Update to WACC Parameters for Drinking Water

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ACM

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28 July 2017

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I. Introduction and Summary

The Dutch Authority for Consumers and Markets (ACM) has commissioned *The Brattle Group* to provide an update of three of the parameters contained in our advice on the Weighted Average Cost of Capital (WACC) for drinking water distribution companies in the Netherlands, dated 28th June 2013 and 3rd July 2015.[1,2] Specifically, we have addressed:

- The selection of the peer group;
- The estimation of the asset beta;
- The estimation of the debt premium.

In preparing our update, we use data up to and including April 2017, this being the most recent data available at the time we started the work. As in the June 2013 and July 2015 reports we use a methodology that complies with the relevant decree and ministerial ruling.[3]

The Dutch water firms for which we are estimating the WACC are not publicly traded. Therefore we have selected a 'peer group' of publicly traded water distribution firms, as well as regulated energy network firms that have similar systematic risk to a regulated water distribution firm. We use the peer groups to estimate the beta for water distribution. The methodology specifies that the equity betas are estimated using daily betas taken over three years and tested for liquidity and statistical robustness. We estimate that the asset beta for water distribution in the Netherlands is 0.42. In our July 2015 report, we estimated an asset beta of 0.39. Hence, there is very little change in the estimated asset beta.

The methodology specifies that the allowed cost of debt should be based on the average cost of debt for bonds with a similar credit risk to the water firms, and the cost of debt for a group of bonds issued by firms engaged in similar activities to drinking water distribution that have a rating at or close to 'A' – so-called comparable bonds. We understand that 'similar activities' in this context means not only firms undertaking drinking water distribution but also firms engaged in activities such as the transport and/or distribution of gas and electricity. We identified a group of bonds that fit these criteria. This methodology results in a debt premium – being the additional return required over the risk-free rate – of 0.95%. This compares to a

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1 The WACC for Dutch Drink Water Companies', Dan Harris, Renato Pizzolla, The Brattle Group, 28th June 2013. Hereafter referred to as the June 2013 WACC report.

2 The WACC for Dutch Drink Water Companies', Dan Harris, Richard Caldwell, Ying-Chin Chou, The Brattle Group, 3rd July 2013. Hereafter referred to as the July 2015 WACC report.

3 The '*Drinkwaterbesluit*' and the '*Drinkwaterregeling*'.

premium of 0.82% in the July 2015 report. All of the increase is from the yields on comparable bonds. The total pre-tax cost of debt is 1.93%, which includes 15 basis points for the cost of issuing debt.

We calculate the risk-free rate based on the two-year and five-year average yield on 10-year Dutch government bonds. This results in a risk-free rate of 0.83%. The risk-free rate in the July 2015 report was 1.83%. The decrease is because the relatively high interest rates of 2010 and earlier no longer enter the five-year data window.

II. Selection of Peers

The Dutch water distribution firms for which we would like to estimate beta are not publicly traded. Therefore we need to find publicly traded firms which have similar systematic risk to the Dutch water distribution firms. We can then estimate a beta value from these firms, which we call 'comparables' or 'peers'.

We first identify a group of potential peers. We then apply test to see if the firms' shares are sufficiently liquid before deciding on the final peer group.

In determining the number of peers that should be in each peer group, there is a trade-off. On the one hand, adding more peers to the group reduces the statistical error in the estimate of the beta. On the other hand, as more peers are added, there is a risk that they may have a different systematic risk than the regulated drinking water firms, which makes the beta estimate worse. In statistical terms, once we have 6-7 peers in the group the reduction in the error from adding another firm is relatively small.

In the earlier 2013 and 2015 reports, to reach a sufficient number of peers, we first attempted to include companies involved in similar business lines in the EU. However, as there were not sufficient EU firms which met the criteria, we added peers from the United States.

In this report we begin with the July 2015 peer group of 12 firms. We include one new potential peer – Fluxys – and firms that were rejected as peers in July 2015 but which may meet the criteria on sufficient revenue and liquidity this time. We also check if July 2015 peers still meet the criteria. Table 1 summarises the potential peers.

Table 1: Firms Selected as Potential Peers

Potential peers	Country	Considered as potential peer in 2015 report	Selected as peer in 2015 report
European and US Water Companies			
Severn Trent PLC	United Kingdom	Yes	Yes
Pennon Group PLC	United Kingdom	Yes	Yes
United Utilities Group PLC	United Kingdom	Yes	Yes
Athens Water Supply & Sewerage	Greece	Yes	No
Tallinna Vesi	Estonia	Yes	No
Thessaloniki Water and Sewage Company SA	Greece	Yes	No
Dee Valley Group PLC	United Kingdom	Yes	No
Eaux de Royan SA	France	Yes	No
Societe des Eaux de Douai SA	France	Yes	No
California Water Service Group	United States	Yes	Yes
Aqua America	United States	Yes	Yes
European Network Companies			
Snam	Italy	Yes	Yes
Terna Rete Elettrica Nazionale	Italy	Yes	Yes
REN - Redes Energeticas Nacionais	Portugal	Yes	Yes
Red Electrica	Spain	Yes	Yes
Enagas	Spain	Yes	Yes
National Grid	United Kingdom	Yes	Yes
Elia System Operator	Belgium	Yes	Yes
Fluxys Belgium	Belgium	No	No

II.A. Liquidity and Revenue Tests

The potential illiquidity of shares is a particular issue when estimating betas using daily returns, as the ACM's methodology specifies.[4] Illiquid stocks will tend to underestimate a beta. Accordingly, we apply two initial 'screens' or criteria to test whether a firm can be included in our sample for beta – a liquidity test and a revenue test. We describe the tests below.

II.A.1. Liquidity Tests

We first test each firm to see how frequently its shares are traded, the idea being that more frequent trading will give a more reliable beta estimate. For example, suppose that the true beta of a firm was 1.0, so that every day the firm's true value moved exactly in line with the market. But the firm's shares only change price when they are traded. Suppose that the firm's shares are traded only every other day. In this case, the firm's actual share price will only react to news the day after the market reacts. This will give the impression that the firm's value is not well correlated with the market, and the beta will appear to be less than one. Using weekly returns to calculate beta mitigates this problem, since it is more likely that the

[4] If we calculated beta using weekly returns for example, the volumes of shares traded would be higher, and share price would have more time to react to new information.

firm's shares will be traded in the week. However, using weekly returns have other disadvantages, such as providing 80% less data points over any given period.

Specifically, we check to see if a firm's shares trade on more than 90% of days in which the market index trades. Table 2 shows that Dee Valley, Eaux de Royan and Eaux de Douai failed this test. We therefore exclude these firms from the list of final peers.

