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NERA

Benchmark of European Electricity Transmission Betas

Prepared for Terna

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Executive Summary

Scope of Work

- On 30 July 2024, ARERA published consultation document 342/2024/R/com (hereafter DCO 342/24),[1] in which it sets out its proposals regarding the mid-term review of the WACC parameters for the second sub-regulatory period of the 2PWACC (2025-27) and ARERA's proposals to review asset betas for the regulated energy sectors, including for the electricity transmission sector
- Within this context, **NERA** has been commissioned by **Terna** to perform an international benchmark of the methodologies adopted by regulators in major European countries to identify the best and most common practices for estimating asset betas for regulatory purposes, with a particular focus on the methodological choices made by regulators with respect to estimating empirical betas, namely:

  1. The choice of comparators, including the selection criteria used and differences (if any) across sectors and/or services
  2. Adjustments to the beta
  3. De-levering formula and approach used to determine the formula inputs
  4. Market reference index
  5. Estimation window and averaging period (if any)
  6. Frequency of observations

- The countries covered in this report include **all countries considered by ARERA in DCO 342/2024 for the purpose of its international benchmark** (Austria, Belgium, France, Germany, Netherlands, Portugal, Spain and Great Britain)
- This report has been prepared using information in the public domain

In the next slide, we summarise the key lessons from our review of regulatory approaches across Europe to estimating empirical betas, which are then described in detail in the remainder of the report, and report the asset beta range for the electricity transmission sector resulting from adopting the most common methodological choices at the European level[2]

1. ARERA (30 July 2024), 342/2024/R/COM Tasso di Remunerazione del capitale investito: Orientamenti per la definizione del parametro beta e l'aggiornamento dei parametro per il sub-periodo 2025-2027; 2. Empirical asset beta estimates have been provided by Terna.

Executive Summary

Methodological Choice	Lessons from European Regulatory Precedent
Comparator Pool, Selection Criteria and Differences Across Sectors/Services	• Most European regulators surveyed in this report **adopt the same comparator pool across all or most sectors and services**; with **differences in allowed asset betas** reflecting **regulators' qualitative assessment around differences in systematic risk** across sectors and/or services • Whilst there is **no consensus regarding the exact pool of comparators** to be used to estimate asset betas (whether for all sectors, or individual sectors / services), **most regulators rely on a pool of regulated companies operating in the gas and electricity sectors at the European or OECD level**, for which stocks are considered sufficiently liquid
Beta Adjustments	• **Half of the European regulators** surveyed adjust the raw beta using either the **Blume or Vasicek adjustment** to correct for estimation errors in the equity beta values associated with the statistical regression method, **in line with ARERA's proposal**
De-levering Formula Inputs	• **All European regulators** for which information is available use **market capitalisation as a measure of equity** and **most regulators use net debt as a measure of debt.** • **ARERA's approach** on both parameters is therefore **not in line with European regulatory precedent**
Market Reference Index	• **Most European regulators** use a **regional index**, and specifically the Eurostoxx, **as the market reference index** for European comparators. **ARERA's approach** of using national indices is therefore **not in line with European best practice**
Estimation Window and Averaging Period	• **Most European regulators estimate asset betas over a 2-to-5-year estimation window** and **rely directly on the coefficient of the OLS regression ("spot value")** without averaging betas over time • ARERA's estimation window is in line with European best practice, but **ARERA** is the **only regulator** surveyed which relies exclusively on averages of betas rather than **considering also the spot beta value**

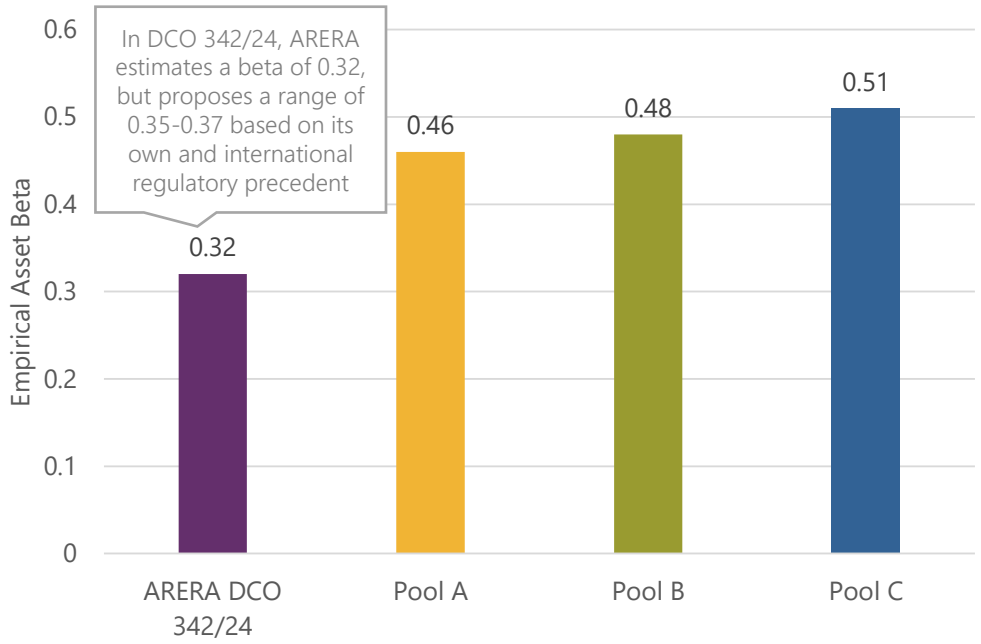
Notes: Any conclusion or statement in this and the following slides referring to "European regulators" shall be interpreted as "European regulators surveyed in this report" and not *all* regulators in Europe.

Executive Summary

Applying the methods commonly used by European regulators to estimating asset betas – as identified in the previous slide - to a range of possible comparator pools, results in materially higher asset betas for the electricity transmission sector[1]

- Comparator Pool:
  - Pool A: ARERA's electricity transmission comparator pool in DCO 342/24 (Terna, Elia, National Grid, Red Electrica, REN)
  - Pool B: 'Pure play' regulated electricity and gas companies (Pool A + Enagas, Fluxys, Snam, Transgaz, Italgas)
  - Pool C: ARERA's long-list of comparators in DCO 342/24 (Pool B + A2A, Acea, Hera, Iren, Electricitè de Strasbourg, Ascopiave)
- Beta Adjustment: Blume
- De-levering: Hamada formula with market capitalisation, net debt, effective tax rate
- Market Reference Index: Regional index (Eurostoxx 600 except for National Grid and Transgaz due to currency risk)
- Estimation Window and Averaging Period: Spot asset beta as of 30 June 2024 estimated via 2-year OLS regression
- Frequency of Observation: Daily data

Empirical Asset Beta for the Italian Electricity Transmission Sector[1]



The analysis shows that using a beta estimation methodology which is in line with the methods used at the European level results in a materially higher asset beta range (between 0.46 and 0.51 depending on the comparator pool) relative to both the empirical asset beta estimated by ARERA in DCO 342/24 (0.32) and the range ultimately proposed for the second sub-period of the 2PWACC (between 0.35 and 0.37)

1. Comparator pools and empirical asset beta estimates have been provided by Terna.

1

Comparator Pool

Selection of comparators and differences across sectors and/or services

The choice of comparators requires assessing relative risk across countries, sectors and services to strike a balance between reliability and relevance

ARERA's approach to the comparator pool relies on selecting a wide range of comparators and then sub-comparator pools for each regulated sector and activity[1]

