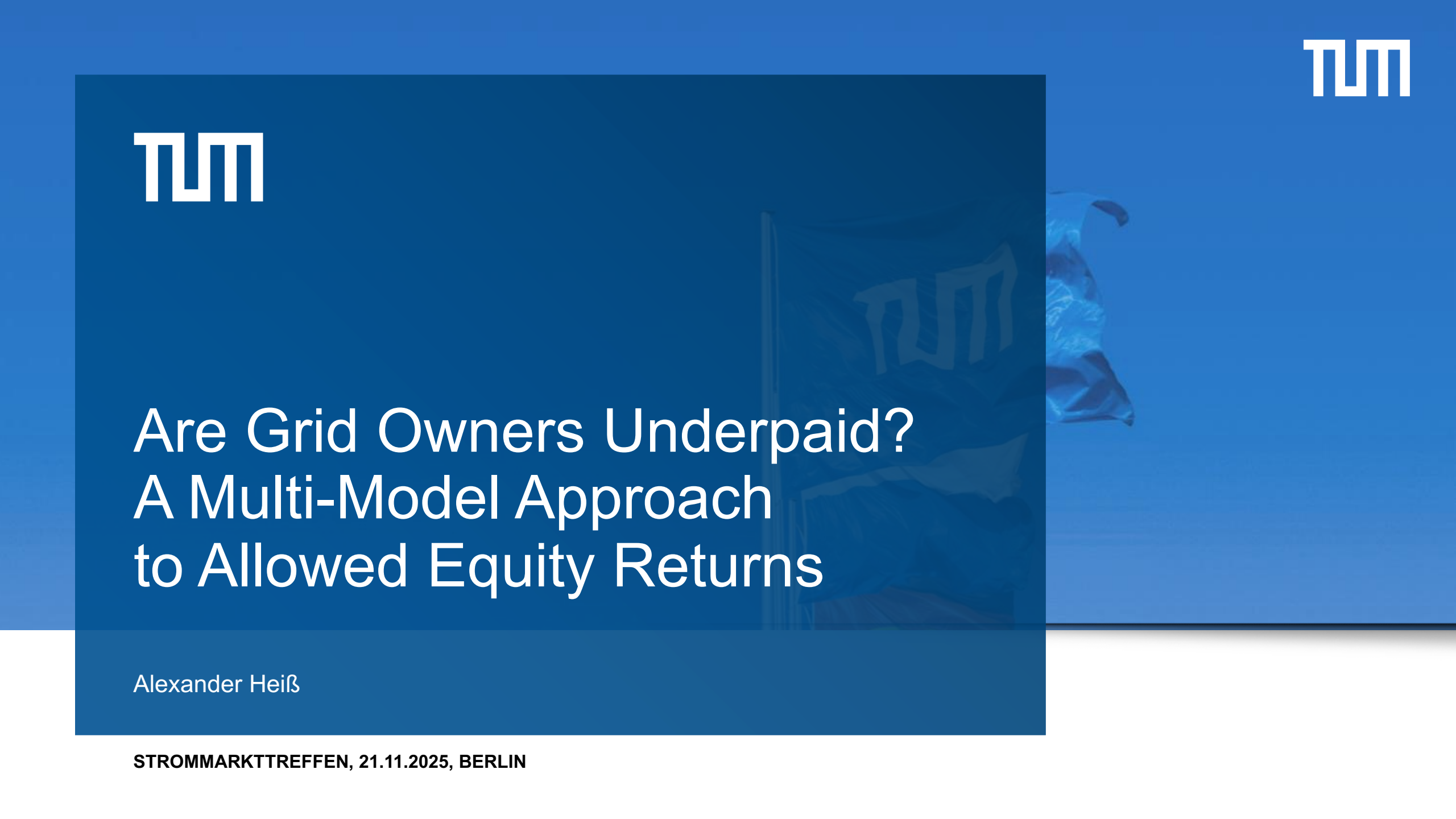

Are Grid Owners Underpaid? A Multi-Model Approach to Allowed Equity Returns

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STROMMARKTTREFFEN, 21.11.2025, BERLIN

Executive Summary

Motivation:

- High grid investments of ~€560B until 2045 require ~€170B additional equity
- BNetzA's current return-on-equity (ROE) model is not dynamic & reliable (5-year reg. periods, manual adjustments, …)

Research Questions:

- What ROE should German grid owners receive so they can refinance on capital markets?
- How to design a system that adjusts to capital market changes?

