

TRIANGULATING BETA EVIDENCE FOR ELECTRICITY TRANSMISSION IN RII0-3

A report prepared for National Grid Electricity
Transmission

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1 Introduction

On behalf of the Energy Networks Association (ENA), Frontier Economics has prepared a paper that analyses what we have called the low beta puzzle. This paper builds on our work for the ENA, to consider how Ofgem should approach setting beta for the Electricity Transmission sector for RIIO-3.

1.1 The low beta puzzle

As the UK continues its journey towards net zero, the energy networks are facing a wide range of new challenges. In the case of electricity transmission, these new challenges relate primarily to the need to rapidly expand the network to accommodate large increases in generation, in particular widely dispersed intermittent renewable generation, to meet increasing demand as more end uses of energy are electrified. This construction and delivery challenge must be faced at a time when supply chains are tight, and only likely to tighten in future, which is also leading to uncertainty over future cost.

While there may be an academic debate to be had around the extent to which these risks are diversifiable rather than systematic, it does not seem controversial to assert that the business risks facing the electricity transmission (ET) sector have increased and are likely to continue to increase in future. This is likely to remain even after considering the impact of the anticipated regulatory mechanisms (which consider aggregate risk and return for companies). Yet, despite this underlying context, utility betas have not increased since RIIO-2.

1.2 Conclusions from our work for the ENA

Our paper for the ENA highlighted how, in periods of high volatility, estimated betas for defensive stocks are biased downwards. There is then a danger that when these “low” betas are combined with a “stable but not fixed” TMR in line with prevailing GB practice, the overall estimate cost of equity that results will also be biased downward.

For this reason, we recommended that little/no weight should be put on estimation windows that are affected by high volatility, and instead placing most/all weight on estimations windows least affected by volatility. At this time, that means most/all weight should be placed on 10 year betas, and little/no weight on 2 and 5 year betas.

However, we also highlighted a concern with this recommendation in our ENA paper. 10 year betas are least likely to take appropriate account of growing business risk, i.e. if business risk is indeed growing over time, as seems likely given the consensus appraisal of the challenge of delivering net zero, this effect will not be captured in full by 10 year betas, but will be heavily diluted by the long estimation window. While considerations around volatility dictate that one cannot place reliance on 2 and 5 year betas at this time, this then raises the question as to whether 10 year betas, while largely clear of volatility problems, may require uplifting to better

reflect crystallising sector risk. We reached the conclusion that logic suggests that an uplift of some kind is necessary, and that further work was needed on this topic.

1.3 This report

The remainder of this report is comprised of the following sections:

- Section 2 sets out a range of relevant context for beta estimation at RIIO-3, including highlighting some ET specific elements of the low beta puzzle.
- Section 3 explores the risks that 10 year betas may fail to capture in full, drawing on extensive work on RIIO-3 risks undertaken by PWC, and also complementary research on how the beta of stocks change over time as they move between “growth” and “value” stages.
- Section 4 draws the evidence together, building on the baseline estimates of beta contained in Oxera’s Cost of Equity report (prepared for the ENA), and the key findings of Section 3, to provide an indicative adjusted range for the ET sector at RIIO-3 that may address our concern that 10 year betas may fail to adequately capture all risks.

In particular this paper draws on evidence from and triangulates across:

- Oxera’s estimation of an appropriate beta range as part of its analysis of the reasonable range for the cost of equity as commissioned by the Energy Networks Association (ENA);¹
- PWC’s risk and beta comparator assessment for National Grid Electricity Transmission (NGET), which considers the key risks for T3;² and
- Frontier’s analysis of the low beta puzzle for the ENA.³

The analysis set out in this paper supports NGET’s proposed COE range for RIIO-3, set out in a separate Frontier paper titled “Cost of Equity for NGET at RIIO-3”.