Sector	Asset Beta	Comparator Pool	Selection criteria
ET	0.35-0.37	Elia, National Grid, Red Electrica de Espana, REN, Terna	• Listed on the financial markets in the Euro area or Great Britian, sufficiently liquid (with average bid-ask spread < 2%), a minimum of 20% share of revenues from regulated activities; active in the relevant regulated service and sector
ED	0.4	A2A, Acea, Electricite de Strasbourg, Hera, Iren, National Grid	
GT	0.37-0.384	Enagas, Fluxys Belgium, National Grid, REN, Snam, TRANSGAz	
GD	0.41-0.439	A2A, Acea, Ascopiave, Hera, Iren, Italgas, National Grid	

- Ideally, the **comparator set of firms should share all or at least most characteristics of the regulated entity** for which the asset beta is being set. However, in practice it is often the case that **only very few listed firms reflect the activities and characteristics of the regulated business**
- Therefore, in identifying the comparator set, regulators must **strike a balance** between increasing the **statistical reliability of the estimates** (through a wider sample) and the **loss of relevance of the estimates** (as firms operate in businesses with a different risk profile relative to the regulated firm)
- Due to the limited number of listed firms that reflect the activities and characteristics of the regulated firm for which the beta is being set, the **choice of comparators requires assessing relative risk across countries, sectors and services**. This in turn, has led some regulators to adopt the same comparator pool across all or some sectors/services when they deem systematic risk to be similar
- It follows that when estimating asset betas, the **decision around the comparator pool is often tied also to the view taken by the regulator regarding the relative systematic risk faced by regulated business across different sectors/services**

In the following slides, we review the choice of comparators made by European regulators across all regulated businesses (ET, GT, ED, and GD) and the rationale for using different or the same comparator pool and asset beta values across businesses

Sources: 1. ARERA (30 July 2024), DCO 342/24, pp. 7-9, paras.3.4-3.9.

Four of the countries considered by ARERA use the same asset beta and rely on the same comparator pool across all regulated sectors (1/2)

	Sector	Asset Beta	Regulatory Period	Decision	Comparator Pool & Criteria	Rationale for Adopting Same Asset Beta Across Sectors
DE	ET	0.395	2024-2028 (5 years)	12-Oct-2021	• **Pool:** National Grid, RED Electrica, REN, Terna, Elia, Snam, Enagas, TC Pipelines, Spark, Ausnet, APA • **Selection criteria:** Geography (OECD), data availability, regulated revenues threshold (>75%), liquidity (bid-ask spread <1%)	• BNetzA argues that electricity and gas networks are subject to similar regulation in all industrialised countries due to the natural monopoly nature of networks, and has therefore set the same beta across sectors and relied on the same comparator pool for setting such value
	ED					
	GT		2023-2027 (5 years)			
	GD					
ES	ET	0.41	2020-2025	20-Nov-2019	• **Pool:** EON, RWE, EVN, Verbund, Elia System Operator, Enagas, Endesa, Gas Natural SDG, Iberdrola, REE, EDF, Engie, A2A, ACEA, Ascopiave, Enel, Hera, Iren Snam, Terna Rete, EDP, REN, National Grid, SSE • **Selection criteria:** Geography (Western Europe, >20,000km^2), "high relative weight" of regulated revenues, sovereign credit rating above BB-/Ba3, data availability, liquidity (bid-ask spread <1%)	• In using the same comparator pool and values of asset betas across sectors, the CNMC argues that the four regulated sectors have similar risk profiles due to their natural monopoly status and high investments in fixed assets. Additionally, the CNMC notes that some energy companies are involved in both sectors, with few purely electric or purely gas companies • The different beta values for ET/ED vs. GT exclusively reflect a difference in the regulatory periods and therefore when the decision on the asset beta was taken
	ED					
	GT	0.42	2021- 2026			
	GD	N/A	In 2019, the CNMC decided to continue with its previous approach not to rely on WACC approach to remunerate gas distribution[1]			

1. CNMC, (12 November 2019), CIR/DE/011/19, p.114.
Sources: NERA Analysis. See the Annex for detailed sources.

Four of the countries considered by ARERA use the same asset beta and rely on the same comparator pool across all regulated sectors (2/2)

	Sector	Asset Beta	Regulatory Period	Decision	Comparator Pool & Criteria	Rationale for Adopting Same Asset Beta Across Sectors
GB	ET	0.349	2021-2026 (5 years)	8-Dec-2020	• Pool – RIIO-2 FD: National Grid, SSE, Severn Trent, United Utilities and Pennon – RIIO-3 SSMD: National Grid, United Utilities and Severn Trent. Ofgem has stated that it is open to the possibility of including European comparators across the gas and electricity sectors (Enagas, Red Electrica, Terna, Snam, Italgas) • Selection criteria: – RIIO-2 FD: Geography (Great Britain) and regulated sectors (energy, water)[2] – RIIO-3 SSMD: Ofgem opens to including European comparators, but does not provide details around the specific criteria employed to select them	• In taking a decision to align asset betas across sectors at RIIO-2, Ofgem argued that "it is not clear to [Ofgem] whether individual energy sectors will hold materially different levels of systematic risk"[3] • In the on-going review for RIIO-3 which covers the ET, GT and GD sectors, Ofgem has opened to the possibility of considering evidence indicating that these sectors face "different levels of systematic risk on a sectoral basis" and therefore that "it may be appropriate to use different beta estimates for the different network sectors". – Following initial feedback from stakeholders, in its SSMD, Ofgem stated that "at this stage of the analysis, [Ofgem] note[s] that the drivers of systematic risks faced by the GB energy networks may have the potential to diverge. However, given the over-arching influence of the RIIO regulatory regime, [Ofgem does not] currently consider there to be sufficient evidence to justify using different beta estimates for gas and ET". – Ofgem stated that it will keep its "position under consideration and will review at DD"[4]
	ED[1]		2023-2028 (5 years)	30-Nov-2022		
	GT		2021-2026 (5 years)	8-Dec-2020		
	GD		2021-2026 (5 years)	8-Dec-2020		
NL	ET	0.39	2022-2026 (5 years)	20-Sept-2021	• Pool: Elia, Enagas, Red Electrica, REN, Snam, Terna, and TC Pipelines • Selection criteria: Geography (Europe and North America), regulated company (unclear threshold), liquidity (bid-ask spread < 1%)	• The ACM adopts the same comparator pool and sets the same asset beta for all regulated sectors on grounds that there is a limited number of publicly traded network operators. Moreover, the ACM argues that electricity and gas network operators' activities, risks and regulatory frameworks are similar in nature
	ED					
	GT					
	GD					

1. The Ofgem SSMD covers the ET, GT and GD sectors. However, based on RIIO-2, we assume that Ofgem will take a similar approach and view on cost of capital for ED; 2. At the RIIO-2 DD, Ofgem's consultants CEPA agreed with Ofgem's proposed beta range also performing a cross-check with European comparators. To select these, it CEPA used a more detailed set of criteria than those reported by Ofgem; 3. Ofgem (3 February 2021), RIIO-2 Final Determinations – Finance Annex (Revised), para.3.75; 4. Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, paras.3.203-3.212. Sources: NERA Analysis. See the Annex for detailed sources.