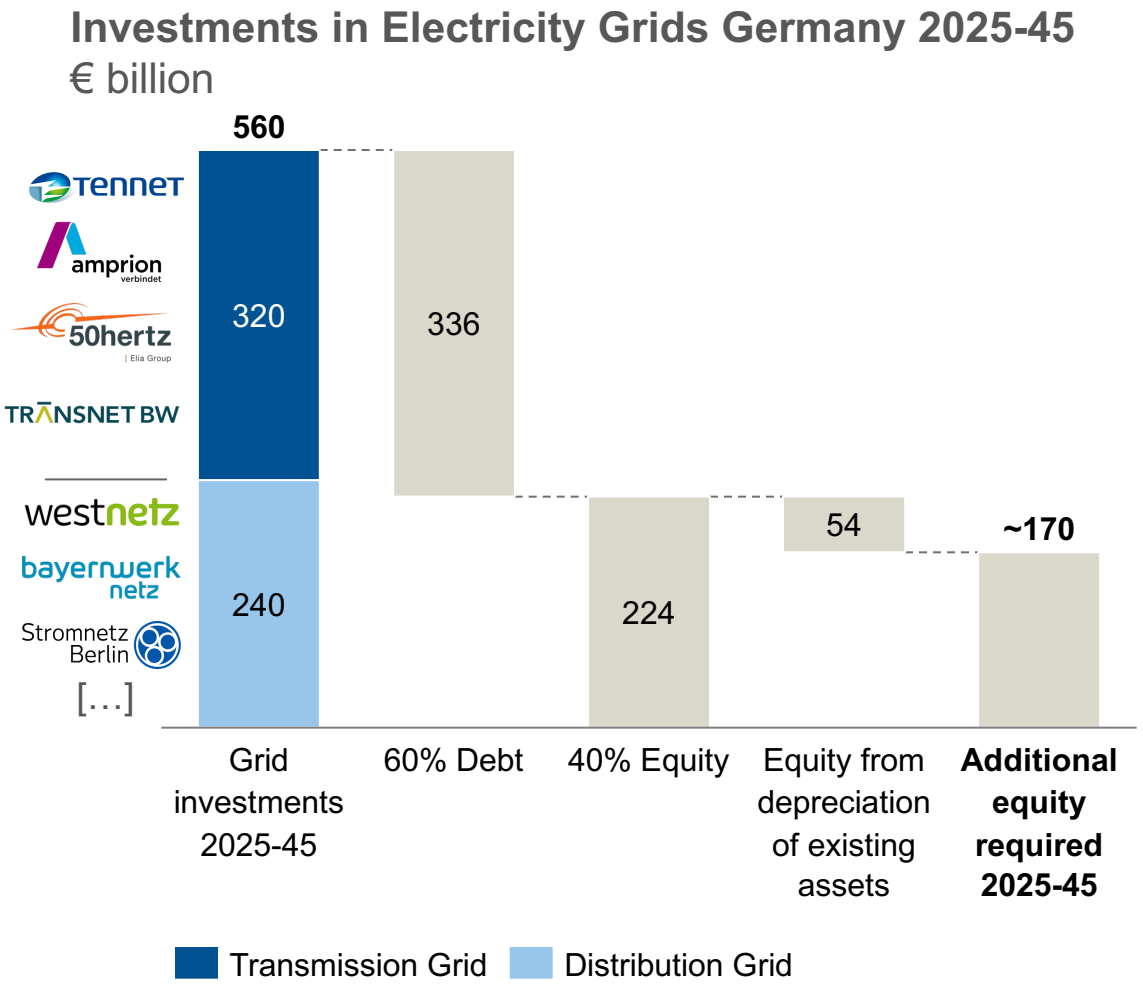
Contribution:

- Compared 3 common cost-of-equity approaches over last 15 years (CAPM, Dividend-Discount-Model, Factor-Model)
- Developed a model-average approach as a possible long-term framework for regulators

Results and Conclusion:

- Current BNetzA CAPM-methodology leads to a >5 year time-lag of regulated-return vs. actual market conditions
  → Return rate adjustments/ regulatory periods should be shorter to adjust to market changes
- Dividend-Discount-Model and Factor-Model find much higher returns than CAPM
  → Regulated returns ~2%p. lower than suggested model-average approach since 2019

Motivation | Investments of €560B into grid infrastructure needed until 2045 – grid owners struggle to finance ~€170B additional equity



ZfK: Zeitung für kommunale Wirtschaft
"Viele Stadtwerke sind am oberen Limit dessen, was Banken noch finanzieren"

