **Generation / nuclear:** Ca. 20% of capacity is nuclear, the rest largely fossil fuel. **Wholesale exposure:** Entergy's primary source of revenue is from retail electric sales sold under tariff rates approved by regulators in its various jurisdictions.				
Con Edison				US regulated utilities
Profile: Con Edison's principal business operations are those of CECONY, O&R and Con Edison Transmission. CECONY's principal business operations are its regulated electric, gas and steam delivery businesses. O&R's principal business operations are its regulated electric and gas delivery businesses. Con Edison Transmission invests in electric transmission projects and manages both electric and gas assets while seeking to develop electric transmission projects.[73] **Generation / nuclear:** The company does not own nuclear generation. Majority of generation mix is solar and wind (73%) the rest natural gas.[74] **Wholesale exposure:** On March 1, 2023, Con Edison completed the sale of all of the stock of the Clean Energy Businesses, transitioning to a pure-play regulated business. Even prior to the divestment of the clean energy business, CECONY and O&R made up 90% of revenue and earnings. These segments are subject to cost-of-service regulation.[75]				
Polaris				Contracted generators /utilities
Profile:[76] A Canadian publicly traded company engaged in the acquisition, development and operation of renewable energy projects in Latin America. This comparator appears to have a large proportion of activities outside its market of listing – which may impact its observed beta estimates. **Generation / nuclear:** Portfolio includes solar, hydro, geothermal. No nuclear. **Wholesale exposure:** 98% of revenues fully contracted with government entities, for an average remaining duration of 13.8 years.				
Encavis				Contracted generators /utilities
Profile:[77] Encavis operate wind and solar parks in Europe. **Generation / nuclear:** 100% renewable. **Wholesale exposure:** Appear to be largely under long-term contracts (p.91).				
TransAlta Renewables				Market-exposed generators / utilities

[73] https://investor.conedison.com/static-files/bdf3cf05-7e90-4150-8424-5befa73a3a41

[74] https://lite.conedison.com/ehs/2022-sustainability-report/report-introduction/fuel-mix-and-generating-capacity/

[75] https://investor.conedison.com/static-files/0306eb84-89c5-44f5-91dc-f6801b2a3eec, p.7 and 180.

[76] https://polarisrei.com/investors/ Corporate presentation February 2024.

[77] https://www.encavis.com/en/green-capital/investor-relations/financial-reports

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Profile:[78] TransAlta is one of the largest renewable power producers in North America, one of the largest producers of wind power in Canada and the largest producer of hydro power in Alberta. It operates a diverse and growing fleet of electrical power generation assets in Canada, the United States and Australia consisting of hydro, wind, solar, battery storage, gas and energy transition facilities. **Generation / nuclear:** Primarily renewable. **Wholesale exposure:** Revenues appear to be largely merchant (p.18).				
CEZ AS				Market-exposed generators / utilities
Profile:[79] CEZ is involved in electricity generation, distribution, and supply, trading, mining. It is listed in Czechia. Main operations in Czechia, also has operations in Germany, France, Italy, Poland, Slovakia and Hungary. CEZ plan to start construction of a new nuclear unit in 2029.[80] **Generation / nuclear:** EBITDA breakdown: 36% nuclear, 17% fossil fuel, 9% renewables, 17% trading, 14% distribution, 3% sales, 5% mining. Generation GWh breakdown: nuclear 57%, coal and gas 38%, hydro and renewables 6%. Note retail sales are a fraction of owned generation. **Wholesale exposure:** As of 2022, 98% of electricity to be sold in Czechia in 2023 is hedged, 77% in 2024, 51% in 2025, 20% in 2026. This indicates a relatively short-term contracting strategy.				
Drax Group				Market-exposed generators / utilities
Profile: Drax Group plc, trading as Drax, is a power generation business. The principal downstream enterprises are based in the UK and include Drax Power Limited, which runs the biomass fuelled Drax power station, near Selby in North Yorkshire. The Group also runs an international biomass supply chain business. **Generation / nuclear:** Main business (by contribution to revenue and profits) is generation, which is largely from renewables, mainly the large biomass Drax plant in the UK. "Generation" also includes a large number of PPAs with smaller independent UK power producers. Drax also has a supply arm, serving mostly industrial and commercial customers, and a pellet production business based in North America (which appears to provide the fuel for the Drax plant). **Wholesale exposure:** The annual report mentions the following as key mitigations to market risks: *"We continue to build on our high levels of forward power hedges (sales) for 2023 to 2025, and the CfD on one of our biomass generation units reduces our exposure to volatility [this CfD expires in 2027 and only covers a fraction of Drax generation].* *Our UK portfolio of Industrial and Commercial electricity customers provides liquidity for forward power and renewable certificate sales through the Customers business. We maintain high hedge levels of customer sales through our power trading capability*".[81] Fitch notes: *"Drax's exposure to electricity price volatility is reduced chiefly by the support schemes for its biomass units (about 70% of projected EBITDA based on prices of about GBP130/MWh). Near-term visibility is bolstered by a hedging policy of most power for about two years forward for three renewable obligation (RO)-supported biomass units. Drax also holds contracts for difference (CfDs) for baseload power prices on another biomass unit. However, these renewable subsidies schemes supporting Drax's biomass generation expire in March 2027."*[82]				

