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BEYOND THE REARVIEW MIRROR: ESTIMATING THE COST OF EQUITY FOR REGULATED NETWORKS FACING EXCEPTIONAL INVESTMENT PROGRAMMES

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19 November 2026

KEY TAKEAWAYS



Exceptional investment programmes are reshaping the risk profiles of regulated electricity networks, raising questions about whether conventional cost of equity estimates based on historical market evidence adequately reflect forward-looking investment conditions.



Historical market data and listed comparator companies may understate investors' required returns where prospective investment intensity and associated risks differ materially from those reflected in past observations or peer-group evidence.



Large and sustained investment programmes can increase business risk through higher operating leverage, greater execution risk, and longer-term capital commitments that expose investors to future regulatory uncertainty.



Exceptionally large equity financing requirements can increase the cost of attracting capital, as infrastructure companies compete for investors with differing return requirements and existing shareholders face additional funding commitments or potential dilution.

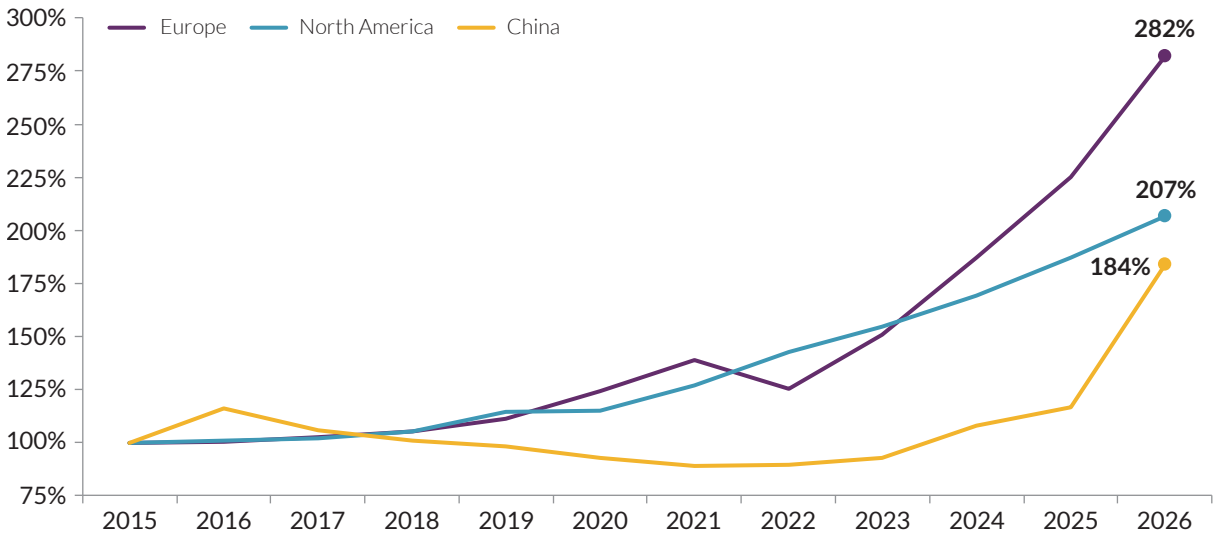


The impact of exceptional investment programmes on investors' required returns can be quantified using established economic methods: Financial theory, company fundamentals, and observable capital market evidence provide complementary approaches to quantifying these risks, enabling regulators to supplement conventional cost of equity estimates with transparent, forward-looking risk assessments.

EXCEPTIONAL INVESTMENT PROGRAMMES CAN REDUCE THE REPRESENTATIVENESS OF HISTORICAL ESTIMATES

The energy transition is driving an **unprecedented expansion of electricity networks worldwide**. Across global markets, transmission and distribution system operators are expected to invest at levels substantially above historical averages to accommodate growing renewable generation; increasing electrification of transport, heating, and industry; rising demand from data centres and artificial intelligence; and the replacement and reinforcement of ageing infrastructure. This trend is already reflected in the substantial increase in investment volumes: **Since 2015, electricity grid investment has almost tripled in Europe, more than doubled in North America, and nearly doubled in China** (see Figure 1).

Figure 1. **Electricity Grid Investment Has Surged Over the Past Decade**



Note: Electricity grid investment across the three regions is indexed to 100% in 2015. Values for 2026 are IEA estimates. Underlying investment figures are expressed in constant 2025 US dollars, converted using market exchange rates (MER).

Source: NERA illustration based on IEA (2026), World Energy Investment 2026 Datafile.

These developments mark a **structural change in the investment landscape for regulated infrastructure**. Rather than representing a temporary increase in capital expenditure, many infrastructure businesses are expected to operate under sustained periods of exceptionally high investment intensity. This raises a broader methodological question: To what extent do conventional approaches to estimating the cost of equity remain informative when the underlying investment environment changes fundamentally?