Table 2: Liquidity Test

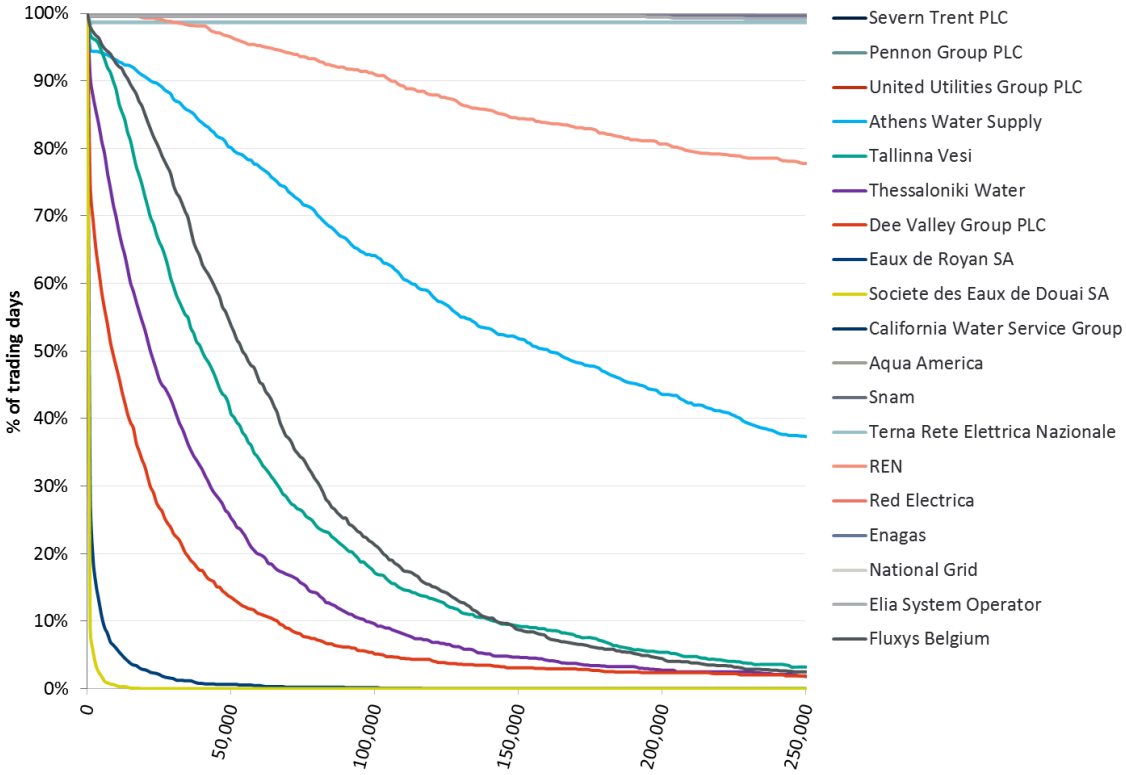
	Country	Liquidity test: Volume as % of share outstanding [A]	Liquidity test: % of days company traded [B]	Liquidity test: Average value traded (€) [C]
European and US Water Companies				
Severn Trent PLC	UK	1.49%	100.00%	17,693,556
Pennon Group PLC	UK	1.26%	100.00%	9,696,670
United Utilities Group PLC	UK	1.55%	100.00%	22,004,565
Athens Water Supply & Sewerage	GR	0.28%	94.85%	427,918
Tallinna Vesi	EE	0.14%	97.35%	70,740
Thessaloniki Water and Sewerage Company SA	GR	0.14%	94.15%	44,897
Dee Valley Group PLC	UK	0.23%	80.05%	43,981
Eaux de Royan SA	FR	0.06%	39.55%	5,911
Societe des Eaux de Douai SA	FR	0.05%	15.37%	2,228
California Water Service Group	US	2.33%	100.00%	4,601,392
Aqua America	US	2.02%	100.00%	16,081,291
European Network Companies				
Snam	IT	1.64%	98.75%	48,605,621
Terna Rete Elettrica Nazionale	IT	1.92%	98.75%	30,453,309
REN - Redes Energeticas Nacionais	PT	0.49%	99.69%	1,345,115
Red Electrica	ES	3.53%	99.69%	55,795,690
Enagas	ES	4.37%	99.69%	46,898,158
National Grid	UK	0.98%	100.00%	80,210,439
Elia System Operator	BE	0.33%	99.69%	1,569,567
Fluxys Belgium	BE	0.14%	98.21%	84,436

Notes and sources:
[A] to [C]:
Based on data from Bloomberg.
Average data from 01/05/2012 to 30/04/2017.

Figure 1 shows, for the potential beta peers, the percentage of days in which the amount of trading exceeded a given value of shares traded per day from 1 May 2012 to 30 April 2017. We have explored values between €0 and €250,000 of shares traded per day. Clearly, when the value is zero, all the firms pass the threshold. Six water firms and six network firms exceed the €250,000 threshold for nearly 100% of the trading days. The Portuguese network firm – REN exceeds the €250,000 threshold by more than 77% and exceeds the €50,000 threshold by 97%. The Greek water firm – Athens Water Supply & Sewerage (Athens Water

Supply) exceeds the €250,000 threshold by 37% and exceeds the €50,000 threshold by more than 80%. Shares of the Belgian network firm Fluxys exceeds the €250,000 threshold by about 3% and exceeds the €50,000 threshold by 54%. Tallinna Vesi, Thessaloniki Water, Dee Valley, Eaux de Rayan and Eaux de Duai exceed the €250,000 threshold by about 3%% and exceed the €50,000 threshold by less than 40%.

Figure 1: Trading Frequency



Source: Bloomberg data and Brattle calculations.

II.A.2. Revenue Tests

The second test we apply is that peer companies should have annual revenues of at least €100 million for the last three years. This is a criterion which we applied in previous reports for the ACM. This revenue test is related to the liquidity test, the idea being that companies with low revenue may have shares which are relatively illiquid.

Table 3 shows that Dee Valley, Eaux de Royan, Eaux de Douai, Tallinna Vesi and Thessaloniki Water all had revenues less than €100 million. We exclude these five companies from the peers on this basis.