[78] https://transalta.com/investors/results-reporting Q3 2023 report

[79] https://www.cez.cz/webpublic/file/edee/ospol/fileexport/investors/investment-stories/2023-12-investment-story-published-en.pdf

[80] https://www.world-nuclear-news.org/Articles/Westinghouse,-EDF-and-KHNP-submit-final-Czech-bids

[81] https://www.drax.com/wp-content/uploads/2023/03/Drax_AR2022_single_pages.final_.pdf

[82] https://www.fitchratings.com/research/corporate-finance/fitch-affirms-drax-group-holdings-limited-at-bb-outlook-stable-24-04-2023

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
Endesa				Market-exposed generators / utilities

Profile: Endesa, S.A. is a Spanish multinational electric utility company, the largest in the country. The firm, a majority-owned subsidiary of the Italian utility company Enel, has 10 million customers in Spain.

Generation / nuclear: EBITDA drivers: 48% conventional generation and others, 32% networks, 12% renewables, 8% retail. Generation mix is 41% nuclear, 40% combined cycles and classic thermal, 12% solar and wind, 7% hydro.

Wholesale exposure: There is limited information on contractual arrangements. As of the end of 2022, 98% of inframarginal output (hydro, nuclear, and merchant renewables) was hedged in 2023, and 85% in 2024.

Fitch notes: Endesa S.A.'s 'BBB+' Issuer Default Rating and 'bbb+' Standalone Credit Profile (SCP) largely reflect the company's leadership position in the Spanish electricity market, with half its earnings either regulated or supported by incentives mechanisms for renewables. This still suggests a large proportion of generation may be uncontracted.

Enel				Market-exposed generators / utilities

Profile:[83] Enel S.p.A. is an Italian multinational manufacturer and distributor of electricity and gas, as well as an artificial intelligence company.

Generation / nuclear: EBITDA breakdown:[84] 30% "conventional" generation, 19% Enel Green Power (renewable generation), 40% networks, 10% retail. Production is close to 50% renewables (half of which is hydro), 39% fossil fuels, 12% nuclear.[85]

Wholesale exposure: According to Moody's, 61% of EBITDA in 2022 is driven by regulated and contracted activities.[86]

Engie				Market-exposed generators / utilities

Profile:[87] Engie is a large multinational business, with activities spanning renewable generation, networks, flexible generation, retail, and other energy solutions.[88]

Generation / nuclear: Engie as nuclear assets in Belgium, under what appears to be a risk mitigation mechanism. EBIT breakdown: nuclear 11%, thermal 20%, renewables 18% (all generation ca 50%), networks 26%, Energy solutions, trading, and others ca 25%.

Wholesale exposure: According to S&P:[89] *"We believe Engie will retain a greater than 50% share of both regulated and contracted activities within its business mix. During the European energy crisis and the pandemic, Engie demonstrated its resilience, notably thanks to the stability of its 30% of EBITDA coming from purely regulated networks and more than 20% of EBITDA coming from long-term contracted activities. The vast majority of Engie's renewable business is contracted, with wind and solar plants benefiting from 10-15-year contract*

[83] https://www.enel.com/investors/sustainability/strategy-sustainable-progress/occupational-health-and-safety/enel-nuclear

[84] https://www.enel.com/content/dam/enel-com/documenti/investitori/informazioni-finanziarie/2022/trimestrali/fy-2022-risultati.pdf, p. 45

[85] https://www.enel.com/media/explore/search-press-releases/press/2023/03/enel-publishes-2022-fourth-quarter-and-full-year-group-operating-data-report

[86] https://www.moodys.com/research/Moodys-affirms-ENEL-and-Endesas-Baa1-ratings-outlook-remains-negative-Rating-Action--PR_482243