WELT
Stromnetze: Wegen hoher Investitionen – Tennet will Deutschlandgeschäft weiterhin verkaufen

tagesschau.de
Höhere Renditen für Betreiber: Netzausbau soll sich stärker lohnen

WELT
Westenergie: Bis zu 15 Jahre warten – Warum Großbatterien am Netz scheitern

Spiegel
Energiewende: Engpässe im Stromnetz kosteten 2023 knapp 3,1 Milliarden Euro

ZfK: Zeitung für kommunale Wirtschaft
370 Millionen Euro in einem Monat: Höchste Redispatch-Kosten seit Energiekrise

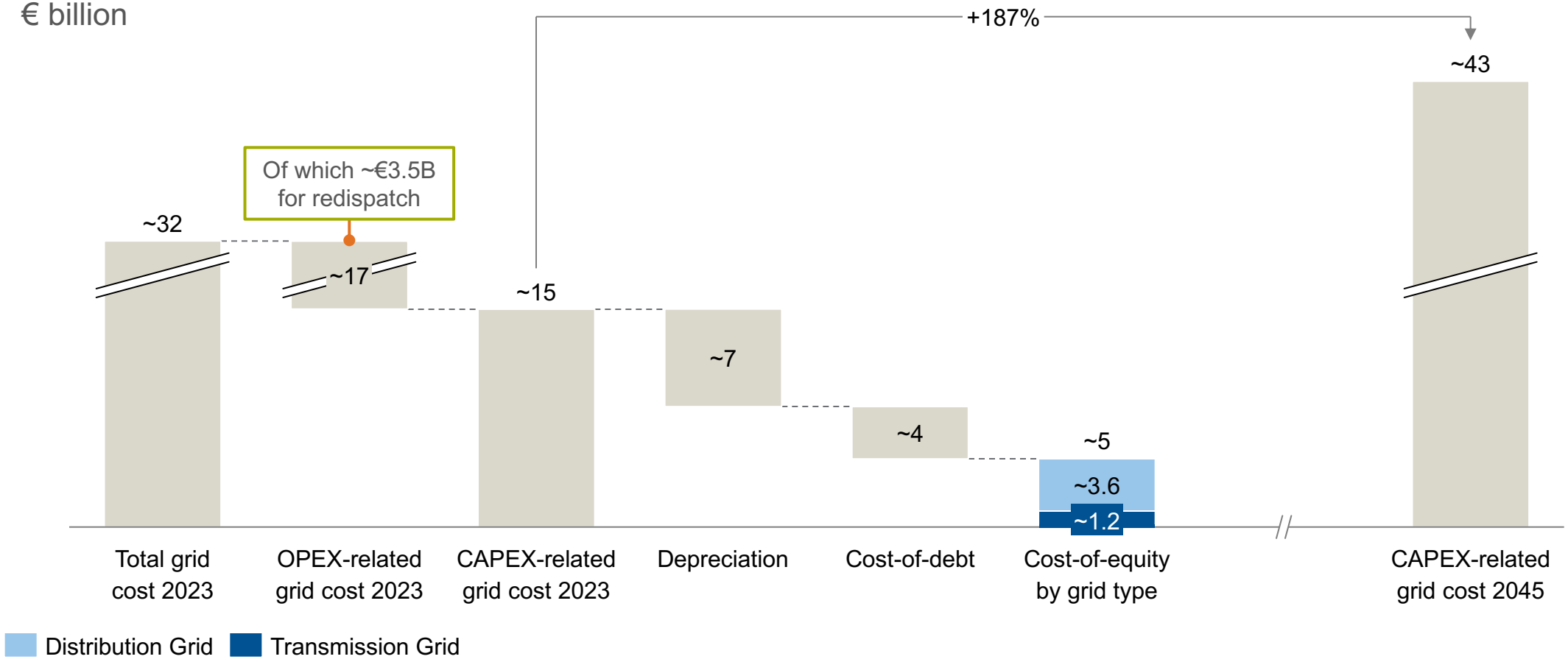
Handelsblatt
Energie: Netzagentur-Chef stellt Betreibern höhere Renditen in Aussicht

energate messenger
Amprion fordert EK-Zinssprung auf 9 Prozent

Source: Agora Energiewende (2025); Bundesnetzagentur (2024); Frontier Economics/Consentec (2024).