Table 3: Annual Revenues

	Total Revenues					% of Regulated Revenues				
	2012 [A]	2013 [B]	2014 [C]	2015 [D]	2016 [E]	2012 [F]	2013 [G]	2014 [H]	2015 [I]	2016 [J]
European and US Water Companies										
Severn Trent PLC	2,676	2,763	2,815	2,759	2,725	81%	82%	82%	86%	86%
Pennon Group PLC	1,844	1,835	1,960	2,047	2,055	100%	100%	100%	100%	100%
United Utilities Group PLC	2,362	2,461	2,570	2,609	2,629	98%	99%	99%	100%	100%
Athens Water Supply & Sewerage	360	354	343	340	347	97%	96%	94%	94%	94%
Tallinna Vesi	53	53	53	56	59	91%	90%	91%	88%	85%
Thessaloniki Water and Sewerage Company SA	77	76	77	77	78	96%	95%	96%	94%	94%
Dee Valley Group PLC	36	37	39	41	39	92%	92%	92%	91%	91%
Eaux de Royan SA	36	35	0	0	0	n/a	n/a	n/a	n/a	n/a
Societe des Eaux de Douai SA	15	13	0	0	0	n/a	n/a	n/a	n/a	n/a
California Water Service Group	541	562	577	567	587	97%	98%	97%	97%	97%
Aqua America	711	721	732	764	769	98%	98%	97%	96%	98%
European Network Companies										
Snam	3,946	3,848	3,566	3,649	2,560	96%	99%	98%	98%	95%
Terna Rete Elettrica Nazionale	1,806	1,896	1,996	2,082	2,103	95%	95%	91%	89%	90%
REN - Redes Energeticas Nacionais	811	789	756	819	739	97%	97%	97%	95%	97%
Red Electrica	1,769	1,773	1,854	1,959	1,954	97%	97%	97%	88%	89%
Enagas	1,198	1,308	1,227	1,222	1,218	95%	94%	97%	95%	94%
National Grid	21,192	21,598	22,310	22,927	22,978	95%	95%	95%	95%	95%
Elia System Operator	1,307	1,390	839	851	868	93%	95%	93%	91%	90%
Fluxys Belgium	626	548	555	538	509	95%	97%	97%	97%	98%

II.A.3. Relevant Regulated Revenues

The peers that we use to estimate beta should have a systematic risk as close as possible to the Dutch drinking water firms. Broadly speaking, the value of the peer firms should react to market conditions in the same way as the value of the drinking water firms would react, if they were observable.

From the perspective of systematic risk, the defining feature of the drinking water firms is that their revenues for water production, transport and supply are subject to a price control - in short-hand, they are regulated. This means that the water firms' revenues are less sensitive to changes in economic conditions than a firm operating in the free market. Accordingly, the peers we use should also earn a high percentage of their revenues from regulated activities. Ideally, we would like firms that earn most of their revenues from a mix of regulated production, network and supply activities which are similar to the drinking water firms. However, even a slightly different mix of regulated production, network and supply activities is still a valid peer company. Accordingly, we include peers in our group if at least 70% of revenues come from either regulated production, network and/or supply activities.

As shown in Table 3, all companies, with the exception of Eaux de Royan, Eaux de Douai, report revenues from regulated activity separately. For all potential peers these represent at least 80% of total revenues. Regulated revenues of National Grid represent around 95% of total revenues. However over half of the regulated revenues are from activities in the United States. US energy regulation differs somewhat from European regulation, which is why we

give US firms in the sample a lower weight (see Section III.D). Given the higher percentage of National Grid's revenues coming from the US, we think it would be more appropriate to include National Grid in the US peer group. In Section III.E we show the effect on our final beta estimate of including National Grid in the US group of companies, rather than in the European group.

After applying the liquidity and revenue tests, we have four European water companies, three US companies and seven European network companies for the beta estimation. All these firms meet the trading frequency test and the minimum revenue threshold.

II.B. Credit Rating

The peer firms which we use to estimate beta should have an investment grade credit rating. This is because the share prices of firms with lower credit ratings could be more reactive to company-specific news. This will tend to lower the measured beta, in a way that may not be representative of the Dutch drinking water firms.

Table 4 shows the credit ratings for the peers which pass the liquidity and revenue tests. Different credit rating agencies have different rating scales, but based on the scale of Standard & Poor's (S&P), a credit-rating agency, an investment grade rating is BBB- or higher.[5] S&P has assigned a credit rating to eleven of the firms selected and all of them have a rating of BBB- or better. The rating for Aqua America is from Egan-Jones, a credit-rating agency.[6]

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5 S&P actually states that BBB is investment grade. Since S&P adds pluses and minuses to its credit ratings, we interpret a BBB- rating to be investment grade.

6 EJR uses the same credit rating scales as S&P, namely from AAA to D (including the modifiers "+" and "-") for long-term ratings. See Gunter Strobl, Han Xia, The Issuer-Pays Rating Model and Ratings Inflation: Evidence from Corporate Credit Ratings (November 2011).

Table 4: Credit Rating of Liquid Peers

	Rating
European Water Companies	
Severn Trent PLC	BBB-
Pennon Group PLC	n/a
United Utilities Group PLC	BBB-
Athens Water Supply & Sewerage	n/a
US Companies	
California Water Service Group	A+
Aqua America	A-
National Grid PLC	A-
European Network Companies	
Snam SpA	BBB
Terna Rete Elettrica Nazionale SpA	BBB
REN - Redes Energeticas Nacionais SGPS SA	BBB-
Red Electrica Corp SA	A-
Enagas SA	A-
Elia System Operator SA/NV	BBB+
Fluxys Belgium	n/a

S&P rating extracted from Bloomberg as of 02 May 2017.
S&P rating for United Utilities Group from company website.
Aqua America rating comes from Egan-Jones for LC senior unsecured.

There is no credit rating reported for Pennon Group. However, Pennon Group's licence conditions require it to maintain financial metrics consistent with an investment grade credit rating, and so we consider that Pennon Group would be investment grade.[7]

There is also no credit rating for Athens Water Supply. This is likely because, since its listing on the Athens Exchange in 2000 and until 2013, the Company held only a relative small amount of short-term debt, which seemed to fund working capital. From 2014 onwards, the company did not arrange any bank debt, either long-term or short-term.[8] Accordingly, a credit rating does not seem relevant for Athens Water Supply.

Fluxys, in Belgium, also lacks a credit rating. We assume that Fluxys would have a rating consistent with the other Belgian network firm, Elia, which has an investment grade credit rating of BBB+. This assumption seems reasonable. There are four main factors used for

7 For details of the requirement for British water firms to maintain an investment grade rating see Ofwat, November 2016. Monitoring Financial Resilience, p. 11.

8 Athens Water Supply & Sewerage, Annual Report 2016, p. 23.

assessing S&P corporate credit ratings: country risk, industry risk, competitive position and cash flow/leverage.[9] Fluxys has very similar country risk and industry risk as Elia, and, as a price-regulated firm, it has the same competitive position. Fluxys has a lower debt-to-equity ratio than Elia (see Table 9). Therefore, Fluxys faces similar or lower credit risks to Elia, and so should have a similar or higher investment grade rating.