[87] https://www.engie.com/sites/default/files/assets/documents/2023-06/Interim%20agreement%20on%20Belgian%20nuclear%20-%20June%202023%20-%20VDEF.pdf

https://www.engie.com/sites/default/files/assets/documents/2023-02/ENGIE%20FY%202022%20Presentation%20VDEF.pdf

[88] https://www.engie.com/sites/default/files/assets/documents/2024-01/ENGIE-Corporate-EN%200801.pdf

[89] https://www.engie.com/sites/default/files/assets/documents/2023-11/RatingsDirect_EngieSA_56684973_Nov-23-2023.PDF

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
residual lives, and a target to maintain about 70% of renewable capacity contracted by 2030 from 78% as of 2022 (at 100% consolidation) with merchant hydro accounting for about 15% and merchant onshore wind and solar for the remainder. About 35% of thermal generation is contracted (with medium-term average residual life). Finally, from 2026, prolonged nuclear generation in Belgium will benefit from a contract-for-difference type of remuneration versus the merchant type prevalent today. All the above enhances greatly the predictability and stability of cash flow generation."				
Fortum Oyj				Market-exposed generators / utilities
Profile:[90] Fortum is listed in Finland, and mainly undertakes generation operations in Finland and Sweden. **Generation / nuclear:** EBITDA: 84% generation, 8% consumer solutions, 8% city solutions. Generation (GWh): 53% nuclear, 43% hydro, remainder coal, waste, bio. **Wholesale exposure:** Electricity price risks are mainly hedged by entering electricity and gas derivatives contracts on exchanges such as Nasdaq Commodities, ICE, the European Energy Exchange and TGE (Towarowa Giełda Energii S.A. i.e., Polish commodity exchange) as well as directly with counterparties active in the energy markets. Hedges are mainly electricity derivatives quoted on Nasdaq Commodities. At the end of 2022, approximately 75% of the Generation segment's estimated Nordic power sales volume was hedged at EUR 58 per MWh for 2023 and approximately 45% at EUR 42 per MWh for 2024. The distribution of commodity derivatives maturities reported by the company suggests a relatively short-term hedging portfolio concentrated on <2 year maturities, with nearly no hedged volumes beyond 5 years. (p. 53)				
Ibedrola				Contracted generators / utilities
Profile:[91] Iberdrola is a Spanish multinational electric utility company based in Bilbao, Spain. Iberdrola has a workforce of around 40,000 employees serving around 30 million customers. Subsidiaries include Scottish Power and a significant part of Avangrid, amongst others. **Generation / nuclear:** Net profit by business is 63% electricity production and supply, 50% networks, -13% other businesses, corporate and adjustments. [92] Generation is 43% renewables, 17% hydro, 19% nuclear, 17% gas. [93] **Wholesale exposure:** According to Moody's 75% of group EBITDA is contributed by regulated and contracted activities. [94]				
RWE				Market-exposed generators / utilities
Profile: RWE is a major international pure-play generation business, with some supply and trading activities. **Generation / nuclear:** Current generation mix is 40% renewables, 60% gas and coal. Have phased out nuclear power as part of the German decommissioning in 2023. **Wholesale exposure:** Moody's notes over 70% of earnings from renewable generations are contracted, with an average contract life well over 10 years, but thermal generation may be largely uncontracted.[95] Fitch too notes that the share of "quasi-regulated" earnings is below 40%.[96]				

[90] https://www.fortum.com/files/fortum-investor-presentation-december-2023/download?attachment=

https://www.fortum.com/files/fortum-financials-2022/download

[91] https://www.iberdrola.com/sustainability/environment/management-nuclear-performance-indicators

[92] https://www.iberdrola.com/shareholders-investors/fact-sheet

[93] https://www.iberdrola.com/accionistas-inversores/informacion-operativa-financiera/analisis-comparativas

[94] https://www.moodys.com/research/Moodys-affirms-Iberdrolas-Baa1-ratings-stable-outlook-Rating-Action--PR_475168

[95] https://www.rwe.com/-/media/RWE/documents/05-investor-relations/anleihen-und-rating/2023-10-25-moodys-credit-opinion-rwe-ag-update.pdf

[96] https://www.rwe.com/-/media/RWE/documents/05-investor-relations/anleihen-und-rating/2023-06-15-rwe-rating-report-fitch.pdf