Background | Cost-of-equity is about 15% of total grid costs – strong growth expected due to large investments

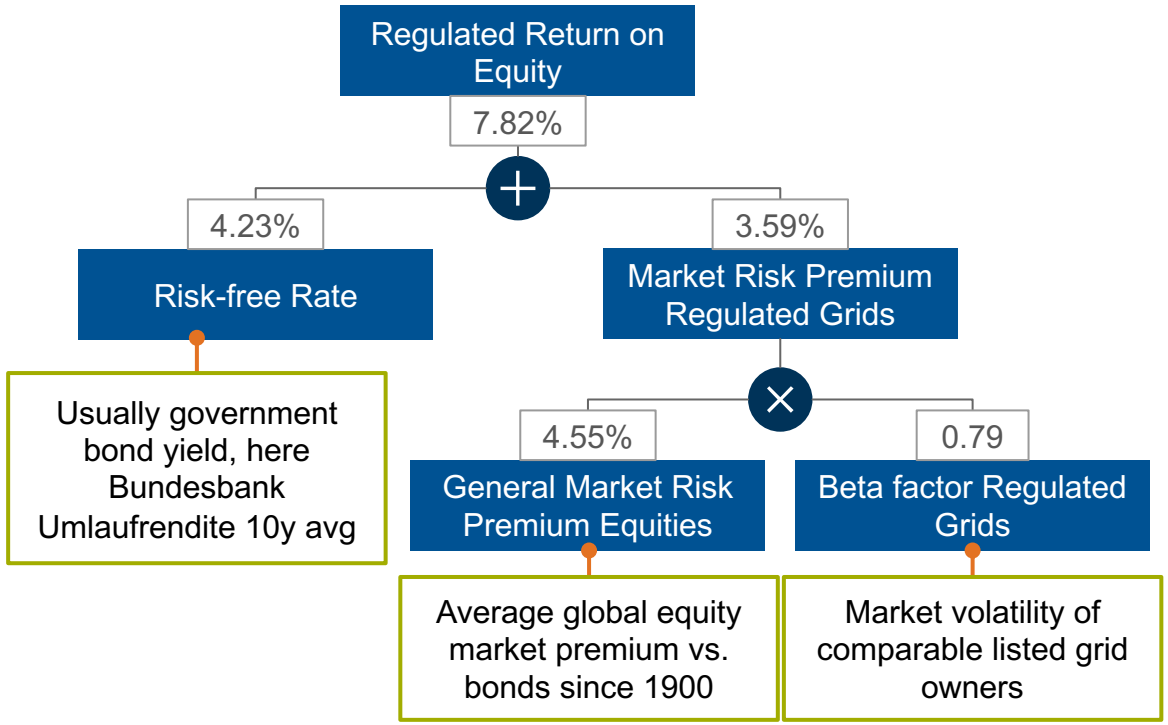
Annual Costs Electricity Grids Germany (2023, approximated)
€ billion



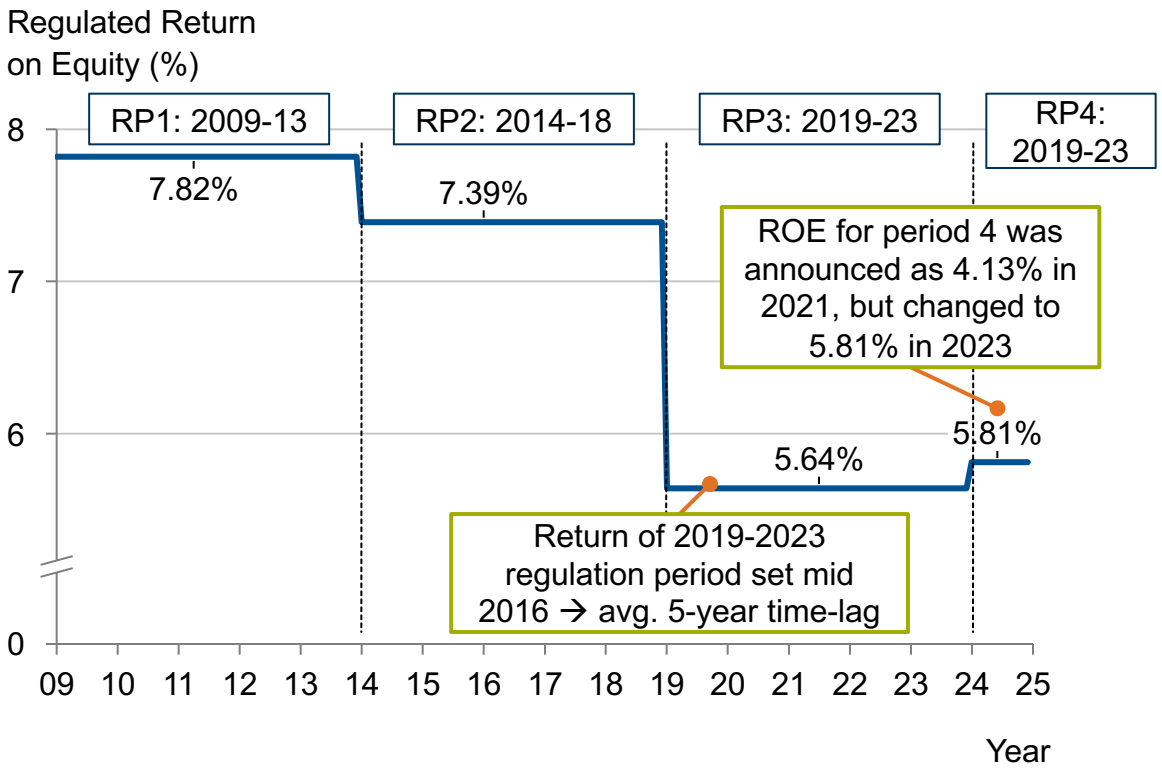
Source: Own calculation based on Agora Energiewende (2025), Bundesnetzagentur (2024), Frontier Economics/Consentec (2024).
Assumptions: TSO asset base of €60B, DSO asset base of €180B; 2.8% depreciation, 2.5% cost-of-debt.