¹ Oxera (2024) RIIO-3 Cost of Equity – Prepared for ENA

² PWC (2024) Beta Comparator Assessment – Prepared for National Grid Electricity Transmission

³ Frontier Economics (2024) The Low Beta Puzzle – Prepared for the ENA

2 The context for estimating beta

The equity beta used in the CAPM formula represents the exposure of shareholders to an asset's systematic risk relative to the market in general, reflecting both the underlying systematic risk in the asset and the financial leverage of the company. This risk can be directly estimated for companies that are publicly listed by regressing the company's stock market returns against the returns of the wider market. Where companies are not listed, the equity beta can be estimated using comparator companies.

Whilst National Grid plc is publicly listed, it is comprised of a number of business units operating in different segments of the energy supply chain and in different geographies. The business footprint of NGET has also changed materially in recent years following a number of high profile transactions. Prevailing regulatory practice is to estimate the equity beta for electricity networks by taking a peer group and comparator approach, not by relying solely on the estimated beta for National Grid plc.

This approach involves first estimating the unlevered beta for a sample of companies which are considered comparable to National Grid, and then calculating an implied asset beta. In order to do so, observed gearing ratios and a debt beta is required.

An important point to note is that while in theory the beta captures the asset's systematic risk relative to the market in general, and the intention is for this estimate to inform on future risk (as cost of capital is forward looking), estimation is necessarily based on historic data. Therefore, if the risk that the company faces is changing (for example as a consequence of changes to its risk or business profile), an estimate based on historic data may not fully reflect future risk relative to the general market. It is also worth stressing that betas are a relative measure of risk, versus the overall market index used in their formulation. It therefore follows as a matter of principle that betas may fall or rise owing to changes in wider market risk, even if the risk of the underlying business of interest is stable. Given this, it is important to consider the cost of equity (CoE) in the round, and the overall coherence of any set of underlying parameter choices, rather than focussing entirely on individual CAPM parameter. We address this in our paper on the Cost of Equity for NGET at RIIO-3.⁴

In the case of National Grid, there are significant future risks that may not be reflected in beta estimates, estimated using historical data covering the past 10 years. The UK government's plan to reach Net Zero involves a significant increase in renewable generation that needs to be connected to the transmission network. Specifically, the government's British Energy Security Strategy (BESS) aims for 50GW of offshore wind capacity to be deployed by 2030 which is a significant increase from 13.9GW.⁵ The strategy also acknowledges that "*Accelerating our domestic supply of clean and affordable electricity also requires accelerating*

⁴ Frontier Economics (2024) Cost of Equity for NGET at RIIO-3

⁵ BEIS, April 2022, "British Energy Security Strategy". Available at: <https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#renewables>

the connecting network infrastructure to support it".⁶ The scale of investment required to achieve this objective will be significant relative to previous capital programs, bringing with it additional complexity and risk.⁷ Not only that, the exact projects that will need to be delivered are subject to change in the light of uncertainties over the delivery of certain Net Zero policies (e.g. as a result of the recent failed offshore wind auction). While it is true that some of this development may have been foreseen by the market over the last 10 years, and hence "priced in", past knowledge of these future developments would have been distinctly imperfect. In addition, capital markets have recently experienced highly volatile conditions. Overall, there is reason to believe that historical betas may not fully capture the risks faced by ET businesses going forward.

2.1 Ofgem's RIIO-2 approach

For RIIO-GD & T2, Ofgem took a beta estimation approach that was methodologically similar to the approach of Ofwat's at PR19 and the CMA's in its PR19 re-determination.

1. Ofgem estimated the unlevered beta by looking at 2, 5 and 10 year windows, with spot, 2, 5 and 10 year averaging periods.
2. Ofgem relied on a peer group comprised of Pennon Group, Severn Trent, United Utilities and National Grid, while it excluded SSE.⁸ Ofgem noted that from this pool of evidence, its final range was informed by putting greater weight on longer data samples and National Grid.
3. Ofgem obtained an unlevered beta range of 0.285 to 0.335 with a mid-point of 0.311. It maintained these estimates for RIIO-ED2. It indicated that in deriving this range, it placed most weight on the beta of National Grid, with some weight on water companies, and that it placed most weight on long term betas (i.e. with a 10 year estimation window).