Two countries surveyed by ARERA, France and Austria, consider the same comparator pool across some, but not all, regulated sectors

	Sector	Asset Beta	Regulatory Period	Decision	Comparator Pool & Criteria	Rationale for Chosen Approach
FR	ET	0.37	Aug 2021-Aug 2025 (4 years)	21-Jan-2021	• **Pool:** Terna, Red Electrica, National Grid, Elia, REN, Spark • **Selection criteria**: Geography (EU and North America), share of regulated revenues (threshold not specified), liquidity criterion (price autocorrelation, bid-ask spread, turnover ratio and floating capital; thresholds are not explicitly stated)[1]	• The CRE relies on Oxera to set asset betas for ET and ED; Oxera uses the same comparator pool for both sectors and builds a range based on different estimation windows • We understand the CRE then sets different betas for ED and ET based on a qualitative assessment of the systematic risk faced by the TSO (RTE) and the DSO (Enedis)
FR	ED	0.36				
FR	GT	0.47	Aug 2024-2028 (4 years)	30-Jan-2024	• CRE did not use the ranges identified by their consultant Compass Lexecon as they would represent a "departure from the methods and parameters used to date by CRE" • For info, we report the **pool** selected by the consultant, noting it has not been used by the CRE: Elia, Enagas, Hera, Italgas, National Grid, Red Electrica, REN, Snam and Terna	• To set the betas for the gas sector, the CRE adopted higher values than suggested by the consultant based on empirical evidence from the gas sector and their assessment of systematic risk associated to the regulatory framework for GT and GD
FR	GD	0.45		15-Feb-2024		
AT	ET	0.40	2023-2028 (6 years)	17-Nov-2022	• **Pool:** Elia, Enagas, Red, REN, Snam, Terna, National Grid, APA, Ausnet, Spark, Hydro, E.on, EVN, Italgas, Chesapeake, Sempra Energy, Southwest Gas Holdings, TC Pipelines • **Selection Criteria**: Geography (OECD), share of revenues in "relevant business fields", data availability, liquidity (Bloomberg score >= 75)	• The Austrian regulator adopts the same asset beta and comparator pool for ET, ED and GD based on a study performed by external consultants in 2022 but does not provide a rationale for its choice. E-Control then takes the highest value from the range to account for uncertainty • For GT, over the 2021-24 period, the asset beta value was aligned with that of other sectors, but E-Control appears to have relied on a different study by the same consultants from 2019, which relies on a different comparator pool[2] – E-Control recently approved the WACC for the 2025-27 period increasing the asset beta for GT to 0.41. This reflects a new 2023 study by the same consultants which have updated the comparator pool.[3] It is unclear, but possible, that this peer group will be used for other sectors too in future reviews, albeit new determinations for these are far away in time
AT	ED		2024-2028 (6 years)	31-Oct-2023		
AT	GD		2023-2027 (5 years)	04-Nov-2022		
AT	GT	0.4	2021-24 (4 years)	2020	• **Pool**: Enagas, Fluxys, Italgas, National Gird, REN, Snam, A2A, Ascopiave, Centrica, ENGIE, E.ON, Gazprom, Hera, Innogy, Naturgy Energy, Polskie Gornictwo Naftowe, RWE, SSE • **Selection criteria**: Bloomberg-made peer-group (BI Europe Gas Transmission & Distribution Top Competitive Peers), which comprises over 85% of market capitalisation of gas network operators in Europe	

1. Thresholds are not specified, but CRE's consultant excludes companies with regulated revenues below c.58%; bid-ask spread <1%; 2. We did not find any explicit reference of E-Control to the 2019 Study within the final decision for GT 2021-24; similarly, we did not find any explicit reference of the Austrian consultants to the final value of 0.4; 3. Peer group includes: A2A, Enagas, ENGIE, Hera, Italgas, Naturgy Energy, REN, Snam, AB Amber, Ascopiave, E.ON, Fluxys, RWE, Centrica, National Grid, SSE, Transgaz. Sources: NERA Analysis. See the Annex for detailed sources.

Other two countries, Belgium and Portugal, adopt bespoke approaches with different comparator pools and values across sectors

	Sector	Asset Beta	Regulatory Period	Decision	Comparator Pool & Criteria	Rationale for Chosen Approach
BE	ET	0.32 (CREG)	2024-2027	30/06/2022	Elia	• **Differences across sectors reflect differences in approaches adopted by regulators in Belgium** at the **federal level** for the ET and GT sectors (CREG), and at the **regional level** for the ED and GD sectors (VREG, CWaPE) • Unlike other countries surveyed in this report and ARERA's own approach, for the ET sector the **CREG** does not rely on a comparator pool but **relies solely on the beta estimate for Elia (the Belgian TSO)** • At the regional level, **VREG** and **CWAPE** both set the same asset beta using the same comparator pool in their respective regions on grounds that the sectors do not display any risk differences
BE	GT	0.39 (CREG)	2024-2027	30/06/2022	N/A (based on regulatory precedent)[1]	
BE	ED	CWaPE: 0.39[2] VREG: 0.40	CWaPE: 2025-2029 (5 years) VREG: 2025-2028 (4 years)	CWaPE: 31-May-2023 VREG: 21-Jun-2024	• **Pool (CWaPE)**: Elia, Terna, Red, REN, Enagas, Snam, ACSM - AGAM, Hera, National Grid • **Selection Criteria:** Geography (Europe), ex post evaluation of beta to eliminate any outliers • **Pool (VREG)** : Elia, Enagas, EVN, Red, REN, Snam, Terna • **Selection Criteria:** Geography (Eurozone), liquidity (bid-ask spread < 1%, trade at least 90% of trading days and annual sales > €100 million), investment grade companies, significant revenues from regulated activities (unclear threshold)	
BE	GD					
PT	ET	0.37	2022-2025 (4 years)	Dec-2021	REN (ET section of the company)	• Unlike all other European regulators, **ERSE relies both on regulatory precedent** and **empirical asset betas** to set the allowed betas • Like in Belgium, the empirical asset beta analysis performed by **ERSE** relies **exclusively** on the **beta estimate for REN (the Portuguese TSO)** • When assessing asset betas, the Portuguese regulator adopts a set of criteria and assumptions that drive its decision around individual sectors' asset betas, including that asset betas for ET should be lower than for ED, and ET and ED should be lower than the allowed beta for gas. It is however unclear how the regulator applies these in practice
PT	ED	0.41			Grupo EDP	
PT	GT	0.38	2024-2027 (4 years)	Jul-2023	REN (GT section of the company)	
PT	GD	0.46			• **Pool**: Ascopiave, Enagas, EVN AG, Italgas, REN SGPS, Snam, National Grid PLC • **Selection Criteria** Geography (Europe), gas networks and significant revenues from regulated activities (unclear threshold)	

Notes: 1. CREG notes that due to the scarcity of publicly traded shares, the sensitivity of the combined network operator's stock price (Fluxys) to market fluctuations is not representative of the companies' intrinsic risk profile. Also, Fluxys LNG SA is not listed; natural gas storage and terminal activities are often unregulated and are smaller in size in Belgium. Therefore, CREG states if these activities were listed, they would face higher volatility and sets a beta value equal to the one used in DE and the NL; 2. The CWaPE only provides the equity beta value, the asset beta value provided is based on the information in ARERA's DCO 342/2024. Sources: NERA Analysis. See the Annex for detailed sources.