This question is particularly relevant where cost of equity estimates rely on historical market evidence. Such evidence is most informative where future investment conditions broadly resemble those reflected in the underlying data. Where prospective investment conditions differ materially from historical conditions, it becomes increasingly important to assess whether the available evidence remains representative of investors' forward-looking expectations. Representativeness can be considered along two dimensions: time-series representativeness and cross-sectional representativeness.

- **Time-series representativeness**: Historical market evidence necessarily reflects the risks and investment conditions present during the observation period. Where a business is entering an exceptional investment programme, the associated risks may not be fully reflected in past observations. This problem becomes more pronounced over longer estimation windows, as recent observations are increasingly diluted by periods that predate the exceptional investment programme. As a result, **historical market evidence may understate the risks investors expect the business to face going forward**.
- **Cross-sectional representativeness**: Cost of equity estimation often relies on evidence from listed comparator companies. Where these companies differ materially in investment intensity, their observed market data may reflect a different risk profile from that of the regulated business being assessed. This becomes particularly relevant where a company undertakes an exceptional investment programme that is not mirrored by the peer group. In such cases, **peer-group evidence may not fully capture the risks associated with the company's prospective investment regime**.

Conventional approaches remain an important starting point for cost of equity estimation under exceptional investment programmes. However, where prospective investment conditions differ materially from those reflected in historical market evidence, **a robust assessment may require supplementary evidence**. The following sections examine the channels through which investment intensity may affect investors' required returns and how these effects can be quantified.

EXCEPTIONAL INVESTMENT PROGRAMMES CAN INCREASE RISK AND REQUIRED RETURNS THROUGH DIFFERENT CHANNELS

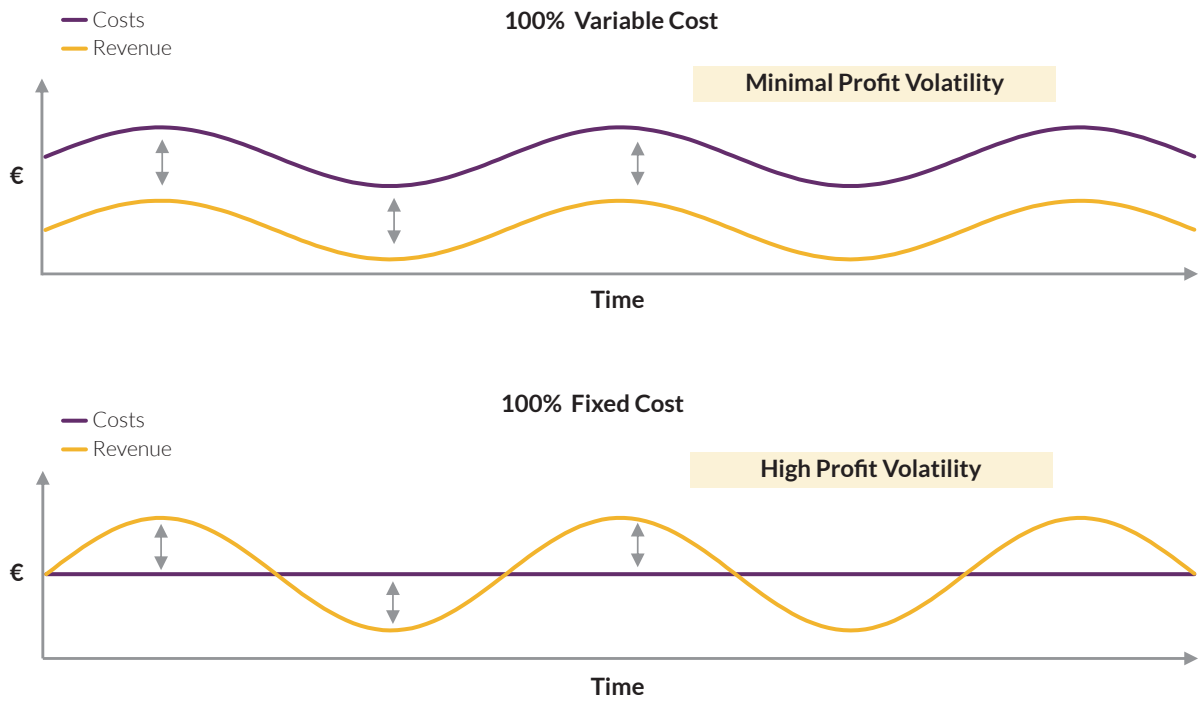
Exceptional investment programmes may increase investors' required returns through two broad channels. First, elevated investment intensity can increase the risks borne by equity investors through greater execution risk, operating leverage, and longer-term capital commitments. Second, exceptionally large financing requirements can create market frictions that increase the return required to attract additional capital.