Comparator	Nuclear operation	Generation	Price/ demand risk exposure	Classification
BKW AG				Market-exposed generators / utilities
Profile: BKW is a power production and distribution utility based in Bern, Switzerland. It also provides gas and heat through subsidiaries or partner companies. **Generation / nuclear:** The company has an energy segment (generation), a grid segment, and a services segment (engineering and consulting). Energy provided 56% of revenue and 86% of earnings in 2022. Grid ca 10% of revenue and 14% of earnings (p. 53).[97] The generation mix is ca 25% nuclear, 25% thermal, 33% hydro, and 17% wind and solar.[98] **Wholesale exposure:** The most recent annual report (p. 101) suggests that most of the generation portfolio has not been historically under long-dated contracts.				
EnBW				Market-exposed generators / utilities
Profile: An integrated utility with a diversified business portfolio. **Generation / nuclear:** Generation accounts for >70% of EBITDA, system-critical infrastructure (electricity and gas grid in Germany and central Europe) ca 30%. An additional segment, smart infrastructure for customers (electricity and gas retail supply and other services), accounts for a sizeable portion of revenue but a negligible share of earnings. Nuclear used to account for >20% of generation, coal and gas ca 50%, and renewables close to 30%. The nuclear plants have been decommissioned in 2023 following German phase-out of nuclear. **Wholesale exposure:** Hedging of merchant earnings for up to 3 years in advance.				
Innergex				Contracted generators / utilities
Profile: [99]100% renewable energy project developer and operator with a focus on North American market Diversified portfolio including hydro, wind, solar and battery storage facilities. Presence in Chile and France provides geographical diversity. ***Note – this comparator has international operations, which may impact beta estimates measured with respect to a US stock exchange.*** **Generation / nuclear:** 100% renewable. **Wholesale exposure:** 13 years of average remaining contract duration (but note that a majority of contracts are less than 10 years).				

Source: CEPA analysis

97 https://www.bkw.com/fileadmin/user_upload/04_Ueber_uns/04_03_Investoren/Berichte___Praesentationen/2022/GB22/Geschaeftsbericht_Englisch.pdf

98 https://www.bkw.com/fileadmin/user_upload/04_Ueber_uns/04_03_Investoren/Berichte___Praesentationen/1_2023/HJB_2023/230905_Praesentation_HJ_2023_EN.pdf

99 https://cms-prod-innergex.cossette.digital/files/documents/2023/11/INE_INVESTOR_Q3-2023_EN.pdf

Appendix B COMPARATOR ESTIMATES

This appendix reports the beta estimation results for each comparator, including the associated gearing and bid-ask spread.

B.1. US REGULATED INTEGRATED UTILITIES

		Spot			1-year average			2-year average			5-year average			10-year average		
Company	Ticker	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread
Ameren	AEE US Equity	0.32	40%	0.0%	0.32	39%	0.0%	0.33	38%	0.0%	0.38	37%	0.0%	0.35	38%	0.0%
AEP	AEP US Equity	0.32	46%	0.0%	0.31	45%	0.0%	0.29	45%	0.0%	0.29	42%	0.0%	0.30	42%	0.0%
Avangrid	AGR US Equity	0.37	37%	0.0%	0.35	33%	0.0%	0.34	32%	0.0%	0.37	32%	0.0%	NA	NA	0.1%
CMS	CMS US Equity	0.29	43%	0.0%	0.28	42%	0.0%	0.28	42%	0.0%	0.30	43%	0.0%	0.29	45%	0.0%
Con Edison	ED US Equity	0.26	42%	0.0%	0.25	44%	0.0%	0.24	45%	0.0%	0.26	44%	0.0%	0.24	42%	0.0%
Dominion	D US Equity	0.29	46%	0.0%	0.28	43%	0.0%	0.29	41%	0.0%	0.35	40%	0.0%	0.34	40%	0.0%
Duke Energy	DUK US Equity	0.26	49%	0.0%	0.25	48%	0.0%	0.25	47%	0.0%	0.29	48%	0.0%	0.27	46%	0.0%
Edison	EIX US Equity	0.34	56%	0.0%	0.32	55%	0.0%	0.33	54%	0.0%	0.39	48%	0.0%	0.35	43%	0.0%
Entergy	ETR US Equity	0.28	55%	0.1%	0.27	54%	0.1%	0.29	54%	0.1%	0.33	52%	0.1%	0.31	51%	0.0%
Evergy	EVRG US Equity	0.31	47%	0.0%	0.31	45%	0.0%	0.32	44%	0.0%	NA	NA	0.4%	NA	NA	0.2%
Firstenergy	FE US Equity	0.29	50%	0.0%	0.29	50%	0.0%	0.29	51%	0.0%	0.34	51%	0.0%	0.30	55%	0.0%
PG&E	PCG US Equity	0.33	63%	0.0%	0.32	65%	0.0%	0.34	66%	0.0%	0.36	64%	0.0%	0.35	52%	0.0%
Pinnacle West	PNW US Equity	0.27	52%	0.0%	0.27	50%	0.1%	0.29	48%	0.1%	0.36	42%	0.1%	0.36	38%	0.1%
PNM	PNM US Equity	0.13	52%	0.0%	0.12	50%	0.0%	0.18	49%	0.0%	0.33	48%	1.1%	0.34	48%	0.5%
Sempra	SRE US Equity	0.39	36%	0.0%	0.38	36%	0.0%	0.40	36%	0.1%	0.42	39%	0.0%	0.42	38%	0.0%
Southern Co	SO US Equity	0.29	43%	0.0%	0.28	43%	0.0%	0.30	43%	0.0%	0.34	45%	0.0%	0.29	43%	0.0%
Xcel Energy	XEL US Equity	0.32	41%	0.0%	0.31	40%	0.0%	0.32	40%	0.0%	0.34	39%	0.0%	0.31	41%	0.0%
WEC	WEC US Equity	0.32	36%	0.0%	0.30	35%	0.0%	0.29	34%	0.0%	0.33	33%	0.0%	0.33	34%	0.0%
	Average	**0.30**	**46%**		**0.29**	**45%**		**0.30**	**45%**		**0.34**	**44%**		**0.32**	**43%**	