Most European regulators surveyed in this report adopt the same comparator pool across all, or most, sectors and/or services

6 out of 8 of the countries considered by ARERA rely on the **same comparator pool across all, or most, regulated sectors**

DE, GB, NL, ES, FR and AT

- **Germany**, **Great Britain**, and the **Netherlands**, adopt the same asset beta across regulated sectors by relying on the same comparator group of companies for the purpose of estimating the empirical beta
- **Spain** adopts the same approach and comparator pool for estimating the beta, but values differ between the ET and ED sectors (0.41) relative to the GT sector (0.42) due to the timing of the decision making for the gas transport sector, which came one year later than for the electricity sector
- All regulators motivate their choice on grounds that there is **no material difference in systematic risk across sectors** due to the **monopoly nature of the sectors** and/or the **common regulatory framework**
- In **Austria,** the regulator adopts the **same asset beta for ET, ED and GD by relying on the same comparator pool**, but relies **on a different comparator pool for the GT sector** despite setting historically the same value across all sectors (0.40)
- In **France,** the regulator relies on the **same comparator pool** of regulated gas and electricity companies to identify an **asset beta range for the ET and ED sectors** but sets **different beta values based on its qualitative assessment of differences in systematic risk** across sectors driven by the regulatory framework
- Across these six countries, regulators have identified a **wide range of comparator pools across the electricity and gas sectors** using a range of selection criteria most notably: a geographic criterion, a regulated revenues criterion and liquidity threshold

2 out of 8 countries adopt **bespoke asset beta values** and **different comparator pools** across all sectors

BE and PT

- Both **Belgium and Portugal adopt an alternative** approach to setting allowed betas **by relying exclusively on the empirical beta estimates** for the regulated company if listed (e.g., in the ET sector) and using regulatory precedent to set point estimates (Portugal across all sectors, Belgium only for GT)
- **Different asset betas across sectors in Belgium also reflect different regulatory bodies responsible** for ET and GT (CREG at the federal level) and GD and ED (VREG and CWaPE at the regional level) with the latter adopting same asset beta for ED and GD and comparator pools within their region

Whilst there is no consensus amongst regulators regarding the exact pool of comparators to be used to estimate asset betas (whether for all sectors, or individual sectors and services) most regulators rely on a pool of regulated companies operating in the gas and electricity sectors at EU or OECD level for which stocks are considered sufficiently liquid

2

Beta Adjustment

There are two adjustments regulators have commonly adopted to correct equity betas for regulated utilities

To reduce the impact of **estimation errors** on equity beta values associated to the OLS regression method and to address their **temporal instabilities**, academic studies have suggested applying post-estimation adjustments to raw equity betas. The two most common adjustments are the Blume-adjustment and the Vasicek-adjustment:

Blume Adjustment[1]

- The **Blume adjustment** originates from Blume's observation in the 1970s that equity betas exhibit **mean-reversion**
  - This means that finding a low equity beta in one period for a given stock increases the likelihood of finding a higher equity beta in the next period for that stock
- To reduce this error, Blume finds that the beta for the next period is best forecasted by a **weighted average** of the **raw equity beta** (weight = **2/3**) and the **market beta of 1** (weight = **1/3**)
- The Blume adjustment is often adopted as it is computationally easy to implement

Vasicek Adjustment[2]

- The **Vasicek adjustment** originates from Vasicek's findings in 1973 that: **first**, a stock with a raw beta <1 is more likely to have been affected by a negative estimation error, and that the best forecast of the "true" beta is a value above the raw beta; **second**, the adjustment to eliminate the estimation error depends on the precision of the beta estimate (as measured by the standard error of the OLS regression)
- Consequently, Vasicek proposes an adjustment where the beta is calculated as the **weighted average** of the **raw equity beta** and a "**prior" expectation**, with the weights depending on the standard error of the raw beta. In practice, the Vasicek adjustment **shifts the beta estimate towards a prior expectation,** with the speed of convergence being greater the lower the precision of the beta estimate (i.e., the higher the standard error)
- The Vasicek adjustment is considered more difficult to implement as it requires making an assumption about the prior beta expectation (which in Blume is assumed to be 1)

1. Blume (1971), On the assessment of risk, *Journal of Finance*: 26 (1–10); 2. Vasicek (1973): A note on using cross-sectional information in Bayesian estimation of security betas, *Journal of Finance*: 28 (1233–1239).

European regulators are broadly equally divided amongst those who decide to adjust raw betas and those which rely exclusively on raw betas

	Blume	Vasicek	No Adj.	Stated Rationale
AT		✓		• The regulator argues for a Vasicek adjustment to address the potential estimation error and relies on a prior based on the beta across the Bloomberg World Utilities Index and the Austrian comparator pool beta, after accounting for capital structure
BE	✓		✓	• The beta for ET is not adjusted, but CREG does not provide a rationale. CWaPE adopts a Blume adjustment arguing that it adjusts for possible estimation errors. The VREG considers applying a Dimson correction,[1] but - following statistical tests - it ultimately does not
FR			✓	• In its previous decision (2016), the CRE used a Vasicek adjustment. However, in its latest decision (2021), the CRE no longer uses Vasicek adjusted betas on grounds that it is difficult to implement accurately in practice
DE		✓		• The German regulator argues in favour of the Vasicek method as there is no evidence that this method is inaccurate and because this approach, relative to Blume, corrects for the high statistical uncertainty (estimation error)
NL			✓	• The Dutch regulator argues that it does not have sufficient evidence to determine an appropriate prior to apply the Vasicek adjustment. It argues that the beta of regulated companies is lower than 1, due to regulated sectors' demand and related returns being relatively insensitive to the economic cycles; and that beta values estimated in previous regulatory periods are also not a good prior as they may contain an estimation error
PT	✓			• The Portuguese regulator notes that its approach is in line with its previous regulatory decisions for the electricity and gas sectors
ES			✓	• The Spanish regulator argues that an adjustment would be applicable if companies had the option to diversify across sectors and in the context of using a forward-looking approach, further arguing that regulated sectors' betas have historically remained lower than 1
GB			✓	• Ofgem's RIIO-2 consultant (Indepen) argues that an adjustment towards a beta of 1 is not appropriate when considering a single company or sector. At RIIO-3, as far we understand the beta adjustment has not been discussed
IT	✓			• ARERA argues that using the Blume adjustment corrects for the risk of systematically underestimating (overestimating) the cost of equity for firms with a beta lower (higher) than 1. However, for the ED and GD sectors, ARERA is considering adopting the average between the Blume-adjusted beta and raw betas due to its choice of comparators which have a higher share unregulated revenues

Half of the European regulators surveyed adjust the raw beta using either the Blume or Vasicek adjustment to correct for estimation errors in the equity beta values associated with the statistical regression method, in line with ARERA's proposal

1. When betas are calculated using daily returns, there is a risk of differences in the company's stock price and the market index. A Dimson correction allows to correct for this by basing estimates on the same-day market index as independent variable, supplemented with the market index from one period earlier and one period later. Sources: NERA Analysis. See the Annex for detailed sources.