Regulation Germany | Currently regulated return only calculated using CAPM method with long time lag to actual market conditions

Components Capital Asset Pricing Model (CAPM)



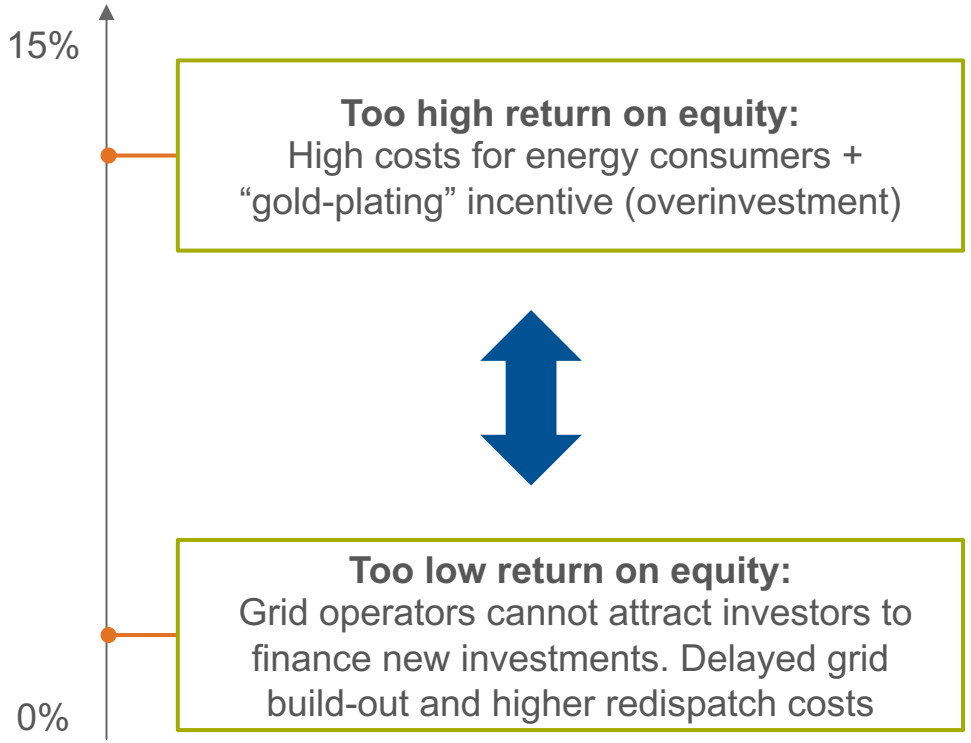
Regulated Return on Equity (ROE) (after tax)



xxx Values Regulation Period 1 (2009-13)

Source: Bundesnetzagentur

Research question | The allowed return on equity should be in line with comparable investments to enable investment and avoid too high costs