As part of the RIIO-2 CMA appeal process, appellants argued inter alia that:

1. less/no weight should be placed on water companies;
2. most/all weight should be placed on National Grid;
3. at least some weight should be placed on SSE; and
4. at least some weight should be placed on European comparators.

The CMA rejected each of these arguments and found that Ofgem's approach was not wrong.

⁶ BEIS, April 2022, "British Energy Security Strategy". Available at: <https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#renewables>

⁷ This is happening during a time when other developed nations are also pursuing their own decarbonisation goals, which leads to higher supply chain risk.

⁸ We note that Ofwat and the CMA excluded National Grid from their peer groups at PR19, and instead relied solely on water company peers.

2.2 UKRN guidance on the methodology for setting the cost of capital for beta estimation

The UK Regulators Network (UKRN) issued guidance for regulators on the methodology setting the cost of capital, including for beta estimation. Ofgem is expected to have regard to the recommendations in the guidance “*where permitted by their statutory duties and to deviate only where they consider there are good reasons to depart from these recommendations.*”⁹

In relation to beta estimation, this guidance found that significant regulatory judgement is needed in selecting comparators where there are no obvious pure play comparators, and that a one-size-fits all approach is unlikely to be appropriate. Severn Trent, United Utilities, BT and National Grid were all discussed as GB regulated utilities, with Pennon considered appropriate for future use.

Recommendation 5: *Regulators should estimate equity beta for the notional company using comparable listed companies and standard regression techniques (i.e. ordinary least squares (OLS)). Where the listed comparator has different gearing to the notional company, regulators should continue to de-lever and re-lever the raw equity beta.*¹⁰

2.3 Ofgem’s SSMC for RIIO-3

Ofgem’s Sector Specific Methodology Consultation (SSMC) for RIIO-3 sets out Ofgem’s current views on beta estimation, along with other WACC parameters.¹¹

Ofgem intends to use a range of timeframes and frequencies, using its regulatory judgement to weight the data on the basis of evidence considered. Ofgem notes that there is no single correct answer, and the benefits of longer and shorter term estimations need to be weighed.

Ofgem has noted the potential disconnect between beta estimates based on historical evidence and future risks, noting:

*“However, we recognise that there may be evidence to indicate that energy networks face higher or lower levels of systematic risk on a forward-looking basis in the round after accounting for relevant price control mechanisms, which may not be accurately reflected in beta samples which are backwards looking”*¹²

To address this potential concern, Ofgem has also stated that it intends to consider applying different weights to RIIO-3 peer group firms and potentially introducing a broader set of peer

⁹ UKRN (2023) UKRN guidance for regulators on the methodology for setting the cost of capital, p 8. Accessible here : https://ukrn.org.uk/app/uploads/2023/03/CoC-guidance_22.03.23.pdf

¹⁰ UKRN (2023) UKRN guidance for regulators on the methodology for setting the cost of capital, p 25

¹¹ Ofgem (2023) RIIO-3 Sector Specific Methodology Consultation – Finance Annex

¹² Ofgem (2023) RIIO-3 Sector Specific Methodology Consultation – Finance Annex, para 3.75.

group firms where there is sufficient evidence that this enables a more accurate estimation of the beta appropriate for energy networks.¹³

Lastly, Ofgem has introduced the notion of investability and considers that the beta estimation may be an appropriate lever to use to appropriately reflect the forward view on risk. Ofgem considers that differences in beta may be appropriate to reflect differences in ET and in gas.¹⁴

¹³ Ofgem refers to these as comparator firms. We distinguish between peer group firms which make up the estimation sample and comparator firms used to cross check the findings.