De-levering of Comparators' Equity Betas

There are two main de-levering formulae European regulators rely upon to adjust for the company-specific financing structures of comparator companies

Equity betas estimated using statistical regression reflect the business and financial risk of comparator companies. The financial risk is closely associated to the capital structure of the company, which often differs from the capital structure of the regulated entity for which the equity beta is being set. Therefore, regulators correct the equity betas of comparator firms for the company-specific financing structure and tax rates. To do so, the two most common delivering formulae are the Hamada and Harris-Pringle:

Hamada[1]

- The Hamada-formula is used to de-lever the equity betas of the comparator companies for their respective financial leverage, i.e., their capital structure, and differences in tax rates
- The Hamada formula assumes that firms adopt a constant debt policy - i.e., fixed debt (in absolute terms). Further, the Hamada formula assumes that the risk associated with the tax shield and with the debt of the company is the same, such that the cost of debt is used to discount the firm's tax shield
- The resulting formula is as follows: $\beta^{levered} = \beta^{unlevered}(1 + (1 - T)\left(\frac{D}{E}\right))$

Harris-Pringle[2]

- The Harris–Pringle formula assumes that a firm follows a constant leverage policy—that is, that debt changes in proportion to the equity value such that the D/E ratio is always constant
- Further, the Harris-Pringle formula assumes that the risk associated with the tax shield and with the equity of the company is the same, hence the tax shield is discounted using the weighted average cost of capital and therefore is not present in the de-levering formula
- The resulting formula is as follows: $\beta^{levered} = \beta^{unlevered}(1 + \left(\frac{D}{E}\right))$

1. Hamada, R.S. (1972), The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stock, *Journal of Finance*: 27 (435–452); 2. Harris, R.S. and Pringle, J.J. (1985), Risk-Adjusted Discount Rates Extensions form the Average Risk Case', *Journal of Financial Research*, 237–244.

When applying the de-levering formula, regulators have to choose which values of debt, equity and tax to use for the comparator companies

Regulators have a choice with respect to what debt, equity and tax rate input values to use. Regulators may also take different views regarding the estimation window for each of the above parameters, whether to take a single value or an average of different values. We set out the choices regulators face for each parameter of the de-levering formulae:

Equity

- There are two measures of equity that can be considered for the purpose of calculating D/E ratios for listed companies:
  - The **book value of equity** which is the value of a firm's assets as reported on the balance sheet
  - The **market value of equity**, as measured by the **market capitalisation**, which is the current total value of its outstanding shares in the market
- Financial literature recommends the use of market values to determine the equity in debt-to-equity ratios:[1]
  - This is because **market capitalisation**, **reflects the current market consensus of the company's equity value**, incorporating all available information, whereas book equity is based on historical cost and is influenced by accounting policies and generally does not represent the true current and intrinsic value of a company's equity
  - This is **particularly important when calculating beta** since the beta is assessed based on the market value of common stock and the consistent measure of equity is the market value of common equities

Debt

- There are two choices to be made to determine the debt value for the purpose of calculating D/E ratios for listed companies:
- Market vs. book value of debt: The **market value** of debt is the amount that an investor is willing to pay to buy a company's outstanding debt. This amount is usually different from the **book value** reported in the company's financial reports. Whilst market values may be preferred for similar reasons set out above for market equity values, these are often difficult to estimate in practice and therefore not commonly used
- Gross vs. Net Debt: Net debt is the value of a company's gross debt less any cash and cash-like assets on the balance sheet. Net debt shows how much debt a company has once it has paid all its debt obligations with its existing cash balances and therefore allows to consider the effect of liquidity on risk exposure. **Gross debt** is the total value of a company's debt obligations
  - Gross debt may fail to measure the effective leverage of a firm, as it ignores cash and liquid assets, which offset the increased market risk exposure due to leverage. Therefore, **academic literature suggests the beta should be estimated using a net debt ratio rather than gross debt ratio**[2]

Tax

- There are two possible tax measures that can be used: the **effective tax rate** which usually reflects the actual tax paid by a company in a given year in % terms of profits; and the **statutory tax rate** which is the prevailing corporate tax rate as established by law in each country

1. Brealey et al., Principles of Corporate Finance, 14th edition, p.530; 2. Brealey et al., Principles of Corporate Finance, 14th edition, pp.87-88; Ross S., Westerfield R., Jaffe J., Corporate Finance, 6th Edition.

ARERA is the only European regulator which uses the book value of equity (instead of the market capitalisation) and long-term debt to calculate D/E[1]

	De-levering Formula	D/E Ratio	Debt Value	Equity Value	Tax Shield
AT	• Hamada	• Observed individual comparator firms' D/E values, averaged over the relevant estimation window	• Book value (not further specified)	• Market capitalisation	• Effective tax rates estimated over time horizon consistent with beta estimation window
BE	• Hamada	• D/E reflects value for Elia Transmission and not the Elia Group	• Not specified	• Not specified	• Effective tax rate (corporate tax rate after considering the relevant tax reductions)
FR	• Hamada	• Individual comparator firms' values of D/E estimated over the same time horizon as the beta estimates (2 and 5 years)	• Net debt	• Market capitalisation	• Effective tax rates estimated over time horizon consistent with beta estimation window
DE	• Hamada	• Individual comparator firms' D/E	• Book value of net debt[2 3]	• Market capitalisation	• Average statutory corporate tax rate across regions
NL	• Hamada	• Unique value applied to all comparators estimated as the median of the three-year average D/E of each comparator	• Net debt	• Market capitalisation	• Average value of statutory tax rate over the three-year period (2018-2020)
PT	• Hamada	• Estimated as the average D/E value of REN and Grupo EDP between 2018 and 2020 (previous regulatory period)	• Net debt	• Market capitalisation	• Statutory tax rate as of 2021, calculated as the sum of corporate income tax rate, municipal surcharge, and the state surcharge
ES	• Hamada	• Observed individual comparator firms' D/E values calculated as the averages between 1st January 2012 and 31st December 2017 (beta estimation window)	• Book value of net debt[3]	• Market capitalisation	• Statutory tax rate for each country as of 31st December 2017
GB	• Harris-Pringle	• Actual gearing level of comparator company used to de-lever asset beta, on grounds that different from notional value	• Market value and book value of net debt	• Market capitalisation	• N/A
IT	• Hamada	• Not specified, but we assume ARERA uses individual comparator firms' values of D/E	• Book value of long-term debt[3]	• Book value	• Effective

1. Note the slide reflects regulatory approaches taken by regulators in the electricity transmission sector only; 2. This is our understanding of the German approach. BNetzA does not explicitly refer to net debt, but it mentions that it uses Bloomberg's "Cash and Marketable Securities" and "Short-Term and Long-Term debt" entries to calculate a debt value. 3. Regulators refer to the Bloomberg value rather than explicitly to book or market value. We have separately confirmed with Bloomberg that they consider book values. Sources: NERA Analysis. See the Annex for detailed sources.

For de-levering equity betas of comparators, most regulators use the Hamada formula, and adopt market capitalisation and net debt to calculate D/E ratios

De-Levering Formula	• ARERA adopts the **Hamada formula to de-lever** the equity beta, in line with **the approach adopted by most European regulators**, except for Great Britain which adopts the Harris-Pringle formula (i.e., no tax shield)
D/E	• In line with our understanding of ARERA's approach, **most regulators adopt company-specific values for de-levering each comparator's firm equity beta**, with the exception of the Netherlands which relies on a single D/E value estimated based on the comparators' actual D/E values
Equity Value	• In setting the value of equity, **all regulators for which information is available (i.e., excl. Belgium), except for ARERA, estimate the equity value using market capitalisation**
Debt Value	• In setting the value of debt, **all regulators for which information is available (i.e., excl. Austria and Belgium), except for ARERA, estimate the debt value using net debt**. Most, but not all regulators, refer to the book value instead of the market value
Tax rate	• Regulators adopt different approaches with regards to the tax rate assumption, with **some regulators using the statutory tax rate and others relying on the effective tax rates** of the comparator firms

ARERA's use of the Hamada formula for de-levering is aligned with European regulatory practice. However, ARERA's is the only regulator amongst those surveyed that uses book value of equity, and not market capitalisation, and long-term debt rather than net debt for calculating the debt-to-equity ratios

4 Market Reference Index

Most European regulators rely on a regional index as the market reference for estimating betas for the electricity transmission sector