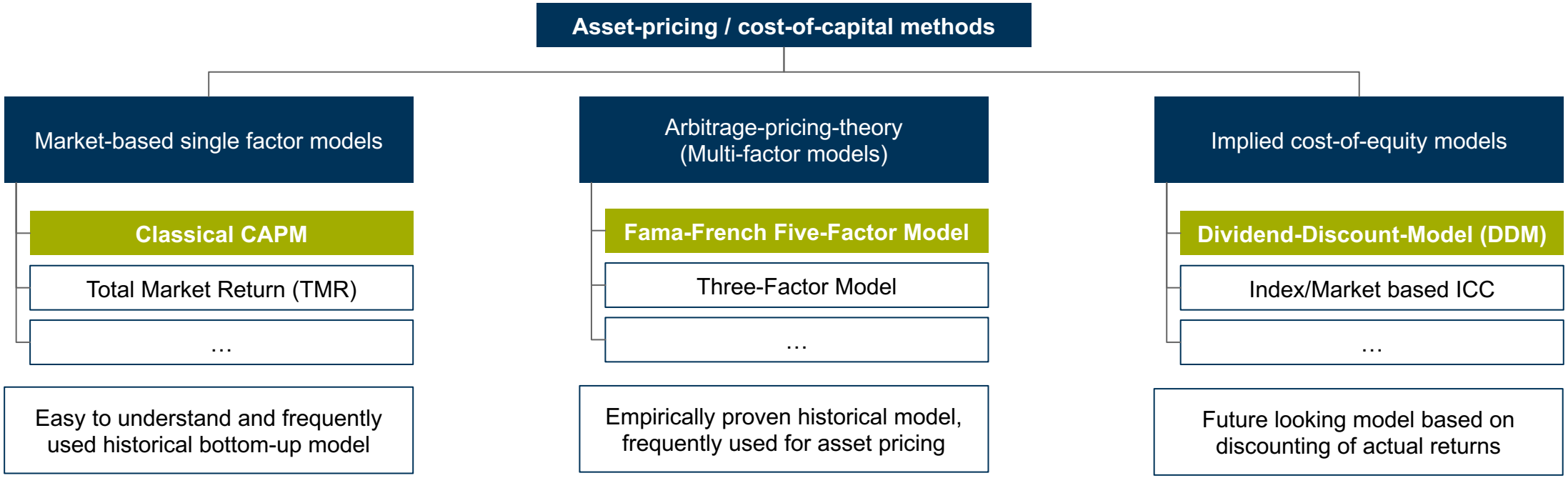


Research questions:

- What is the right return on equity?
- How can the return dynamically adjust to a changing capital market environment?

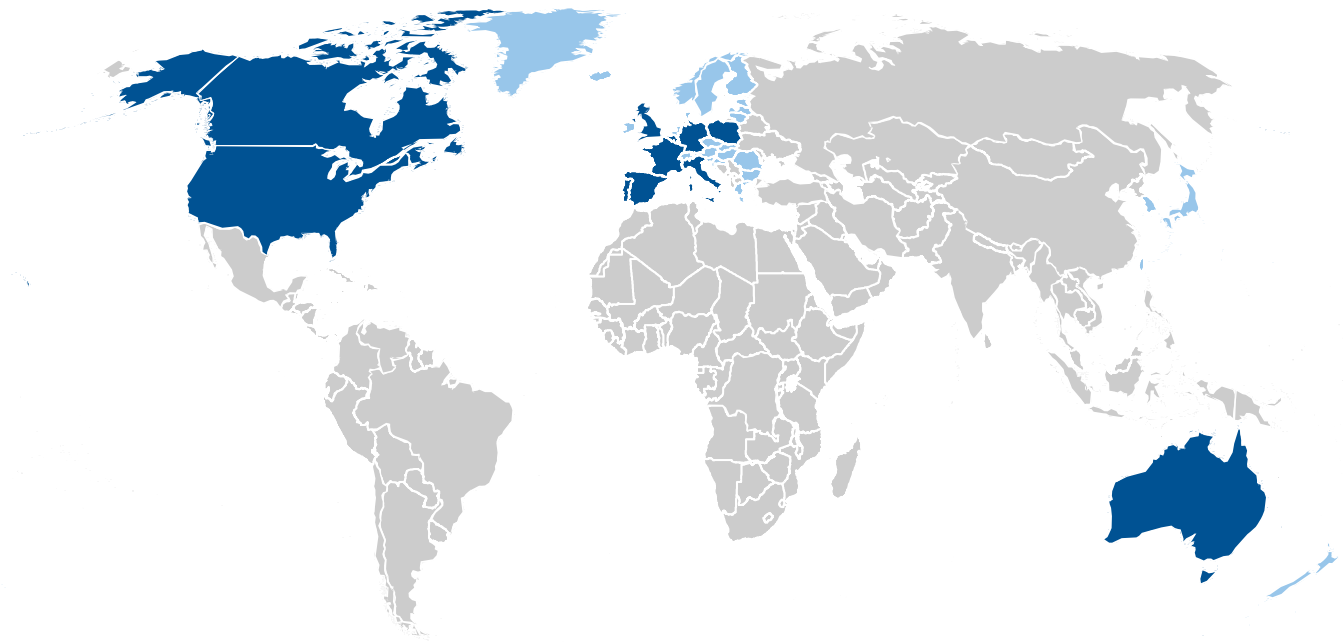
Methodology | We use the most common method from three approaches to asset-pricing/cost-of-capital estimation