II.C. M&A Activity

The peer firms should also not be involved in any substantial mergers and acquisitions (M&A) during the period for which data is used to calculate the beta. This is because substantial M&A activity will tend to affect the firm's share price in ways that are unrelated to systematic risk of the business, and will tend to reduce estimated beta. We define substantial M&A as involving more than 30% of the market capitalisation of the firm.[10] Two firms were involved in 'large' M&A activity toward the end of the analysis period:

- On 8 December 2016 National Grid sold a majority interest in its gas distribution business for GBP 5.4 billion. The value of the transaction represented 14% of its market capitalization at the end of Q4 2016.[11] The sale of National Grid's stake in its distribution business was not large enough to be classified as 'substantial' so we include it in our sample;
- On 7 April 2017 REN announced the purchase of 100% of the capital of EDP Gás for EUR 532.4 million. The value of the transaction represented 38% of REN's market capitalization at the end of Q1 2017.[12] Hence, the REN M&A activity meets our definition of substantial.

To see the effect of the announcement on the share price, in Figure 2 we compare the daily returns of REN shares to those of Enagas and Red Electrica (REE), two potential network peers in our sample that operate in the Iberian Peninsula. As the figure shows, daily returns for REN were clearly affected on the day following the announcement, but there was no

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9 Standard & Poor's Rating Services, Guide to Credit Rating Essentials (McGraw Hill Financial), p. 11.

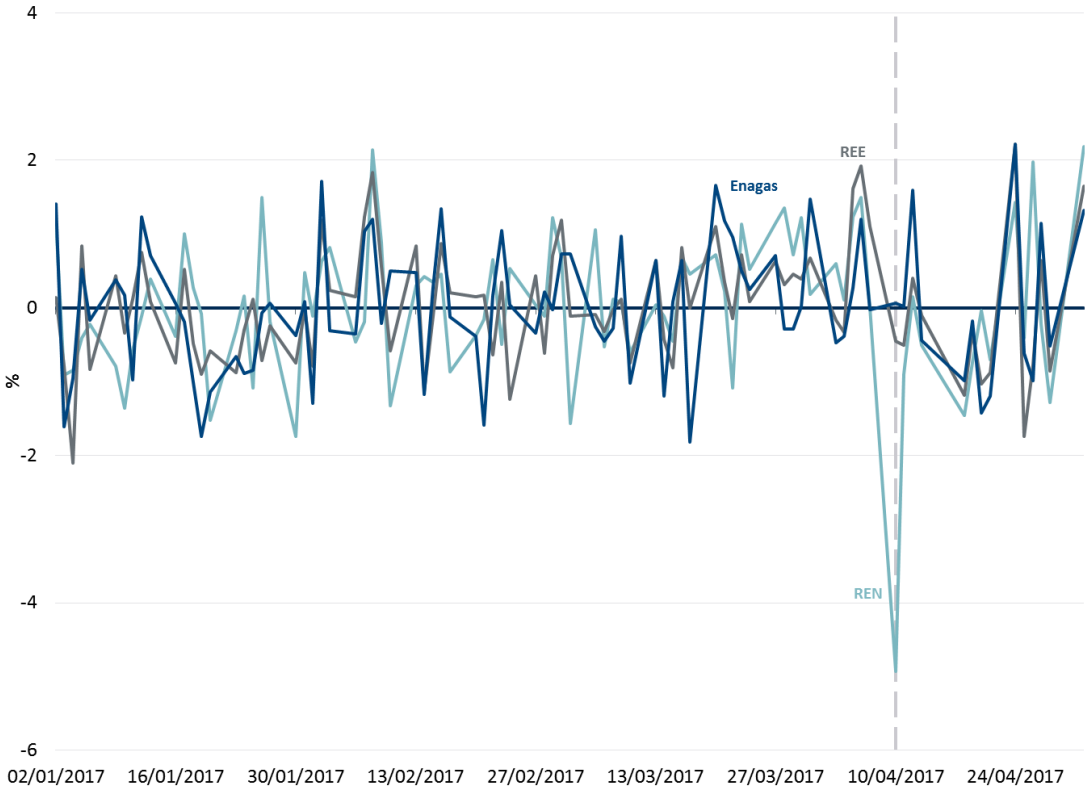
10 Harris, Caldwell, Bazzucchi, and Lo Passo, "Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization", The Brattle Group (2016), p. 59.

11 Emily Gosden, "National Grid returns £4bn to shareholders after selling 61pc stake in gas networks", The Telegraph, December 8, 2016, accessed May 4, 2015, http://www.telegraph.co.uk/business/2016/12/08/national-grid-returns-4bn-shareholders-selling-61pc-stake-gas/.

12 "Ren acquires EDP Gás", REN press release, April 7, 2017.

significant impact before that date. Since the announcement of the transaction is right at the end of the period we use to estimate beta,[13] rather than eliminate REN as a peer we shift the data window to eliminate the period of the announcement. Specifically, we estimate beta using the three year period preceding 31 March 2017, rather than the three year period preceding April 30 2017 as with all of the other firms.

Figure 2: Impact of EDP Gas acquisition announcement on REN daily returns



II.D. Final Peers

Starting from a group of nineteen potential peers, we have performed several tests for inclusion in in the peer group from which we estimate the beta:

- The firms should have liquidly traded shares;
- The peers should have an average turnover of at least €100 million, with at least 70% of revenues coming from regulated activities;
- The peer firms should not have been involved in any major M&A activity;
- The peer firms should have an investment grade credit rating.

Based on the results of the tests we have excluded the following potential peers from our sample: Dee Valley, Eaux de Royan, Eaux de Douai, Tallinna Vesi and Thessaloniki Water.

[13] Three year period ending April 30 2017.

Table 5 shows the peers selected for the beta estimation.

Table 5: Peers Considered in the Beta Estimation

Final peers	Country
European Water Companies	
Severn Trent PLC	United Kingdom
Pennon Group PLC	United Kingdom
United Utilities Group PLC	United Kingdom
Athens Water Supply & Sewerage	Greece
US companies	
California Water Service Group	United States
Aqua America	United States
National Grid	United States
European Network Companies	
Snam	Italy
Terna Rete Elettrica Nazionale	Italy
REN - Redes Energeticas Nacionais	Portugal
Red Electrica	Spain
Enagas	Spain
Elia System Operator	Belgium
Fluxys Belgium	Belgium

III. Asset Beta

Because the Dutch water distribution firms are not listed on a stock exchange we cannot measure the beta directly by measuring the covariance of firm value against the movement of the market as a whole. Accordingly, we estimate the beta for Dutch water distribution using our peer group of firms which are publicly traded and derive the majority of their profits from regulated supply, distribution and network activities.