¹⁴ Ofgem (2023) RIIO-3 Sector Specific Methodology Consultation – Finance Annex, para 3.6, for example

3 Additional RIIO-3 risks and how to capture them

Prevailing practice among GB regulatory offices is to estimate betas using the usual four listed GB utility stocks, blended in some combination. Any peer selection process run from first principles would be likely to identify Pennon Group, Severn Trent, United Utilities and National Grid as relevant peers, albeit there may be questions around how to weight these appropriately.¹⁵ Ofgem has also historically considered this to be appropriate given the similarities in risks and regulation across the water and electricity sectors. Oxera's beta analysis for the ENA is consistent with Ofgem's RIIO-2 approach in placing weight on GB water companies as well as National Grid.

However, there is a clear concern that reliance on this group will, in the context of RIIO-3, miss something, i.e. the expected rapid growth in the size of NGET and the resulting construction and delivery risk exposure.

In this section we review this question further.

- We explore the findings set out by PWC in their detailed assessment of the risks facing NGET at RIIO-3, and provide our view.
- We complement PWC's analysis with our own review of how the difference in beta between growth and value stocks, and how beta changes over time as stocks switch between growth and value phases.

3.1 PWC's assessment of NGET RIIO-3 risk

National Grid has commissioned PWC to undertake a detailed and independent review of its business risks over the RIIO-3 period to consider the appropriate comparator group for beta estimation.¹⁶ PWC's work is extensive and detailed, and we do not attempt to summarise all their findings here, as we understand that it will be separately submitted to Ofgem by National Grid, alongside their SSMC response.

However, one of PWC's key findings is that, while the usual four listed GB companies may provide an appropriate foundation for beta estimation, this peer group will not sufficiently well capture construction risk. PWC's key conclusion were:

- There are eight NGET T3 specific risks including costs related to the delivery due to "*significant increase in scale and complexity of investment portfolio*" and increased costs of delivery resulting from "*a larger capital programme*".¹⁷ PWC assessed different sectors against the eight risks to identify comparator sectors and companies.¹⁸

¹⁵ Similarly to Ofgem, we exclude SSE and BT as they are not appropriate pure play matches.

¹⁶ This was out of scope for Oxera's beta estimation.

¹⁷ PWC (2024) Beta Comparator Assessment – Prepared for National Grid Electricity Transmission

¹⁸ PWC then assessed against regulatory framework, ownership liquidity and share of regulated activity

- The peer group of companies fully passing the thresholds PWC set for comparison are National Grid, Pennon, Severn Trent and United Utilities.
 - PWC considers it appropriate to reflect further on SSE once business plans for T3 are submitted.
- Given PWC's view that this peer group will not fully reflect construction risk, it is appropriate to supplement this peer group by placing partial weight on GB construction companies¹⁹ when estimating betas at T3:

*"T3 will see NGET undertaking significantly larger programme of construction which will increase risks such as the ability to secure necessary labour and materials via the supply chain. Construction and Engineering (C&E) firms will be facing very similar risks, so there is clear merit, and an economic rationale, in considering their inclusion in the comparator set for beta estimation"*²⁰

While we have not undertaken an in depth study of RIIO-3 ET risks, we find PWC's analysis persuasive. PWC's has reached the same conclusion as we did, i.e. that there is a danger 10 year betas miss something, albeit that our conclusion was based solely on high level considerations, not root and branch review. We also find their proposed approach to addressing this pragmatic.

We also note there is regulatory precedent to support placing some weight on construction firms, i.e. in respect of Interest During Construction for interconnectors, where Ofgem gave 50% weighting to Construction & Engineering (C&E) comparators for interconnectors. Along a same vein, PWC proposed a number of C&E comparators, and considered that a 10-15% weight on C&E comparators could be appropriate for NGET in RIIO-3.²¹

We have estimated the betas from the construction comparators proposed by PWC, with the expectation that we would find higher betas given the nature of construction risks and their closer correlation to market cycles. We found while there is variation across construction companies, the betas are indeed higher than for GB utilities. This is shown in Table 1 below.