Higher Business Risk

Large and sustained investment programmes affect the operating profile of regulated infrastructure businesses. Rather than managing mature asset bases with relatively stable investment requirements, firms become responsible for planning, constructing, and integrating substantial volumes of new infrastructure over extended periods. This can expose investors to a broader range of risks than would typically arise under steady-state investment conditions.

One such risk channel is **increased operating leverage**. As investment programmes expand, a growing share of total costs becomes fixed. Unlike variable costs, fixed costs cannot readily be reduced in response to adverse developments. As a result, changes in revenues translate more directly into changes in profits, increasing firms' exposure to shocks, as illustrated in Figure 2. This mechanism is well established in the financial literature: Zhang (2005) shows that large capital investments that are difficult to reverse reduce firms' ability to adjust costs when economic conditions change, increasing their exposure to adverse shocks and, consequently, investors' required returns.[1]

Figure 2. **Higher Fixed Costs Increase Profit Volatility**



Note: NERA illustration.

Exceptional investment programmes also increase **execution risk**. Delivering major infrastructure programmes requires the successful management of complex engineering projects, large supply chains, permitting processes, and skilled labour constraints. Delays or cost overruns may affect cash flows, financing requirements, and the overall risk profile perceived by investors. The extent of this risk channel depends on the specific design of the regulatory framework.

A further consideration is the continued need to retain and reinvest internally generated cash flows to finance exceptional investment programmes. Due to the scale of investment required, infrastructure businesses may need to reinvest a substantial share of internally generated funds over extended periods rather than distribute these funds to investors. As a result, **cash distributions to equity investors are shifted further into the future, increasing the effective duration of the capital commitment**. Empirical evidence suggests that longer-duration equity cash flows are, on average, associated with higher required returns, although the relationship may vary with economic conditions.[2]

For regulated infrastructure, the positive relationship between investment duration and required returns is arguably particularly pronounced because of the additional exposure to regulatory risk. As capital remains committed for longer periods, investors become increasingly exposed to future regulatory decisions, which are difficult to anticipate over long time horizons. Moreover, longer-term capital commitments exacerbate the **regulatory time-inconsistency problem**: Regulatory terms required to attract investment *ex ante* may come under pressure once capital has been committed and the investment is irreversible. Future regulators may then reassess the efficiency, necessity, or remuneration of investments, including through efficiency benchmarking.

The experience of Australian electricity networks illustrates how large, irreversible investment programmes can expose investors to regulatory risk when economic conditions deteriorate. Following electricity blackouts in 2004, policymakers prioritised network reliability and encouraged substantial investment in network reinforcement and expansion. However, following the Global Financial Crisis of 2008, electricity demand fell short of forecasts, leaving excess capacity and contributing to rising tariffs. As political priorities shifted towards affordability, investments previously considered necessary came under scrutiny, with consumer groups and regulatory bodies calling for asset write-downs.[3] Although these write-downs were not implemented, the regulator subsequently reduced the allowed cost of capital substantially.[4] This illustrates the **cyclical nature of regulatory risk: While the costs of past investments remain fixed, economic downturns increase pressure to contain tariffs and reduce the remuneration allowed on those investments**.