B.2. CONTRACTED GENERATORS / UTILITIES

		Spot			1-year average			2-year average			5-year average			10-year average		
Company	**Ticker**	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread
Atlantica	AY US Equity	0.35	61%	0.0%	0.37	57%	0.0%	0.39	56%	0.0%	0.33	62%	0.0%	NA	NA	0.1%
Clearway	CWEN US Equity	0.42	54%	0.0%	0.41	54%	0.0%	0.41	55%	0.0%	0.35	59%	0.0%	NA	NA	0.0%
Encavis Ag	ECV GR Equity	0.58	37%	0.0%	0.59	37%	0.0%	0.59	38%	0.0%	0.48	49%	0.0%	NA	NA	0.0%
Iberdrola	IBE SM Equity	0.42	41%	0.0%	0.43	40%	0.0%	0.46	40%	0.0%	0.46	41%	0.0%	0.48	42%	0.0%
Innergex	INE CN Equity	0.33	64%	0.0%	0.28	60%	0.0%	0.31	57%	0.0%	0.29	61%	0.0%	0.27	61%	0.0%
Nextera	NEE US Equity	0.53	30%	0.0%	0.54	28%	0.0%	0.56	27%	0.0%	0.49	27%	0.0%	0.41	33%	0.0%
Polaris	PIF CN Equity	0.69	29%	0.1%	0.66	25%	0.1%	0.67	25%	0.2%	0.64	33%	0.1%	0.45	48%	1.9%
AES	AES US Equity	0.49	59%	0.0%	0.50	56%	0.0%	0.51	56%	0.0%	0.44	60%	0.0%	0.40	64%	0.0%
	Average	**0.48**	**47%**		**0.47**	**45%**		**0.49**	**44%**		**0.44**	**49%**		**0.40**	**50%**	