→ See backup for model assumptions



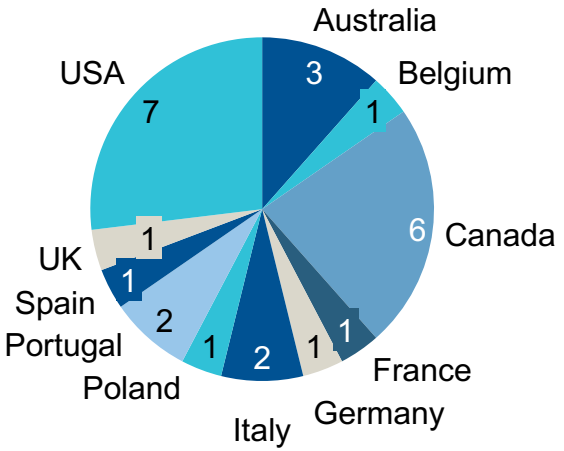
Sample | 26 firms with focus on regulated transmission assets in sample

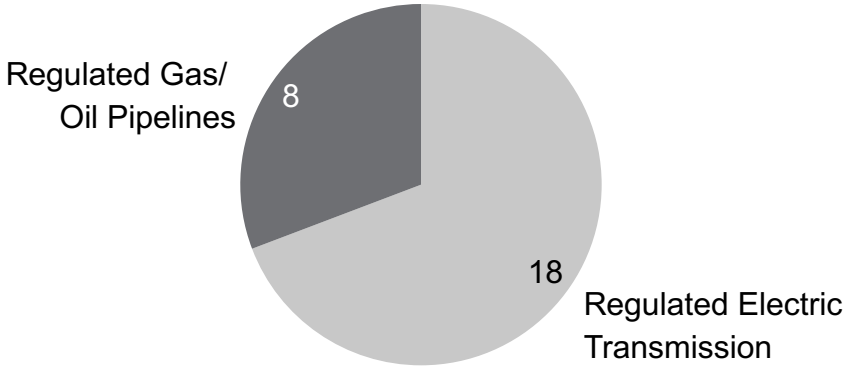
Screening of all public companies with regulated transmission assets in developed countries



Developed country with listed grid owner (in sample)
Developed country without listed grid owner