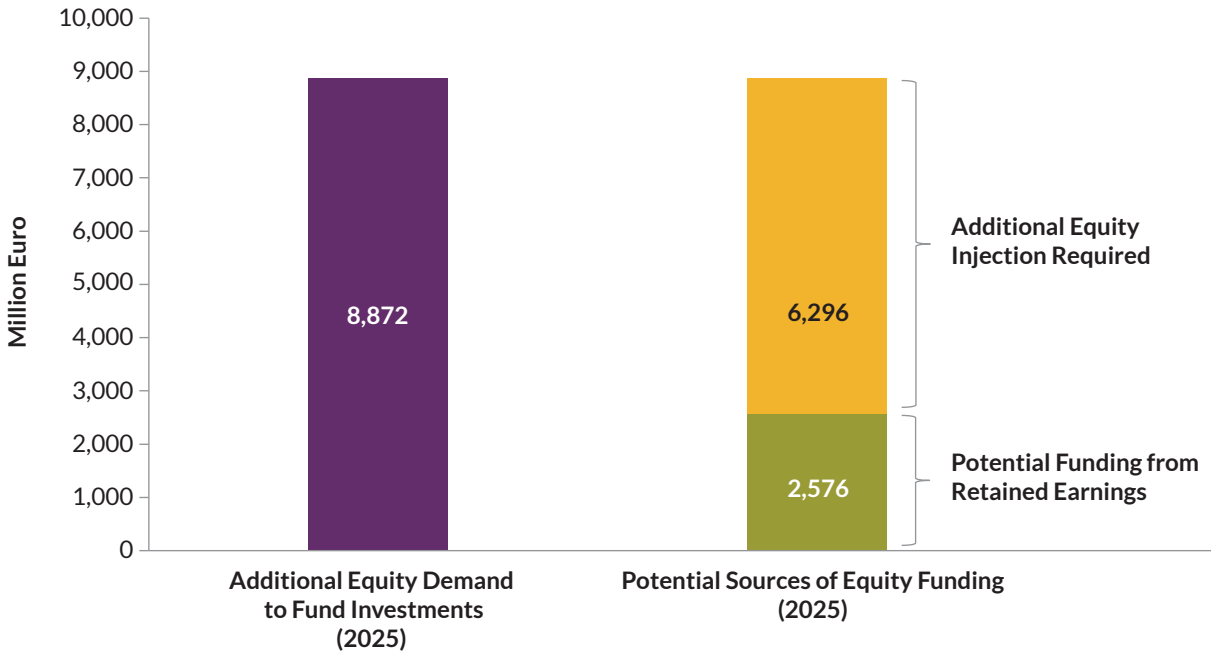
Taken together, **higher operating leverage, increased execution risk, and longer-term capital commitments with associated regulatory risks** can increase the business risk borne by equity investors and, consequently, their required returns.

Capital Market Frictions

Exceptional investment programmes may also increase required returns through mechanisms that arise in capital markets themselves. Where large volumes of new equity need to be mobilised, **investors may require higher returns to commit additional capital**, particularly where other capital-intensive sectors are competing for the same investor base.

The scale of the funding requirement associated with grid investment can be illustrated by the German transmission system operators. As shown in Figure 3, **the equity required to fund 2025 investment exceeds the four TSOs' combined earnings by more than a factor of three**, creating substantial demand for additional equity injections.

Figure 3. **German TSOs' Earnings Cover Only a Fraction of the Additional Equity Needed to Fund Investment**



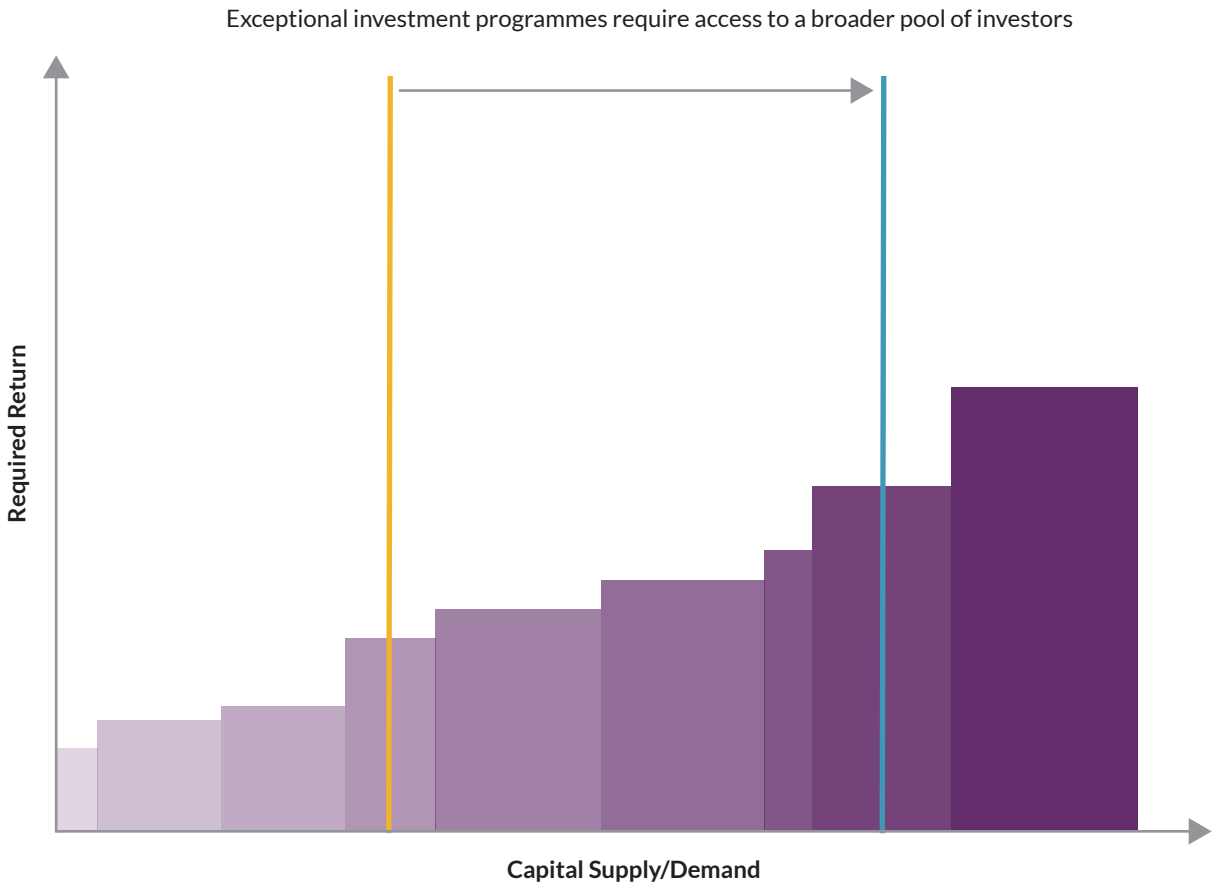
Note: 2025 equity demand is calculated by applying a notional regulatory equity share of 40% to the German TSOs' 2025 investment volume reported in the *Monitoringbericht 2025*. Potential funding from retained earnings represents the sum of 2025 earnings before profit transfer of TenneT TSO, Amprion, 50Hertz Transmission, and TransnetBW, assuming full retention of these earnings.