Some analysts claim that firms with a relatively low market capitalisation – so-called small cap firms – earn a higher return than larger firms. This is referred to as a 'Small Firm Premium'. The water companies would qualify as small firms, but the ACM's WACC methodology does not apply a Small Firm Premium to the cost of equity.

We agree with the ACM's decision not to apply a Small Firm Premium. We note that the existence of the Small Firm Premium is controversial.[14] Some models of risk and return, such

[14] For example, in their well-known text book on corporate finance Professors Brealey, Myers & Allen note that: "The relationship among stock returns and firm size and book-to market ratio has been well documented. However, if you look long and hard at past returns, you are bound to find some

Continued on next page

as the Fama-French model, include an effect for small cap firms. The model measures a statistical size effect for both small and large firms. However, even in this model the results are not universal. Some small firms exhibit no small cap effect, and some large firms do. The results also vary between different countries. As far as we know there is no data to estimate such effects in the Netherlands.

Even if the Small Firm Premium did exist, it seems unlikely that a small Dutch water firm would be exposed to the kinds of effects that give rise to a small cap premium. For example one reason given for a small cap premium is that there is increased estimation risk and information risk, because analysts have less information on the smaller firms. However, analysts have exactly the same information for a small water firm as for a large one. In general, the business model and regulation of the water firms is transparent and well understood. So there would be no equivalent small firm risk. Put another way, from the perspective of systematic risk, a small water firm is much more similar to a large water firm. It is less similar to a small unregulated US firm in a different line of business. We note that no European regulator that we are aware of applies an adjustment for a SFP, most likely due to the reasons given above.

III.A. MARKET INDICES

The relative risk of each peer, as summarised in its beta parameter, must be measured against an index representing the overall market. We are of the opinion that a hypothetical investor in a Dutch water firm would likely diversify their portfolio within the single currency zone so as to avoid exchange rate risk. Accordingly, to calculate betas we use a broad Eurozone index for the European companies, and a national index for the US companies and a national index for the UK companies.[15] Using indices of the currency zone or country concerned avoids exchange rates movements from depressing betas, and should result in a higher beta estimate than if we estimated betas against an index derived in a different currency.

Continued from previous page

strategy that just by chance would have worked in the past. This practice is known as "data mining" or "data snooping". Maybe the size and book-to-market effects are simply chance results that stem from data snooping. If so, they should have vanished once they were discovered. There is some evidence that this is the case. … you will see that in the past 25 years small-firm stocks have underperformed just about as often as they have over performed." (Brealey Myers and Allen, *Principles of Corporate Finance* (10th edition, 2010), p.225). Professors Fama and French, two of the original proponents of a small firm premium, have more recently questioned its appropriateness (Fama and French, "The Value Premium and the CAPM", 2004, Chicago Graduate Business School, p.1).

15 Respectively Euro Stoxx, S&P 500 and FTSE All-Share index.

III.B. Peer Group Equity Betas

The methodology specifies a three year daily sampling period for calculating the equity beta.

We perform a series of standard diagnostic tests to assess if the beta estimates satisfy the standard conditions underlying ordinary least squares regression, which are detailed in Appendix I. Where a sample has heteroskedasticity problems, we correct by using OLS estimators with robust standard errors; where a sample has autocorrelation problems we perform a Prais–Winsten regression and use the resulting beta and standard error.

Table 6: Equity Betas robust to autocorrelation and/or heteroskedasticity

	Country	Beta	Standard error
European Water Companies			
Severn Trent PLC	United Kingdom	0.68	0.04
Pennon Group PLC	United Kingdom	0.67	0.04
United Utilities Group PLC	United Kingdom	0.71	0.05
Athens Water Supply & Sewage	Greece	0.71	0.13
US Companies			
California Water Service Group	United States	0.62	0.07
Aqua America	United States	0.58	0.05
National Grid	United States	0.32	0.06
European Network Companies			
Snam	Italy	0.81	0.03
Terna Rete Elettrica Nazionale	Italy	0.78	0.03
REN - Redes Energeticas Nacionais	Portugal	0.51	0.03
Red Electrica	Spain	0.64	0.04
Enagas	Spain	0.61	0.04
Elia System Operator	Belgium	0.34	0.03
Fluxys Belgium	Belgium	0.03	0.04

III.B.1. Dimson Adjustments

When calculating betas using daily returns, there is a risk that the response of a firm's share price may appear to react to the market index the day before or the day after. This could occur because of differences in market opening times and trading hours, or differences in the liquidity of the firm's shares vs. the average liquidity of the market. If such an effect is present, it could affect the beta estimate which is calculated using only the correlation between the return on the firm's share on day D and the return on the market index on the same day.

The Dimson adjustment deals with this effect. We start by performing a regression of the company returns against the market index returns. We include in the regression the market index returns calculated one day before and one day after the company returns.[16] The Dimson adjusted beta is the sum of the three coefficients calculated by the regression. If the market is perfectly efficient, all information should be dealt with on the same day. If the Dimson adjusted beta estimate is significantly different from the original beta estimate, this suggests that information about the true beta may be lost by considering only the simple regression.

We have performed this test for the firms in our peer groups. The Dimson adjustment is significant for four firms out of the total sample, suggesting that information on systematic risk is contained within the adjacent days. Hence for these four firms we take the adjusted beta. For the remaining firms we take the unadjusted beta. Table 7 shows both the 'raw' unadjusted betas and the Dimson-adjusted betas.

Table 7: Raw and Dimson Adjusted Equity Betas

		'Raw' - unadjusted		Dimson adjustments			Dimson adjusted	
		Beta	Standard error	Beta	Standard error	Significant Dimson	Beta	Standard error
European Water Companies								
Severn Trent PLC	United Kingdom	0.68	0.04	0.68	0.07	No	0.68	0.04
Pennon Group PLC	United Kingdom	0.67	0.04	0.69	0.07	No	0.67	0.04
United Utilities Group PLC	United Kingdom	0.71	0.05	0.71	0.08	No	0.71	0.05
Athens Water Supply & Sewerage	Greece	0.71	0.13	1.17	0.19	Yes	1.17	0.19
US Companies								
California Water Service Group	United States	0.62	0.07	0.44	0.12	No	0.62	0.07
Aqua America	United States	0.58	0.05	0.46	0.09	No	0.58	0.05
National Grid	United States	0.32	0.06	0.58	0.10	Yes	0.58	0.10
European Network Companies								
Snam	Italy	0.81	0.03	0.67	0.06	Yes	0.67	0.06
Terna Rete Elettrica Nazionale	Italy	0.78	0.03	0.64	0.05	Yes	0.64	0.05
REN - Redes Energeticas Nacionais	Portugal	0.51	0.03	0.56	0.05	No	0.51	0.03
Red Electrica	Spain	0.64	0.04	0.64	0.06	No	0.64	0.04
Enagas	Spain	0.61	0.04	0.64	0.06	No	0.61	0.04
Elia System Operator	Belgium	0.34	0.03	0.37	0.05	No	0.34	0.03
Fluxys	Belgium	0.03	0.04	0.00	0.05	No	0.03	0.04