	National	Regional	Index	Rationale
AT		✓	EuroStoxx 50	• The Austrian regulator uses a regional index for the European comparators, and national indices for non-EU\\\\ comparators, to account for currency differences but preferring a regional index for Euro area comparators given the level of integration of EU markets
BE	✓		Euronext - BEL20	• No rationale provided (noting that the only comparator is Elia – Belgian TSO)
FR		✓	European index (not specified)	• CRE's consultant, Oxera, prefers the use of a regional index for the European comparators, and national index for the GB and US comparators, supporting its choice of a regional index on grounds that local capital markets in the euro area are not as deep as the UK market and that evidence shows that Euro area investors prefer regional markets (in this case, the euro area)
DE		✓	Eurostoxx 600	• BNetzA's consultants argue that European capital markets have integrated since 2008, which has eliminated the exchange rate risk between Eurozone countries
NL		✓	Eurostoxx 600	• The ACM uses a regional index arguing that investors diversify at the European level, and that a regional index facilitates comparison and replicability across countries
PT	✓		PSI Geral	• No rationale provided (noting that the only comparator is REN – Portuguese TSO)
ES		✓	Eurostoxx 600, Bloomberg Index (not specified)	• The Spanish regulator prefers a regional index as it facilitates comparison and replicability across countries
GB		✓	FTSE All-Share Index	• In GB, the national and regional indices are effectively the same due to the currency. For Ofgem, regressing GB companies on a European index would mean introducing currency risk • At RIIO-3, for European comparators, Ofgem is minded to use the "most diversified local index in the relevant currency"[1]
IT	✓		ATX (AT), BEL20 (BE), CAC (FR), FTSEMIB (IT), PSI20 (PT), FTSE100 (GB), IBEX (ES)	• ARERA notes that if investors diversify at the Eurozone level, a regional index would be appropriate. However, ARERA considers national indices due to its choice of a comparator pool beyond the Euro area, and argues that national indices sterilise country-specific risks

1. Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, p.82, para.3.159.
Sources: NERA Analysis. See the Annex for detailed sources.

Most European regulators rely on a regional index as the market reference for estimating betas for the electricity transmission sector

European regulators' approach

- In general, the decision to opt for a domestic, regional or global index is contingent on the assessment of the degree of integration of financial markets and the assumption around investors' diversification strategies
- Regulatory precedent shows that **regulators across Europe prefer using a regional index for European comparators, and specifically the Eurostoxx, over national indices.**

Rationale for using a regional index

- Regulators adopting a regional index for their European comparators, justify their choice on grounds that:
  - European financial markets are highly **integrated** and **investors in the Euro area diversify at the European level**;
  - **Local capital markets in the Euro area are not as deep** as other local markets (such as in the UK or US); and
  - That a pan-European index facilitates **comparison and replicability across jurisdictions**

Rationale for using a national index

- **Only 2 out of the 8 countries surveyed rely on national indices** (Belgium and Portugal)
- However, **regulators in both countries fail to provide a rationale for choosing a national index** and we note that Belgium and Portugal are the **only countries that do not rely on a comparator pool** but rather estimate directly betas using the returns on stocks of their national TSOs (Elia and REN, respectively)

ARERA's choice of using a national index is not line with the approaches taken by most European surveyed in this report and with the view – which it acknowledges in the consultation document[1] – that investors in the euro area diversify at the European level and that therefore a pan-European index is preferred for European comparators

1. ARERA, DCO 342/24, para.3.29.

Estimation Window and Averaging Periods

Regulators choose over which time horizon to consider the market data to estimate the beta in terms of estimation window and averaging period

The Capital Asset Pricing Model (CAPM) framework is designed to assess the expected equity returns based on the risk profile of a company or sector. Therefore, in determining the CAPM inputs and to best capture the *expected* returns, regulators must choose an adequate time frame over which parameters are estimated:

Estimation window	• For estimating the beta, the main choice is with respect to the **estimation window** i.e., the period of time (e.g., 2-, 5- or 10- year periods) over which the OLS regression is performed to estimate the equity beta of comparator firms • In **choosing the length of the estimation window**, regulators must strike a balance between **capturing the latest market data** which is the best proxy for future expectations (therefore using short estimation windows) and **volatility of the estimates** due to noise or market fluctuations (therefore preferring longer estimation windows)
Spot values and averaging approach ("averaging period")	• Under the CAPM framework, the **beta estimate reflects directly the beta coefficient of the OLS regression over a given estimation window** (referred hereafter as "spot values") • However, as we show in the next slides, some regulators in Europe – including Ofgem in Great Britain and BNetzA in Germany - have also taken **averaged beta values** (i.e., the average of beta coefficients over a given time horizon, e.g., 2-, 5- or 10- year period) when identifying allowed beta ranges to reduce the impact of short-term market noise and fluctuations • Whilst there could be some merit in this approach to smooth out short-term fluctuations, it is commonly accepted that **averaging betas is not strictly appropriate from an econometric perspective** and, as stated by Ofgem itself, "OLS is not designed to be used in this way"[1]

1. Ofgem (2019), RIIO-2 Sector Specific Methodology Decision – Finance Annex, p.152..

Our review shows that all countries consider spot values when estimating betas, and that the estimation window usually ranges between two and five years

	Estimation Window	Averaging Period	Rationale
AT	• 3 and 5 years	• Spot	• The Austrian regulator argues that a 3-to-5-year estimation window is a good compromise which allows to capture potential dynamics in betas of individual companies over time, without being influenced by random fluctuations in short time
BE	• 2 years	• Spot	• The CREG argues for a 2-year estimation window to align with the methodology adopted by other European regulators and to limit the impact of the volatility of the beta in any given year in the final determination
FR	• 2 and 5 years	• Spot	• The CRE argues that 2 and 5 year-estimation windows are a good compromise between a sufficiently short observation period to reflect the most recent information and a long enough period to accurately represent the non-diversifiable risk of comparator companies
DE	• 1 year	• Spot, 3 and 5 years	• The BNetzA considers both current and averaged estimates, justifying its approach as follows: "(…) determining the [beta] risk factor is all about determining the current risk of the reference company in question. Accordingly, the shortest possible time periods should be used, as close as possible to the cut-off point of the consideration. The additional consideration over periods of 3 and 5 years is therefore only carried out to ensure the stability of the risk factors over time, particularly with regard to the duration of the regulatory period"[1]
NL	• 3 years	• Spot	• The ACM uses a 3-year estimation window to ensure consistency with the risk-free rate calculations
PT	• 3 years	• Spot	• No rationale provided
ES	• 6 years	• Spot	• The CNMC argues for a 6-year estimation window as it allows to capture the cycle of the Spanish economy and is consistent with the length of the regulatory period
GB	• 2, 5, and 10 years	• Spot, 2, 5 and 10 years	• Ofgem considers both current and averaged estimates, arguing that averaged values can reduce the impact of short-term market noise while acknowledging that averaging is not strictly appropriate from an econometric perspective since "taking such averages could affect the underlying econometric principles (e.g., OLS is not designed to be used in this way)".[2] Overall, Ofgem relied on the beta estimates across the different estimation windows and averaging period to identify a potential range of allowed asset betas
IT	2 years	• 5 years	• ARERA argues that more recent observations should be considered, thereby a short estimation window should be applied, but longer-term trends should also be considered to assess how exogenous factors' impact on beta and systematic differences across sectors

Note: The slide reflects regulatory approaches taken by regulators in the electricity transmission sector only. 1. Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), p.36; 2. Ofgem (2019), RIIO-2 Sector Specific Methodology Decision – Finance Annex, p.152
Sources: NERA Analysis. See the Annex for detailed sources.