¹⁹ PWC also considers Openreach appropriate as a comparison for offshore projects which will involve a significant proportion of new technology. We have focused on growth risks.

²⁰ PWC (2024) Beta Comparator Assessment, prepared for National Grid Electricity Transmission, Appendix 3

²¹ PWC (2024) Beta Comparator Assessment, prepared for National Grid Electricity Transmission, Appendix 3.

Table 1 Construction company asset betas

Estimation window	Averaging period	Balfour Beatty	Morgan Sindall Group	Renew Holdings	Average
2	Spot	0.87	1.11	0.62	0.87
2	2 years	0.88	1.13	0.66	0.89
2	5 years	0.87	1.02	0.59	0.83
2	10 years	0.91	0.68	0.49	0.69
5	Spot	0.84	1.10	0.69	0.88
5	2 years	0.83	1.07	0.67	0.86
5	5 years	0.88	0.86	0.59	0.78
5	10 years	0.91	0.60	0.47	0.66
10	Spot	0.88	0.85	0.59	0.77
10	2 years	0.87	0.78	0.57	0.74
10	5 years	0.90	0.64	0.49	0.68
10	10 years	0.89	1.11	0.62	0.87
Overall Average		0.88	0.87	0.57	0.77
5 years plus average		0.88	0.81	0.56	0.75

Source: Frontier Economics, PWC, Bloomberg.

Note: Asset betas are computed using a debt beta of 0.075, consistent with Ofgem's assumption in RIIO-2

It is clear that solely relying on construction betas set out above would not be an appropriate direct comparator to be included in the NGET peer group. However, they have value in providing an indicative value of the construction risk that NGET will be taking on in the RIIO-3 period.

3.2 Evidence from growth stocks

Given the context for RIIO-3, one potentially relevant consideration is how betas evolve as the underlying company moves from being a growth stock to a value stock. Given the material growth in RAV that NGET will experience over the period ahead, it might be argued that NGET will, for a period of time, demonstrate characteristics which are more consistent with a growth stock.

3.2.1 Growth index versus value index

To illustrate the differences in the betas of growth and value stocks, we have reviewed growth and value indices from the S&P to understand the relationship. We find that the S&P Growth Index has persistently higher betas than the S&P Value Index, as expected, showing the relationship between higher growth and higher betas. This is shown in the table below.

Table 2 Growth and Value indices betas

Estimation window	Averaging period	S&P Growth Index	S&P Value Index
2	Spot	1.20	0.80
5	Spot	1.08	0.91
10	Spot	1.07	0.92

Source: Frontier Economics, Bloomberg

Note: Daily data, last decade. The table shows equity beta as it does not make sense to de-lever and re-lever the growth and value indices

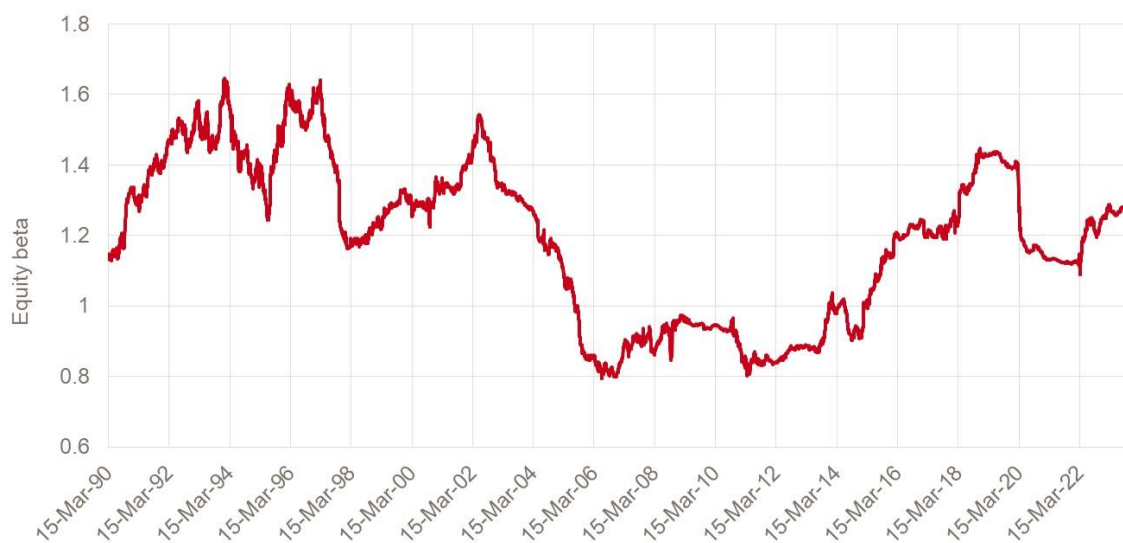
This evidence shows that betas are higher for growth companies. This relationship supports the hypothesis that NGET's beta might be expected to increase over the period ahead, as its business size grows rapidly as net zero investments accrue into its RAV.