Source: NERA analysis based on Bundesnetzagentur and Bundeskartellamt, *Monitoringbericht 2025*, p. 100–101 and 218 and the German TSOs' 2025 annual financial statements.

The need to mobilise equity at this scale can affect required returns through two distinct capital-market channels.

First, the scale of the financing requirements may become sufficiently large to affect the price at which additional capital can be raised. **The supply of capital is not perfectly elastic**, resulting in an upward-sloping capital supply curve, as investors differ in their required rates of return, investment preferences, and portfolio constraints (see Figure 4). As financing needs increase, firms may therefore need to attract additional investors with higher return requirements. This effect may be particularly relevant as investment requirements increase simultaneously across infrastructure sectors and jurisdictions. For example, substantial investment in energy infrastructure coincides with the rapid expansion of data centre infrastructure, adding to demand for long-term capital. As a result, **exceptionally large financing programmes may increase the cost of raising incremental equity**.

Figure 4. **Accessing a Broader Investor Base Requires Higher Expected Returns**



Note: NERA illustration.

The scale of the capital-market challenge is best assessed against observed capital mobilisation. Global private infrastructure funds raised approximately US$200–211 billion in 2025, a record level.[5] By comparison, global electricity network investment of approximately US$448 billion in 2025[6] implies an equity financing requirement of around US$179 billion under an illustrative equity share of 40%.

The two measures are not directly equivalent: Infrastructure fundraising captures only private infrastructure funds, while network investment is financed through a broader mix of retained earnings, public capital, and listed and private equity. Nevertheless, their similar order of magnitude is informative. **Electricity networks alone require an illustrative equity financing volume equivalent to approximately 85–90% of global private infrastructure fund fundraising in 2025**, even before accounting for substantial investment needs in electricity generation, digital infrastructure, telecommunications, transport, water, and waste management. Meeting financing requirements of this magnitude may necessitate substantial additional capital allocations and the mobilisation of new investors, potentially at higher required returns.

Second, exceptional investment programmes may also affect existing shareholders. To maintain their ownership stakes, existing investors may be required to inject further equity over many years. This may result in **increasingly concentrated portfolio exposures**, for which investors may require additional compensation. Alternatively, if additional capital is raised from new investors, existing shareholders may experience dilution of their ownership interests.

Unlike the business risks discussed previously, these effects arise because exceptionally large investment programmes change the interaction between infrastructure companies and capital markets. Their significance will naturally depend on the scale of investment relative to the available investor base. However, where financing requirements become sufficiently large, **capital market frictions may represent an additional channel through which investors' required returns increase**.