B.3. MARKET-EXPOSED GENERATORS / UTILITIES

		Spot			1-year average			2-year average			5-year average			10-year average		
Company	Ticker	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread
BKW AG	BKW SW Equity	0.49	15%	0.3%	0.52	15%	0.2%	0.54	13%	0.2%	0.49	13%	0.2%	0.35	17%	0.2%
CEZ AS	CEZ CP Equity	0.29	16%	0.8%	0.30	18%	1.6%	0.31	20%	1.6%	0.34	24%	1.2%	0.31	27%	1.0%
Drax Group	DRX LN Equity	0.52	35%	1.2%	0.50	34%	1.7%	0.52	35%	1.6%	0.61	33%	1.2%	0.78	19%	0.9%
DTE Energy	DTE US Equity	0.30	46%	0.1%	0.29	45%	0.1%	0.32	45%	0.1%	0.37	43%	0.1%	0.35	41%	0.1%
EnBW	EBK GR Equity	0.24	19%	1.0%	0.21	19%	2.2%	0.21	21%	2.2%	0.25	27%	1.8%	0.17	28%	1.2%
Endesa	ELE SM Equity	0.49	31%	0.0%	0.50	30%	0.0%	0.52	27%	0.0%	0.55	23%	0.0%	0.58	19%	0.0%
Enel	ENEL IM Equity	0.53	54%	0.0%	0.56	51%	0.0%	0.59	47%	0.0%	0.55	46%	0.0%	0.57	50%	0.0%
Engie	ENGI FP Equity	0.54	42%	0.0%	0.53	43%	0.0%	0.57	44%	0.0%	0.59	43%	0.0%	0.62	42%	0.0%
Fortum Oyj	FORTUM FH Eq.	0.85	24%	0.0%	0.78	27%	0.0%	0.79	28%	0.0%	0.77	23%	0.0%	0.74	16%	0.0%
NRG Energy	NRG US Equity	0.44	51%	0.0%	0.46	49%	0.0%	0.48	47%	0.0%	0.52	45%	0.0%	0.45	57%	0.0%
PSEG	PEG US Equity	0.38	38%	0.0%	0.37	37%	0.0%	0.38	37%	0.0%	0.39	36%	0.0%	0.40	34%	0.0%
RWE	RWE GR Equity	0.51	16%	0.0%	0.54	12%	0.0%	0.64	5%	0.0%	0.86	-4%	0.0%	0.72	20%	0.0%
SSE	SSE LN Equity	0.54	31%	1.0%	0.52	32%	1.0%	0.54	34%	1.0%	0.56	38%	0.9%	0.55	34%	1.0%
TransAlta	TA CN Equity	0.39	41%	0.0%	0.31	40%	0.0%	0.35	42%	0.0%	0.40	51%	0.0%	0.42	56%	0.0%
Vistra Corp	VST US Equity	0.41	52%	0.0%	0.41	53%	0.0%	0.42	52%	0.0%	NA	NA	0.0%	NA	NA	0.0%
	Average	**0.46**	**34%**		**0.45**	**34%**		**0.48**	**33%**		**0.52**	**31%**		**0.50**	**33%**	

B.4. EU / UK REGULATED NETWORKS

		Spot			1-year average			2-year average			5-year average			10-year average		
Company	Ticker	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread	Asset beta	Gearing	Bid-ask spread
A2A	A2A IM Equity	0.55	49%	0.0%	0.55	48%	0.0%	0.55	46%	0.0%	0.55	43%	0.0%	0.52	48%	0.0%
Enegas SA	ENG SM Equity	0.27	45%	0.0%	0.26	45%	0.0%	0.28	45%	0.0%	0.35	45%	0.0%	0.38	44%	0.0%
Hera	HER IM Equity	0.52	49%	0.0%	0.53	46%	0.0%	0.53	43%	0.0%	0.50	41%	0.0%	0.42	44%	0.0%
National Grid	NG/ LN Equity	0.29	52%	0.7%	0.28	52%	0.6%	0.29	51%	0.6%	0.34	48%	0.5%	0.38	45%	0.4%
Pennon	PNN LN Equity	0.35	56%	1.7%	0.32	45%	1.7%	0.34	34%	1.6%	0.35	38%	1.6%	0.38	40%	1.4%
Red Electrica	REE SM Equity	0.28	39%	0.0%	0.25	39%	0.0%	0.24	41%	0.0%	0.29	39%	0.0%	0.33	40%	0.0%
REN	RENE PL Equity	0.13	54%	0.0%	0.13	55%	0.0%	0.14	57%	0.0%	0.19	60%	0.0%	0.21	62%	0.0%
Severn Trent	SVT LN Equity	0.31	50%	1.8%	0.29	49%	2.2%	0.28	50%	2.3%	0.30	52%	2.1%	0.34	51%	1.8%
Snam	SRG IM Equity	0.41	45%	0.0%	0.38	44%	0.0%	0.38	45%	0.0%	0.45	45%	0.0%	0.46	46%	0.0%
Terna	TRN IM Equity	0.39	38%	0.0%	0.38	39%	0.0%	0.37	40%	0.0%	0.43	41%	0.0%	0.44	45%	0.0%
United Utilities	UU/ LN Equity	0.31	53%	0.9%	0.28	52%	0.9%	0.28	53%	0.9%	0.29	56%	0.8%	0.32	54%	0.8%
	Average	**0.35**	**48%**		**0.33**	**47%**		**0.33**	**46%**		**0.37**	**46%**		**0.38**	**47%**	

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