All European countries surveyed in this report, but ARERA, consider also spot values when estimating betas and an rely on estimation windows between 2 and 5 years

European regulators' approach	• Regulatory precedent shows that regulators have a preference for **estimation windows between 2 and 5 years** and for using directly OLS coefficient (i.e., **spot / current values)** of the regression, rather than taking averages of betas over time
Estimation window	• ARERA's **estimation window of 2 years** is aligned with the shortest window adopted by most of the European regulators surveyed in this report • Indeed, most European regulators rely on **observation periods ranging from 2 to 5 years**, with the exceptions of regulators in Germany (1 year), GB (2, 5 and 10 years), and Spain (6 years)
Averaging period	• **Most regulators in Europe rely on spot values** for estimating the beta coefficient, therefore directly using the OLS coefficient from the regression rather than taking the average of coefficients • An exception to this are Germany (spot, 3 and 5 years) and Great Britain (spot, 2, 5 and 10 years) which alongside estimating spot values also assess averages over time • **ARERA is therefore the only regulator which does not consider spot values** but sets the beta with exclusive reference to the value estimated considering a 5-year average of 2Y betas

ARERA's estimation window of 2 years is aligned with that used by many regulators across Europe, but is the only regulator not considering spot values and relying exclusively on averaged beta estimates over a 5-year period, despite this approach not being strictly appropriate from an econometric perspective

6

Frequency of Observations

Majority of European regulators rely on daily observations when estimating betas for the electricity transmission sector

	Daily	Weekly	Monthly
AT		✓	
BE		✓	
FR	✓		
DE	✓		
NL	✓		
PT	✓		
ES		✓	
GB	✓		
IT	✓		

European regulators' approach	• **Most European regulators (5/8) rely on daily data**, with only Austria, Belgium and Spain relying on weekly data. No country relies on monthly data
Rationale for using daily observations	• Daily data allows for the most data points, leading to smaller estimation errors and providing more stable and accurate beta estimates (**French, Dutch and Italian regulators**), with some regulators checking that stocks are sufficiently liquid (**Dutch regulator**) and/or that all properties of the OLS estimation are respected when using daily data (**GB and Dutch regulator**)
Rationale for using weekly observations	• The **Belgian Authority** argues that relying on weekly data improves the statistical robustness of beta estimates • Missing data or stock illiquidity in any given day systematically reduce correlation with the market for reasons other than market risk; this may be mitigated by the use of weekly data (**Spanish and Austrian regulators**)

ARERA's proposal to rely on daily data is in line with the approach taken by most European regulators surveyed in this report

Sources: NERA Analysis. See the Annex for detailed sources.

Annex: Sources

Austria

Section	Sources
Comparator pool	• Electricity transmission and distribution - E-Control (17 November 2022), Regulierungssystematik für die Strom-Übertragungsnetzbetreiber 1. Jänner 2023 - 31. Dezember 2028, p.17; E-Control (31 October 2023), Regulierungssystematik für die fünfte Regulierungsperiode der Stromverteilernetzbetreiber 1. Jänner 2024 - 31. Dezember 2028, p.77; Randl, Zechner (7 July 2022), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Strom-Übertragungsnetzbetreiber für die Regulierungsperiode 2023 bis 2027, pp.90-94 • Gas transmission - E-Control (n.d.), METHODE GEM § 82 GWG 2011 DER 4. PERIODE FÜR DIE FERNLEITUNGEN DER XXX GMBH, p. 7; E-Control (n.d.), Methode gem § 82 GWG 2011 der 5. Periode für die Fernleitungen der xy GmbH, p.9; Randl, Zechner (3 November 2019), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Gas-Fernleitungsbetreiber für die Regulierungsperiode 2021 bis 2024, p.34 • Gas distribution - E-Control (4 November 2022), Regulierungssystematik für die vierte Regulierungsperiode der Gas-Verteilernetzbetreiber 1. Jänner 2023 - 31. Dezember 2027, p. 67; Randl, Zechner (11 November 2023), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für die österreichischen Gas-Fernleitungsnetzbetreiber für die Regulierungsperiode 2025 bis 2028, p.90-93
Beta Adjustment	• E-Control (17 November 2022), Regulierungssystematik für die Strom-Übertragungsnetzbetreiber 1. Jänner 2023 - 31. Dezember 2028, p.17 • Randl, Zechner (7 July 2022), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Strom-Übertragungsnetzbetreiber für die Regulierungsperiode 2023 bis 2027, pp.71-73
De-levering of Comparators' Equity Betas	• Randl, Zechner (7 July 2022), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Strom-Übertragungsnetzbetreiber für die Regulierungsperiode 2023 bis 2027, pp.70-71
Reference Index	• Randl, Zechner (7 July 2022), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Strom-Übertragungsnetzbetreiber für die Regulierungsperiode 2023 bis 2027, p.68
Estimation Window and Averaging Periods	• E-Control (17 November 2022), Regulierungssystematik für die Strom-Übertragungsnetzbetreiber 1. Jänner 2023 - 31. Dezember 2028, p.17 • Randl, Zechner (7 July 2022), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Strom-Übertragungsnetzbetreiber für die Regulierungsperiode 2023 bis 2027, p.69
Frequency of Observations	• E-Control (17 November 2022), Regulierungssystematik für die Strom-Übertragungsnetzbetreiber 1. Jänner 2023 - 31. Dezember 2028, p.17 • Randl, Zechner (7 July 2022), Gutachten zur Ermittlung von angemessenen Finanzierungskosten für Strom-Übertragungsnetzbetreiber für die Regulierungsperiode 2023 bis 2027, p.69

Belgium

Section	Sources
Comparator pool	• Electricity transmission - CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027, p.18 • Gas transmission – CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport de gaz naturel, l'installation de stockage de gaz naturel et l'installation de GNL pour la période régulatoire 2024-2027, p.14, art.19 • Electricity and gas distribution – CWaPE (31 May 2023), Annexe 1 - Motivation de la méthodologie tarifaire applicable aux gestionnaires de réseau de distribution d'électricité et de gaz actifs en région wallonne pour la période régulatoire 2025-2029, pp.32-33; VREG (21 June 2024), Tariefmethodologie reguleringsperiode 2025-2028 – Bijlage 2: Kapitaalkostvergoeding, pp.24-26
Beta Adjustment	• No adjustment - CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027 • Blume adjustment - CWaPE (31 May 2023), Annexe 1 - Motivation de la méthodologie tarifaire applicable aux gestionnaires de réseau de distribution d'électricité et de gaz actifs en région wallonne pour la période régulatoire 2025-2029, p.32 • Dimson adjustment - VREG (21 June 2024), Tariefmethodologie reguleringsperiode 2025-2028 – Bijlage 2: Kapitaalkostvergoeding, p. 25
De-levering of Comparators' Equity Betas	• CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027, p.18 • CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027, p.44
Reference Index	• CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027, p.18
Estimation Window and Averaging Periods	• CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027, p.18
Frequency of Observations	• CREG (30 June 2022), Arrêté fixant la méthodologie tarifaire pour le réseau de transport d'électricité et pour les réseaux d'électricité ayant une fonction de transport pour la période régulatoire 2024-2027, p.18