3.2.2 Technology company betas and growth cycles

Above we have explored the static relationship between betas of growth stocks and value stocks at a point in time. While this illustrates the general effect of rapid growth on business risk, the question arises as to whether the same pattern emerges not only between stocks, but within the same stock.

To explore this, we examined betas from technology companies to understand the evolution of beta during different growth cycles, looking at companies with long histories that have gone through cycles of significant and rapid growth, but also other periods of more 'steady state' low growth. We chose large companies with significant market shares and market leading behaviour, to parallel a large regulated utility like NGET. One company that fits this profile is a household name, Microsoft.

The figure below shows the historic betas (estimated with a 2-year window) of Microsoft over the past three decades.

Figure 1 Microsoft's beta over time (2 year estimation window)

Source: Bloomberg, Frontier Analysis

Note: The figure shows equity beta.

A brief look into Microsoft's growth story shows that peaks in its equity beta are often accompanied by key product launches which have fuelled its growth. While not every product launch is associated with a peak in the equity beta, there is a clear pattern.

During the early years of operation throughout the 1990s, Microsoft experienced extremely rapid growth, as it benefited from the uptake of PC technology, having been first to spot the trend towards a PC in every home and office. During this period of rapid growth, beta was relatively high. In the period 2002 to 2016 revenue growth was lower, as Microsoft failed to establish market leading position in key emerging technologies (such as touchscreen mobile, music players, and social media platforms). The majority of revenues are derived from corporate clients where growth prospects were limited; during this period, beta was relatively low for a sustained period of time.

Microsoft again entered a growth phase in the period from 2012 onwards, establishing strong offerings in cloud computing and emerging AI technology. In this period, we observe that Microsoft's beta rises in conjunction with this new growth phase.

This descriptive analysis of the effect of growth phases on beta is consistent with the static analysis of the effect of growth/value stocks on measured beta set out above. While the absolute level of Microsoft's beta is clearly not a relevant point of direct comparison for NGET, this analysis suggests that as the future growth in NGET emerges, we may expect beta to increase.

This again supports the hypothesis that there is a need to uplift prevailing estimates of beta to account for forward looking risk.

4 Triangulating across the evidence base to derive a beta appropriate for NG in RIIO-3

In this section we pull together the various strands of evidence on prevailing estimates of beta, and propose ways in which a beta could be estimated for the ET sector in RIIO-3.

As already noted, we have concerns over the extent to which betas using short estimation windows can be relied upon, given that they may be downwards biased as a consequence of recent high volatility generally in the market. It is not safe, in our view, to presume that these low betas signal a fall in the absolute level of risk faced by NGET and the ET sector, in particular in the face of the compelling evidence that risks will increase over the RIIO-3 period and beyond. We note that this view of increasing risk is directly supported by the thorough research prepared for NG by PWC.