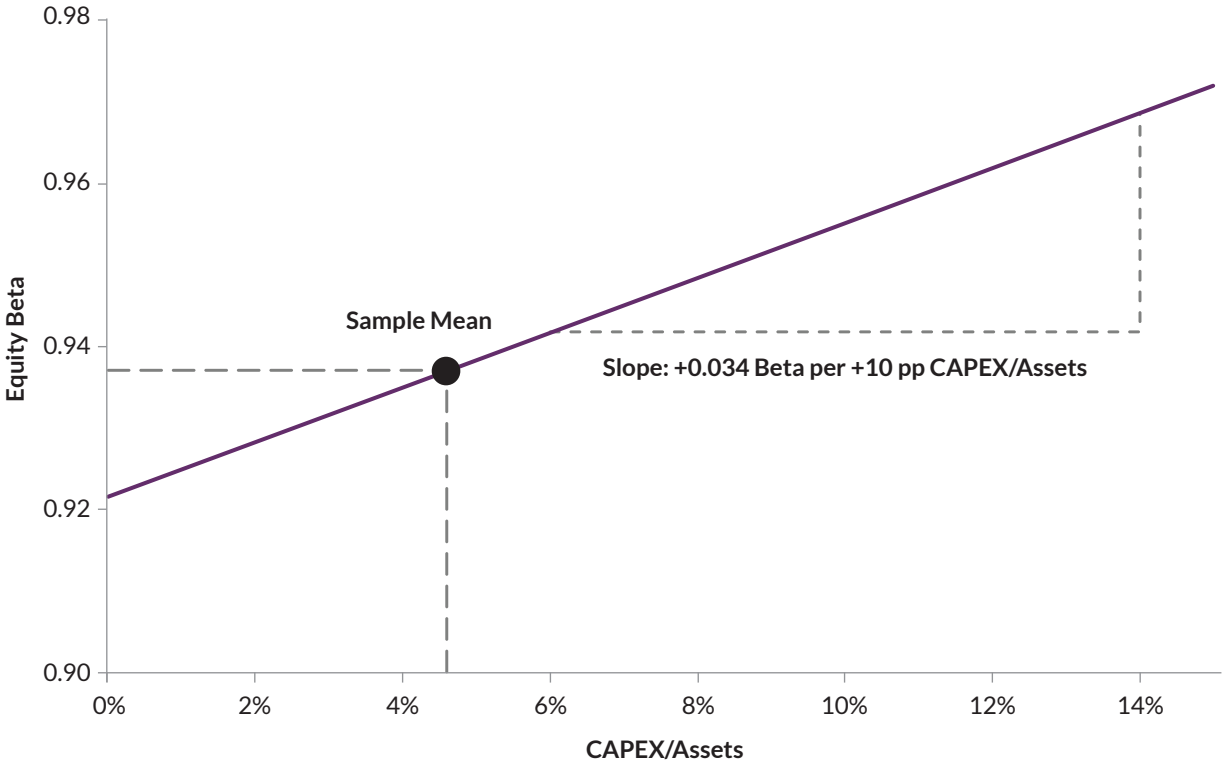
THE IMPACT ON REQUIRED RETURNS CAN BE QUANTIFIED USING FINANCIAL THEORY AND MARKET EVIDENCE

The preceding sections have shown how exceptional investment programmes may increase investors' required returns. The key question for regulators is how these effects can be quantified. **Rather than relying on qualitative adjustments alone, established financial models and observable market evidence provide complementary approaches** for assessing the additional risks associated with exceptional investment programmes.

Quantification Based on Company Fundamentals

Statistical methods such as regression analysis can be used to **quantify the relationship between risk measures and company fundamentals, including investment intensity**. Analysing the relationship between company characteristics and risk measures is well established in the financial literature, with early contributions including Beaver, Kettler, and Scholes (1970)[7] and Rosenberg and McKibben (1973).[8] More recent applications extend this approach to investment intensity. Francisco (2026), for example, finds a **positive and statistically significant relationship between CAPEX intensity and equity beta**. The estimated coefficient of 0.337 implies that a 10 percentage-point increase in CAPEX/Assets is associated with an increase in equity beta of approximately 0.034, holding other factors constant, as illustrated in Figure 5.[9]

Figure 5. **Empirical Evidence Indicates Higher CAPEX Intensity Is Associated with Higher Systematic Risk**



Note: The figure illustrates the linear relationship implied by Francisco's (2026) baseline coefficient for CAPEX/Assets (0.337) on the unconditional two-year equity beta, anchored at the sample means (CAPEX/Assets 4.6%, beta 0.937).

Source: NERA illustration based on Francisco.[10]

While academic applications typically rely on broad company samples to identify the relationship between firm characteristics and risk, the same empirical approach can be applied to samples of regulated infrastructure companies. Importantly, **this approach is not limited to assessing equity betas as in Figure 5**. Examining how other risk and return measures—such as dividend yields, earnings yields, or forward-looking cost of equity estimates derived from dividend discount models (DDMs)—relate to a company's investment intensity can provide further evidence on how exceptional investment programmes affect investors' required returns. The advantage of this framework is that it can provide a **transparent empirical link between observable company characteristics and risk**.

Alternatively, financial theory provides established models for directly linking operating leverage to systematic risk. These models describe how a higher proportion of fixed costs increases the sensitivity of operating profits to changes in revenues and, consequently, may increase a firm's asset beta. By estimating operating leverage for the regulated infrastructure company and its listed comparators, these relationships can be used to **adjust observed peer-group betas for differences in operating leverage**. This provides a complementary, theory-based approach to quantifying the impact of exceptional investment programmes on the cost of equity.