III.B.2. Vasicek Correction

The Vasicek adjustment is a statistical adjustment which aims to avoid extreme estimates of beta, which could be statistically unreliable, by 'pulling' beta estimates toward an estimate of beta that is thought to be more reliable – the 'prior expectation' for beta. The methodology applies the Vasicek adjustments to the observed equity betas. In this case, we have used a prior expectation of the beta of 1.0, which is the market average. We considered applying the

[16] More days of leads and lags can be applied, but in this case we look at only one.

critique of Lally,[17] which among other things argues for using a prior expectation of the beta which is specific to the activity in question. However, we could find no objective way of determining the prior expectation of beta which was different from the average of our sample.[18] Accordingly, we have adopted the more neutral assumption of a prior expectation of beta of 1.0.

The Vasicek adjustment moves the observed beta closer to 1 by a weighting based on the standard error of the beta, such that values with lower errors will be given a higher weighting. The prior expectation of the beta given in other consultant reports is 1, which we apply here. For the prior expectation of the standard error we use the standard error on the overall market.[19]

Table 8 illustrates the effect of the Vasicek adjustment, which is very small.

Table 8: Effect of the Vasicek adjustment

		Dimson adjusted		Market average		Weighting		Vasicek
		Beta [A]	Standard error [B]	Beta [C]	Standard error [D]	Company beta [E]	Market beta [F]	Beta [G]
European Water Companies								
Severn Trent PLC	United Kingdom	0.68	0.04	1.00	0.36	98.5%	1.5%	0.68
Pennon Group PLC	United Kingdom	0.67	0.04	1.00	0.36	98.8%	1.2%	0.67
United Utilities Group PLC	United Kingdom	0.71	0.05	1.00	0.36	97.9%	2.1%	0.72
Athens Water Supply & Sewerage	Greece	1.17	0.19	1.00	0.36	78.6%	21.4%	1.13
US Companies								
California Water Service Group	United States	0.62	0.07	1.00	0.39	97.2%	2.8%	0.63
Aqua America	United States	0.58	0.05	1.00	0.39	98.3%	1.7%	0.59
National Grid	United States	0.58	0.10	1.00	0.39	93.6%	6.4%	0.61
European Network Companies								
Snam	Italy	0.67	0.06	1.00	0.36	97.4%	2.6%	0.68
Terna Rete Elettrica Nazionale	Italy	0.64	0.05	1.00	0.36	98.3%	1.7%	0.64
REN - Redes Energeticas Nacionais	Portugal	0.51	0.03	1.00	0.36	99.3%	0.7%	0.52
Red Electrica	Spain	0.64	0.04	1.00	0.36	99.0%	1.0%	0.64
Enagas	Spain	0.61	0.04	1.00	0.36	98.9%	1.1%	0.61
Elia System Operator	Belgium	0.34	0.03	1.00	0.36	99.4%	0.6%	0.35
Fluxys	Belgium	0.03	0.04	1.00	0.36	99.0%	1.0%	0.04

Notes and sources:
[A], [B]: Table 7: Raw and Dimson Adjusted Equity Betas.
[C], [D]: Assumed.
[E]: [D]^2/([D]^2+[B]^2).
[F]: 1-[E].
[G]: [A]x[E]+[C]x[F].

17 Lally, Martin, *"An Examination of Blume and Vasicek Betas"*. Financial Review, August 1998.

18 Pulling each beta closer to the sample average, and then taking the average beta, would narrow the distribution of betas but make no difference to the final result.

19 The standard error on the FTSE 100 index is used as a proxy for the European market, and is reported by the London Business School. Valueline reports the standard deviation of all stocks in the US market.

As we are using the market average beta for our prior expectation, it is consistent to use the standard deviation of the distribution of the betas underlying the market population as the prior expectation of the standard error. We used the same value in our July 2015 WACC report.

III.C. Peer Group Asset Betas

The equity beta measures the relative risk of each company's equity, which will reflect the financing decisions specific to each company. As debt is added to the company the equity will become riskier as more cash from profits goes towards paying debt in each year before dividends can be distributed to equity. With more debt, increases or decreases in a firm's profit will have a larger effect on the value of equity. Hence if two firms engage in exactly the same activity, but one firm has more debt, that firm will have a higher beta than the firm with less debt.

To measure the relative risk of the underlying asset on a like-for-like basis it is necessary to 'unlever' the betas, imagining that the firm is funded entirely by equity. The resulting beta is referred to as an asset beta or an unlevered beta. To accomplish the un-levering, the methodology specifies the use of the Modigliani and Miller formula.[20] Table 9 illustrates both the equity beta and the asset betas for each firm.

[20] The specific construction of this equation was suggested by Hamada (1972) and has three underlying assumptions: A constant value of debt; a debt beta of zero; that the tax shield has the same risk as the debt.

Table 9: Equity and Asset Betas

			Equity beta [A]	Gearing (D/E) [B]	Tax rate [C]	Asset beta [D]
European Water Companies						
Severn Trent PLC	United Kingdom		0.68	92.0%	20.3%	0.39
Pennon Group PLC	United Kingdom		0.67	70.9%	20.3%	0.43
United Utilities Group PLC	United Kingdom		0.72	104.5%	20.3%	0.39
Athens Water Supply & Sewerage	Greece		1.13	0.0%	28.3%	1.13
Median		[1]				0.41
US Companies						
California Water Service Group	United States		0.63	43.6%	40.0%	0.50
Aqua America	United States		0.59	35.5%	40.0%	0.48
National Grid	United States		0.61	68.6%	40.0%	0.43
Median		[2]				0.48
European Network Companies						
Snam	Italy		0.68	101.4%	31.4%	0.40
Terna Rete Elettrica Nazionale	Italy		0.64	94.3%	31.4%	0.39
REN - Redes Energeticas Nacionais	Portugal		0.52	176.7%	21.5%	0.22
Red Electrica	Spain		0.64	61.0%	27.3%	0.44
Enagas	Spain		0.61	69.0%	27.3%	0.41
Elia System Operator	Belgium		0.35	102.1%	34.0%	0.21
Fluxys Belgium	Belgium		0.04	73.9%	34.0%	0.03
Median		[3]				0.39

Notes and sources:
[A]: Table 8: Effect of the Vasicek adjustment.
[B]: Calculated from Bloomberg data. Average values from Q2 2014 to Q1 2017.
[C]: KPMG. Average values from Q2 2014 to Q1 2017.
[D]: [A]/(1+(1-[C])x[B]).