26 firms in sample by country and asset type

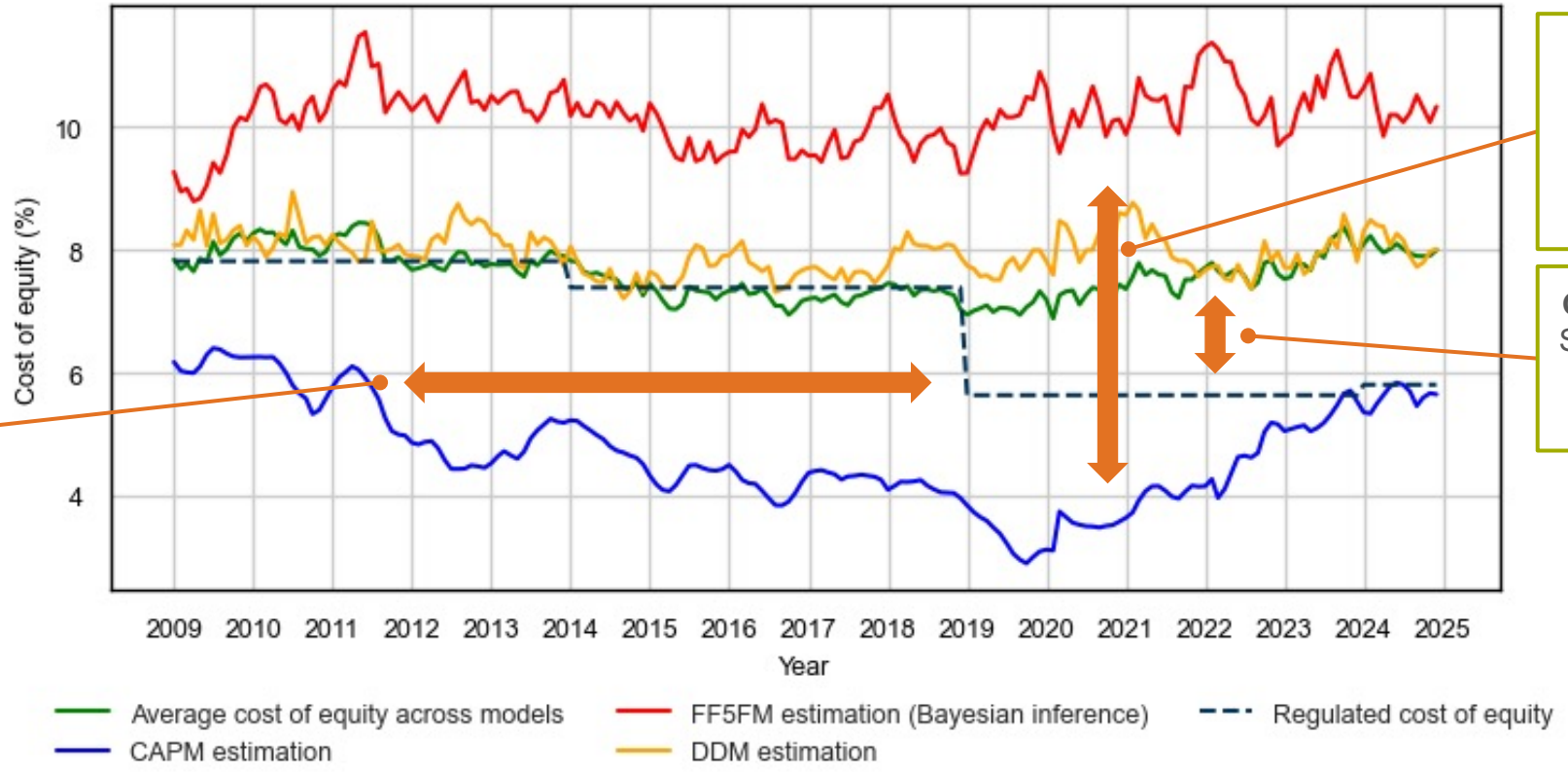




Source: Bloomberg

Results | Regulated return with long time-lag to dynamic CAPM and ~2%p. lower than model-average since 2019

Resulting cost-of-equity



CAPM time-lag: Regulated return set 2.5 years before 5 year reg. periods using 10-year avg. debt returns

Model differences: Factor-Model and Dividend-Discount-Model find higher returns than CAPM

Gap vs. reg. return: Since 2019 reg. ROE ~2%p. lower than model-average

Conclusion | Dynamic, multi-model approach best suited to set right equity return for financing of grid expansion

Results

- Due to rapid grid expansion grid operators need **€170B additional equity** until 2045
- Currently cost-of-equity make up **~15% of total grid costs**
- Returns should be in line with capital market and **neither too high or low**
- **Long time-lag in current methodology** leads to returns differing from market conditions
- Cost-of-equity methods DDM and FF5FM **find higher returns than CAPM**
- Regulated return is **~2% lower** than three-method average since 2019

Implications for Regulators

- **International multi-model** methodology could improve reliability of regulation
- Return rate adjustments/ regulatory periods should be **shorter to adjust to market changes**
- Current **returns might be too low** to enable grid owners' refinancing

Methodology | Three different methods applied to estimate the cost-of-equity

Method	Calculation	Assumptions
(1) Capital Asset Pricing Model (CAPM)	$r_e = R_f + \beta_i \cdot MRP$ [ROE = Risk-free rate + (Risk of Regulated Grid firms vs. market * Equity market risk premium)]	• Risk-free rate from 10Y govt. bond yields (AAA-rated countries + US, no FX-adjustment); 2-year beta; MRP since 1900 from DMS dataset.
(2) Fama-French Five-Factor Model (FF5FM)	$r_e = R_f + \beta_M(\text{Market}) \cdot \lambda_{\text{M}} + \beta_S(\text{Size}) \cdot \lambda_{\text{S}} + \beta_V(\text{Value}) \cdot \lambda_{\text{V}}$ $+\beta_P(\text{Profitability}) \cdot \lambda_{\text{P}} + \beta_I(\text{Investment}) \cdot \lambda_{\text{I}}$ [ROE = Risk-free rate + Traits (Factors) that explain returns (Factor loading * Factor premiums)]	• Monthly performance vs. risk-free rate, Fama-French Factor values; Betas from signif. equities ($p<0.1$); 12-months smooth. + Bayesian inference.
(3) Dividend Discount Model (DDM)	$r_e = \frac{D_1}{P_0} + g$ [ROE = Dividend return + Growth rate]	• Dividends + Share buybacks last 12 months; avg. share price of last month; 3.5% growth rate.