For this reason, we agree with Oxera, that that a baseline level of beta should be estimated using long estimations to minimise any distortion from volatility, placing most weight on NG and some weight on water companies, consistent with the approach adopted by Ofgem at the RIIO-2 price control. On this basis, Oxera concluded that an **asset beta range of 0.323 to 0.373 (with a midpoint of 0.349) was appropriate.**²²

However, for the reasons set out in this report, there is a risk that reliance on long run betas may fail to capture the construction and delivery risk faced that will be faced by NG over the RIIO-3 period. This risk has been separately identified by PWC in the course of their work, and to address this concern PWC recommended that some small weight could be placed on construction firms. As noted above, there is regulatory precedent for this arising from the determination of allowed interest during construction for new interconnector assets.

PWC identified a starting range of 16% through using evidence on interconnectors, noting that “*identifying the appropriate weight is an exercise in judgement*”.²³ PWC note that

*“A starting point would be to look at the weighting that Ofgem gave the C&E sector in its beta analysis for interconnectors (50%).”*²⁴

PWC estimated that offshore transmission projects are “about 32% of NGET’s portfolio”. Using this 50% weighting on this activity gives 16% as a starting point for the weighting of C&E applicable to NGET.²⁵

²² Oxera (2024) RIIO-3 Cost of Equity – Prepared for the ENA, Section 2.3.3

²³ PWC (2024) Beta Comparator Assessment, prepared for National Grid Electricity Transmission, p. 7

²⁴ PWC (2024) Beta Comparator Assessment, prepared for National Grid Electricity Transmission, p. 7

²⁵ We also note that PWC had conducted a bottom-up risk assessment and concluded that the higher risks in T3 could warrant a 250bps uplift on the low end of the CAPM range. This implies a CoE of about 7.5% when taken relative to the low end of Oxera’s range. In any case, we consider that the two approaches for accounting for risks on the horizon point in the same direction with respect to setting the COE for RIIO-3.

Noting the remaining uncertainty and need for judgement in identifying the appropriate weight, as an illustration of the effect of including construction companies within the peer group with a small weight, we have derived an asset beta range based on a 10%-15%²⁶ weighting on construction betas, as PWC have noted that the 16% weight that they estimate is likely to be an upper bound. For simplicity, we consider the mid-point of this range of 12.5%.

Table 3 Proposed beta range for NGET and estimation steps

Step 1: Consider betas from construction comparators		
Average (asset) beta from construction comparators identified by PWC	0.77 ²⁷	

Step 2: Including construction comparators to develop a suitable beta range for National Grid in RIIO-3		
Oxera midpoint asset beta as a starting point	0.349	
Weight on construction (asset) betas	0%	12.5%
NGET proposed asset beta	$0\% \times 0.77 + 100\% \times 0.349$ = 0.349	$12.5\% \times 0.77 + 87.5\% \times 0.349 =$ 0.402

Source: Frontier, Oxera, PWC, Bloomberg

Note: The asset betas shown in the table above include a debt beta assumption of 0.075

The table above sets out how we arrive at an adapted beta range for NGET and the ET sector for RIIO-3, based on the following considerations:

- As a starting point, we consider the midpoint of Oxera's asset beta range. Given the heightened risks in RIIO-3, we agree with Oxera that this midpoint is likely to understate ET business risk at RIIO-3.
- As a second step, we include consideration of the construction comparators proposed by PWC, considering the mid-point of the weighting that PWC proposes for simplicity.
- This gives an asset beta range of **0.35 – 0.40**

We consider that starting from the mid-point of Oxera's range, and the inclusion of construction comparators more accurately reflects NG's risks and challenges going into RIIO-3, and represents a financeable and investable proposition.²⁸

²⁶ PWC (2024) Beta Comparator Assessment, prepared for National Grid Electricity Transmission, p. 7

²⁷ See Table 1

²⁸ Please see Frontier (2024) Equity Investability in RIIO-3, Prepared for the ENA.

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