III.D. Asset Beta for Dutch Water Distribution

Table 9 illustrates the median asset betas for European water companies (0.41), US companies (0.48) and European network companies (0.39). There are several reasons to believe that the US firms have structurally higher betas because of differences in regulation and the US water industry more generally. US firms have a price cap, rather than a revenue control. There are reasons to believe that firms with a price caps will tend to have higher betas, because they face volume risk, which itself tends to be correlated to economic activity.[21] In other words, a downturn in economic activity could cause a reduction in transported volumes, which in turn leads to reduced revenues and profits for the network. Hence the price cap increases the correlation between the firm's share price and the market index – giving a higher beta. In the

[21] However, the sample size is too small to determine whether the higher median asset betas for US firms are statistically significant.

US, regulated firms change their tariff or rates when either the water company or its customers asks for the tariffs to be changed via a 'rate case'. Since rate cases are expensive and risky – in that tariffs could change in unpredictable ways – they tend to be only brought when a large change in the market has occurred. Accordingly, there is a qualitative case that the revenues for regulated US firms will tend to be more highly correlated with the market, since it is more likely that for example the water firms' customers will ask for lower rates when there is a decrease in economic activity. This does not occur in Europe, where tariff reviews or price controls take place at regular fixed intervals, which are independent of macroeconomic activity. We also understand that US water firms are engaged in a historically high level of capital expenditure. This will lead to increased 'operating leverage', which will again tend to increases betas, all else being equal. Therefore, we conclude that the betas for regulated US firms are likely to overestimate the true beta for a Dutch water distribution firm.

European network firms have similar regulation to Dutch water distribution firms, in that they are subject to a regulated revenue control. However, they are not water firms. We expect that water demand may be less sensitive to macroeconomic conditions than demand for electricity or gas. While a regulated firm may have a revenue guarantee, a fall in revenues may only be compensated in a later period, and the present value of the compensation may not be sufficient to offset completely the earlier fall in revenues. Hence, differences in the sensitivity of demand to macroeconomic conditions could affect a regulated firm's beta. To the extent that water demand may be less sensitive to macroeconomic conditions than demand for electricity or gas, the beta for European network firms may be structurally higher than the beta for a Dutch water distribution firm.[22]

We conclude that the asset betas we estimate for both US water companies and European network firms may tend to overestimate the true beta for a Dutch water distribution firm. Given this, our proposal is to give more weight to the European water firms, and less weight to the US firms and the European network firms when estimating the asset beta for Dutch water distribution. Specifically, we give the European water firms a 50% weight, and the US firms and the European network firms a 25% weight each. Table 10 shows that this results in an asset beta of 0.42, which is slightly above the median asset beta estimate for European water companies. For the reasons set out above, our estimate is more likely to overestimate than underestimate the true asset beta.

[22] However, as we discuss below, for this data period, the asset betas for European network firms and European water firms are very similar.

In practice, for this period and with the selected peer group, the median beta for European network firms is almost identical to the median beta for the European water companies. Hence, the weighting of the European network firms makes very little difference to the final beta estimate. We note that if we had simply taken the median of the European and US water firms, we would have obtained a similar but slightly higher asset beta of 0.46, reflecting the influence of the higher US firm betas. The median of the entire unweighted peer group is 0.40.

We also note that the final peer group contains two extreme values: Fluxys, which has an asset beta of only 0.03; and Athens Water, which has a very high asset beta of 1.13.[23] Both companies satisfy all selection criteria of the ACM methodology, which we use to select the peers. However, as we show below, the final beta estimate is not sensitive to the inclusion or exclusion of these two firms.

Table 10: Estimation of the Asset Beta for Dutch Water Distribution

		Median beta [A]	Weights [B]
European Water Companies	[1]	0.41	50%
US Companies	[2]	0.48	25%
European Network Companies	[3]	0.39	25%
Weighted average	[4]	0.42	

Notes and sources:
[1] to [3]:
[A]: Table 9: Equity and Asset Betas.
[B]: Assumed.
[4][A]: [1][A]x[1][B]+[2][A]x[2][B]+[3][A]x[3][B].

III.E. BETA SENSITIVITIES

Table 11 illustrates that, if we exclude Fluxys from the peer group, then the resulting asset beta is slightly higher at 0.43. Including Fluxys but excluding Athens Water Supply results in an asset beta of 0.42, identical to our base case. Excluding both Fluxys and Athens Water

[23] As explained in the July 2015 report the beta of Athens Water Supply may be affected by events specific to the Greek market, due to the risk of Greek default. We note that in February 2015, halfway through the period of analysis, the Greek default risk rose to its highest level since 2012. See Elaine Moore, "Greek default risk at highest since 2012", Financial Times, February 9, 2015, accessed May 4, 2015, https://www.ft.com/content/74508932-b048-11e4-92b6-00144feab7de html. However, we would expect this kind of idiosyncratic risk to depress beta, rather than to result in an unusually high beta, as is the case with Athens Water.

Supply also results in an asset beta of 0.42. We conclude that our final beta estimate is not sensitive to the inclusion or exclusion of either Fluxys or Athens Water Supply. This is because we calculate a median asset beta, and the median gives less weight to 'extreme' values, so that the final estimate will be less sensitive to the inclusion of very high or low beta values.

Table 11 shows that including National Grid among the European Network companies leads to a very slightly higher beta at 0.43. We conclude that the results are not sensitive to whether we classify National Grid as a European or US network firm.