Quantification Based on Capital Market Evidence

A complementary perspective can be obtained from observable capital market evidence. While many regulated infrastructure businesses are not publicly listed, they nevertheless access capital markets through debt financing. Credit rating agencies therefore provide detailed assessments of how exceptionally large investment programmes affect firms' credit quality and business risk.

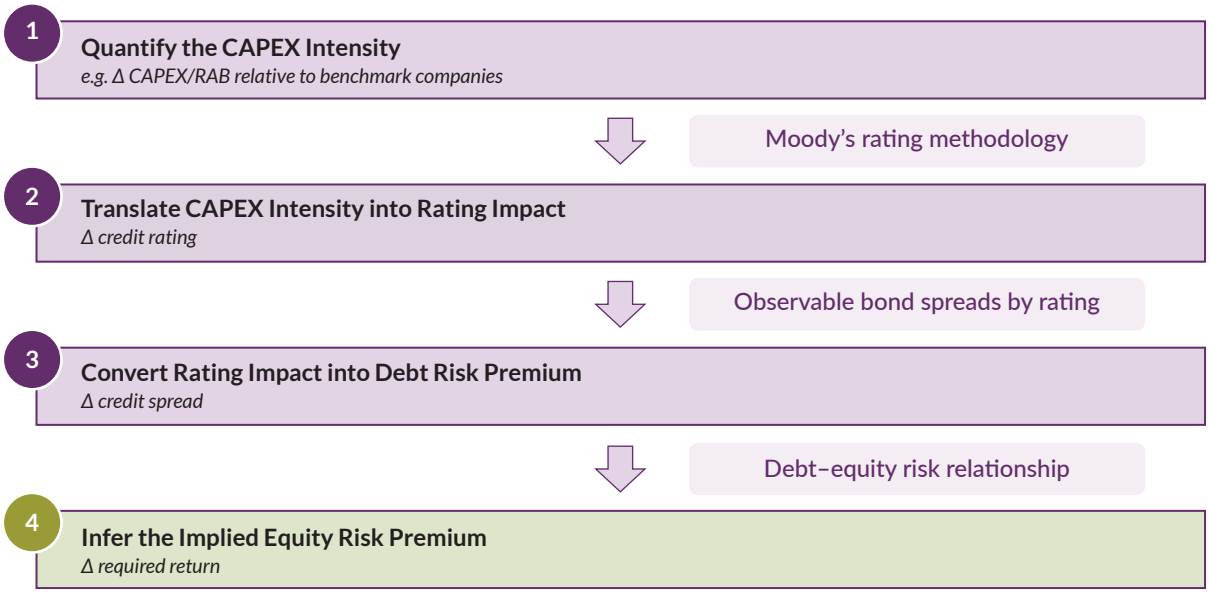
Moody's, S&P Global Ratings, and Fitch all identify large investment programmes as a source of increased business risk. For example, in their rating opinions on the German TSO TenneT, the rating agencies highlight execution and operational risks, uncertainty around future regulatory returns, and the challenge of attracting sufficient capital during a period of exceptionally high investment:

- "The Baa1 rating is constrained by the company's very large capital expenditure programme, amounting to about €67 billion over the 2026–30 period, which entails some execution risk…."[11]
- "...we expect the regulatory return to improve from 2029 with uncertainty about the extent of increase and whether this will be adequate to compensate for higher equity risk due to much higher capital intensity and attract sufficient capital in the massive investment period."[12]
- "We note the execution of the €67 billion capex plan over 2026–2030 embeds significant operational risk…."[13]
- "Massive Capex Implies Execution Risk:…"[14]

The relevance of this evidence extends beyond debt markets. Credit rating agencies assess the underlying business risk of regulated infrastructure companies and explicitly reflect the impact of large investment programmes in their credit assessments. **Business risks affect debt and equity investors**. Because equity claims are subordinated to debt, adverse business outcomes can affect equity investors earlier and more strongly. Consequently, when rating agencies consistently identify exceptional investment programmes as a source of increased business risk, **this provides strong evidence that the underlying risks are also relevant to equity investors**.

A practical way to quantify this effect is to build on Moody's published rating methodology, as illustrated in Figure 6. Moody's explicitly incorporates capital expenditure intensity into its assessment of credit quality, allowing the incremental risk associated with exceptional investment programmes to be translated into an implied rating effect. Observable market spreads can then be used to convert this rating effect into a debt risk premium, which can subsequently be scaled into an implied equity risk premium using relative measures of debt and equity risk.