France

Section	Sources
Comparator pool	• Electricity transmission – Frontier Economics (1 July 2016), Audit des demandes de RTE sur le cadre de remuneration, p. 37; CRE (21 January 2021), Délibération de la Commission de régulation de l'énergie du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de transport d'électricité (TURPE 6 HTB), p. 55; Oxera (22 July 2020), Audit de la demande de rémunération du capital de RTE pour le TURPE 6, pp.21-22 • Electricity distribution – CRE (21 January 2021), Délibération de la Commission de régulation de l'énergie du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de distribution d'électricité (TURPE 6 HTA-BT), p. 51; Oxera (22 July 2020), Audit de la demande de rémunération du capital d'Enedis pour le TURPE 6, pp.21-22 • Gas transmission – CRE (30 January 2024), Délibération de la Commission de régulation de l'énergie du 30 janvier 2024 portant décision sur le tarif d'utilisation des réseaux de transport de gaz naturel de GRTgaz et Teréga, p.54; CRE (July 2023) Public Consultation No. 2023-07 Of 26 July 2023 relating to next tariff for the use of natural gas transmission networks of GRTgaz and Teréga, p.60 • Gas distribution – Compass Lexecon (38 July 2023), Estimation du CMPC des activités régulées de distribution de gaz pour la période 2024-2028 p. 36; CRE (15 February 2024), Deliberation of 15 February 2024 concerning the decision on GRDF's regulated tariff for use of the public natural gas distribution networks, p.57
Beta Adjustment	• Oxera (22 July 2020), Audit de la demande de rémunération du capital de RTE pour le TURPE 6, p.23 • Frontier Economics (1 July 2016), Audit des demandes de RTE sur le cadre de remuneration, p.42
De-levering of Comparators' Equity Betas	• Frontier Economics (November 2015), Évaluation du taux de rémunération des gestionnaires de réseaux d'électricité et de gaz naturel en France, p.87 • Oxera (22 July 2020), Audit de la demande de rémunération du capital de RTE pour le TURPE 6, p.24
Reference Index	• Oxera (22 July 2020), Audit de la demande de rémunération du capital de RTE pour le TURPE 6, p.23
Estimation Window and Averaging Periods	• Oxera (22 July 2020), Audit de la demande de rémunération du capital de RTE pour le TURPE 6, p.22
Frequency of Observations	• Oxera (22 July 2020), Audit de la demande de rémunération du capital de RTE pour le TURPE 6, p.22

Germany

Section	Sources
Comparator pool	• Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), pp.26-27, 36 • Frontier, Randl, Zechner (July 2021), Wissenschaftliches Gutachten zur Ermittlung der Zuschläge für unternehmerische Wagnisse von Strom- und Gasnetzbetreibern, pp.47-49
Beta Adjustment	• Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), p.27 • Frontier, Randl, Zechner (July 2021), Wissenschaftliches Gutachten zur Ermittlung der Zuschläge für unternehmerische Wagnisse von Strom- und Gasnetzbetreibern, p.50
De-levering of Comparators' Equity Betas	• Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), p.34-35 • Frontier, Randl, Zechner (July 2021), Wissenschaftliches Gutachten zur Ermittlung der Zuschläge für unternehmerische Wagnisse von Strom- und Gasnetzbetreibern, p.51
Reference Index	• Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), p.30 • Frontier, Randl, Zechner (July 2021), Wissenschaftliches Gutachten zur Ermittlung der Zuschläge für unternehmerische Wagnisse von Strom- und Gasnetzbetreibern, p.49
Estimation Window and Averaging Periods	• Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), p.36
Frequency of Observations	• Bundesnetzagentur (12 October 2021), Beschluss in dem Verwaltungsverfahren nach 29 Abs. 1 Energiewirthschaftrsegesetz (EnWG) in Verbindung mit 7 Abs. 6 Stromnetzentgeltverordnung (StromNEV), p.30

Netherlands

Section	Sources
Comparator pool	• Comparator pool - ACM (20 September 2021), Bijlage 3 bij het methodebesluit regionale netbeheerders gas 2022-2026, Bijlage 3 bij het methodebesluit regionale netbeheerders elektriciteit 2022-2026, p.24, para.82 • Sectoral differences - ACM (n.d.), Bijlage 2 bij het methodebesluit regionale netbeheerders elektriciteit 2017-2021, p.16
Beta Adjustment	• ACM (20 September 2021), Bijlage 3 bij het methodebesluit regionale netbeheerders elektriciteit 2022-2026, p.22, para.75
De-levering of Comparators' Equity Betas	• ACM (20 September 2021), Bijlage 3 bij het methodebesluit regionale netbeheerders elektriciteit 2022-2026, p.33, paras.108-112 • Brattle (7 April 2021), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, p.19
Reference Index	• ACM (20 September 2021), Bijlage 3 bij het methodebesluit regionale netbeheerders elektriciteit 2022-2026, p.23, para.79
Estimation Window and Averaging Periods	• ACM (20 September 2021), Bijlage 3 bij het methodebesluit regionale netbeheerders elektriciteit 2022-2026, p.23, para.79
Frequency of Observations	• ACM (20 September 2021), Bijlage 3 bij het methodebesluit regionale netbeheerders elektriciteit 2022-2026, p.20, para.68

Portugal

Section	Sources
Comparator pool	• Electricity transmission - ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.256 • Electricity distribution - ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.257 • Gas transmission - ERSE (June 2023), Parâmetros de regulação para o período 2024 a 2027, p.201 • Gas distribution - ERSE (June 2023), Parâmetros de regulação para o período 2024 a 2027, p.201
Beta Adjustment	• ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.254
De-levering of Comparators' Equity Betas	• ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.254
Reference Index	• ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.253
Estimation Window and Averaging Periods	• ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.253
Frequency of Observations	• ERSE (December 2021), Parâmetros de regulação para o período 2022 a 2025, p.253

Spain

Section	Sources
Comparator pool	• CNMC, (12 November 2019), CIR/DE/011/19, p.37
Beta Adjustment	• CNMC, (12 November 2019), CIR/DE/011/19, p.49
De-levering of Comparators' Equity Betas	• CNMC, (12 November 2019), CIR/DE/011/19, pp.75-77
Reference Index	• CNMC, (12 November 2019), CIR/DE/011/19, pp.26,37,70
Estimation Window and Averaging Periods	• CNMC, (12 November 2019), CIR/DE/011/19, p.49
Frequency of Observations	• CNMC, (12 November 2019), CIR/DE/011/19, p.49

Great Britain

Section	Sources
Comparator pool	• Comparator pool - CEPA (2020), RIIO-2: Beta Estimation Issues Annex, pp.41-47, para.3.2.2; Ofgem (3 February 2021), RIIO-2 Final Determinations – Finance Annex (Revised), p.42, para.3.70, Table 10; Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, p.96, Table 7 • European utilities - Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Overview Document, pp.119-120, para.10.10; Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, p.87, para.3.182 • Sectorial differences - Ofgem (3 February 2021), RIIO-2 Final Determinations – Finance Annex (Revised), pp. 43-44, par. 3.75; Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, pp.92-94, paras.3.203,3.212
Beta Adjustment	• Independ (December 2018), Ofgem Beta Study - RIIO-2: Main Report Final, p.10, footnote 17
De-levering of Comparators' Equity Betas	• Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p. 189 • Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p. 42, par. 3.40, Table 13
Reference Index	• CMA (28 October 2021), Final determination Volume 2A: Joined Grounds: Cost of Equity, p.103
Estimation Window and Averaging Periods	• Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, pp.85-86, paras.3.172-3.177
Frequency of Observations	• Ofgem (18 July 2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, pp.85-86, paras.3.172-3.177

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