Figure 6. The Impact of Exceptional Investment on Equity Returns Can Be Quantified by Drawing on Established Credit Rating Principles



Note: NERA illustration.

Taken together, these complementary approaches provide a **transparent, evidence-based framework** for assessing whether exceptional investment programmes warrant adjustments to conventional cost of equity estimates.

COST OF EQUITY ESTIMATION SHOULD REFLECT EXCEPTIONAL INVESTMENT PROGRAMMES

Exceptional investment programmes are fundamentally changing the investment landscape for regulated infrastructure. As investment intensity reaches unprecedented levels, **conventional cost of equity estimates, which often rely heavily on historical capital market data, may no longer fully reflect the risks associated with future investment conditions**.

These programmes can increase investors' required returns through multiple channels, including higher business risk and capital market frictions. Importantly, **their impact need not be assessed qualitatively alone**. Financial theory, company fundamentals, and observable capital market evidence provide complementary approaches for quantifying the additional risks associated with exceptional investment programmes.

As exceptional investment programmes become a defining feature of regulated infrastructure rather than an exception, **cost of equity estimation should evolve accordingly**. Combining conventional estimation approaches with **forward-looking, evidence-based assessments of risk** can help ensure that regulatory returns remain aligned with the risks and financing requirements of tomorrow's infrastructure.

NOTES

1 Zhang, L., "The Value Premium," *The Journal of Finance*, Vol. 60, No. 1, 2005, p. 67–103.

2 Bansal et al., "The Term Structure of Equity Risk Premia," *Journal of Financial Economics*, Vol. 142, 2021, p. 1209–1228. The authors find an upward-sloping unconditional term structure of expected equity returns, although the conditional slope varies across economic regimes.

3 Simshauser, P. and Akimov, A., "Regulated Electricity Networks, Investment Mistakes in Retrospect and Stranded Assets under Uncertainty," *Energy Economics*, Vol. 81, 2019, p. 117–133.

4 For example, the Australian Energy Regulator reduced the nominal vanilla WACC for Energex, an electricity distribution network operator, from 9.72% (2010–2015) to 6.01% (2015–2020). While declining interest rates contributed to this reduction, they do not fully explain the decrease of approximately 40%. Source: Australian Energy Regulator, "Final Decision: Energex Determination 2015–16 to 2019–20," Attachment 3 – Rate of Return, October 2015.

5 Boston Consulting Group, "Infrastructure Strategy 2026: A Year of Increasing Scale and Diversification," 2026, p. 4; McKinsey & Company, "Infrastructure: Investing to Support Global Growth," Global Private Markets Report 2026, p. 4, Exhibit 2.

6 IEA, *World Energy Investment 2026 Datafile*, 2026.

7 Beaver, W., Kettler, P., and Scholes, M., "The Association Between Market Determined and Accounting Determined Risk Measures," *The Accounting Review*, Vol. 45, No. 4, 1970, p. 654–682.

8 Rosenberg, B. and McKibben, W., "The Prediction of Systematic and Specific Risk in Common Stocks," *Journal of Financial and Quantitative Analysis*, Vol. 8, No. 2, 1973, p. 317–333.

9 Francisco, P. M., "Growth Opportunities and Asymmetric Risk: An Empirical Investigation of Upside and Downside Beta," *International Review of Economics & Finance*, Vol. 106, 2026, Article 105033.

10 *Id.*

11 Moody's, TenneT GmbH & Co. KG: New Issuer – First-time Baa1 Rating, Credit Opinion, 8 April 2026, p. 1.

12 S&P Global Ratings, TenneT GmbH & Co. KG Assigned 'BBB+/A-2' Preliminary Issuer Credit Ratings; Outlook Stable, Research Update, 24 March 2026, p. 3.

13 Ibid, p.4.

14 Fitch Ratings, TenneT GmbH & Co. KG, Rating Report, 21 April 2026, p. 1.

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NERA's experts help regulated infrastructure companies, investors, and regulators assess how large-scale investment programmes affect business risk and investors' required returns. Drawing on established financial theory, company fundamentals, and capital market evidence, our experts can evaluate the representativeness of historical market data and comparator companies, quantify the effects of investment intensity on measures of risk and return, and develop robust, forward-looking cost of equity estimates that reflect prospective investment conditions.

NERA also advises clients on the regulatory and financing challenges associated with major infrastructure investment programmes. Our experts assess the implications of regulatory frameworks for investment incentives, capital requirements, and risk allocation; evaluate the economic consequences of alternative regulatory approaches; and provide independent analysis and expert evidence in regulatory proceedings. This work helps clients develop and assess regulatory arrangements that balance the need to attract investment with the interests of consumers and other stakeholders.

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