Table 11: Scenarios for Peer Inclusion

	Weight	Base Case [A]	Scenario 1 (Excl. Fluxys) [B]	Scenario 2 (Excl. Athens Water) [C]	Scenario 3 (Excl. Fluxys & Athens Water) [D]	Scenario 4 (National Grid as European Company) [E]
European Water Companies						
Severn Trent PLC		0.39	0.39	0.39	0.39	0.39
Pennon Group PLC		0.43	0.43	0.43	0.43	0.43
United Utilities Group PLC		0.39	0.39	0.39	0.39	0.39
Athens Water Supply & Sewerage		1.13	1.13			1.13
Median [1]	50%	0.41	0.41	0.39	0.39	0.41
US Companies						
California Water Service Group		0.50	0.50	0.50	0.50	0.50
Aqua America		0.48	0.48	0.48	0.48	0.48
National Grid		0.43	0.43	0.43	0.43	
Median [2]	25%	0.48	0.48	0.48	0.48	0.49
European Network Companies						
Snam		0.40	0.40	0.40	0.40	0.40
Terna Rete Elettrica Nazionale		0.39	0.39	0.39	0.39	0.39
REN - Redes Energeticas Nacionais		0.22	0.22	0.22	0.22	0.22
Red Electrica		0.44	0.44	0.44	0.44	0.44
Enagas		0.41	0.41	0.41	0.41	0.41
Elia System Operator		0.21	0.21	0.21	0.21	0.21
Fluxys Belgium		0.03		0.03		
National Grid						0.41
Median [3]	25%	0.39	0.40	0.39	0.40	0.40
Asset Beta for Dutch Water Companies [4]		0.42	0.43	0.42	0.42	0.43

IV. Debt Premium

ACM's WACC methodology[24] prescribes that we must estimate the cost of debt for water distribution by looking at two different sources of debt yields and spreads:[25]

[24] We understand that this part of the ACM's methodology reflects the relevant legislation directly, and specifically Article 5 of the '*Drinkwaterregeling*'.

[25] By spread we mean the difference between the debt yield and the corresponding risk-free rate.

1. Yields and spreads on an index of corporate Euro bonds issued by firms active in the industry sector with a credit risk similar to that of Dutch water companies. We refer to these yields and spreads as 'generic industry';[26]

2. Yields and spreads on bond issued by firms that engage in activities which are comparable to that of drinking water companies and which have a credit risk similar to that of Dutch water companies. In our view 'activities' which are comparable to that of drinking water companies' in this context means not only firms engaged in drinking water distribution but also firms engaged in activities such as the transport and/or distribution of gas and electricity. We refer to these as the 'comparable' bonds.

In both cases, the ACM's method requires that we calculate a two-year average and five-year average of the differences between the bond yields and the relevant government bond rates, and then take the average of the two periods. We describe the results below.

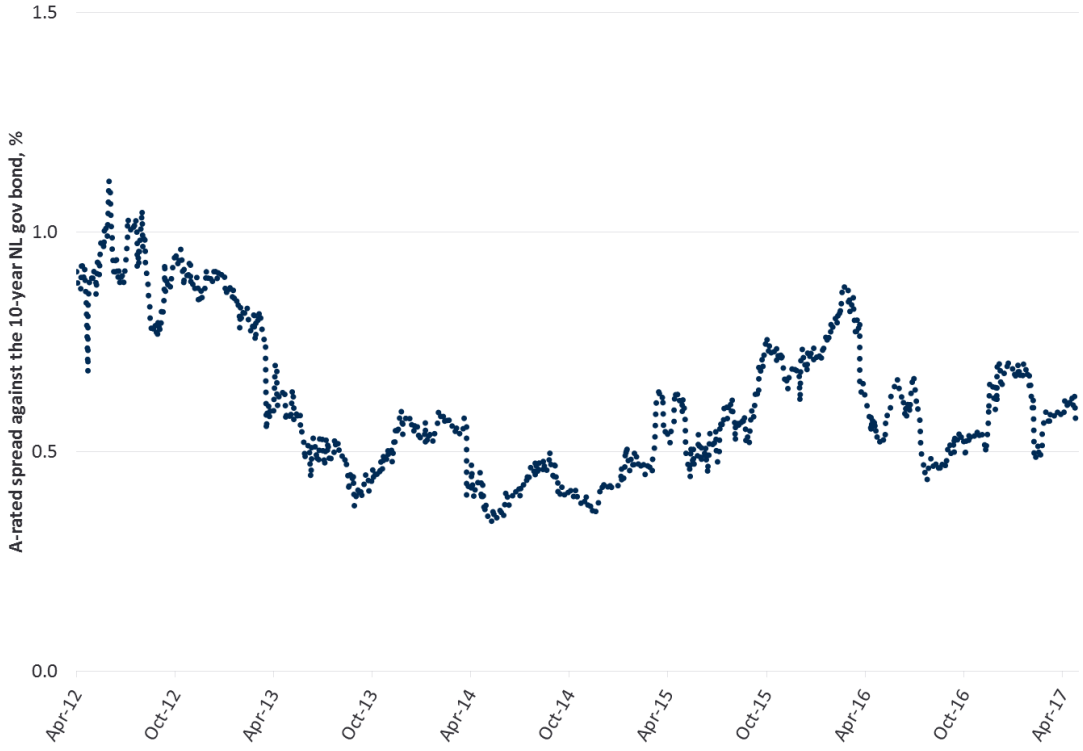
IV.A. Spread on the Generic Industry Bonds

The method requires the calculation of the spread of the cost of 10-year corporate debt over the risk-free rate. We take the risk-free rate to be the contemporaneous yield on a Dutch government 10-year bond. The spread is the difference between the yield on the generic A-rated industrial Euro-denominated debt with 10 years maturity and the contemporaneous yield on a Dutch government 10-year bond.

Figure 3 illustrates how this spread has developed over the last five years. Coincidentally, the average spread both over the last five years and over the last two years is 0.61%.

[26] By 'generic', we mean these are yields for a group of A-rated industrial firms calculated by Bloomberg, where the individual firms used in the sample have not been identified.

Figure 3: Spread of 10-year A-rated European Industrial Debt over 10-year Dutch Government bonds



Source: Bloomberg and Brattle calculations.

IV.B. SPREAD ON THE COMPARABLE BONDS

We considered two sources of 'comparable' bonds: a generic utility bond and individual bonds issued by firms engaged in similar activities to drinking water distribution.

IV.B.1. Generic Utility

We took the difference between the yield on the generic A-rated utility Euro-denominated debt with 10 years maturity and the contemporaneous yield on a Dutch government 10-year bond. The average spread for the generic A-rated EUR utility bonds was 0.74% over the last five years and 0.70% over the last two years. The average of these two numbers gave a spread of 0.72%.

IV.B.2. Firms engaged in similar activities to drinking water distribution

We identified a 'long-list' of 1,711 issuers whose bonds are traded and who seemed to be engaged in similar activities to drinking water distribution. This includes water distribution

companies, but also network companies more generally. To increase the sample size we considered firms from around the world, and not only Europe, though we limited the currencies to GB Pounds Sterling, US Dollars, Canadian Dollars and Euros.[27] We then screened the long-list to find debt which was rated either A, A+ or A- by Standard & Poors (S&P), and had a maturity of between 9 to 11 years during 1 May 2012 to 30 April 2017. We also eliminated so-called 'callable bonds',[28] 'putable bonds',[29] 'convertible bonds'[30] and 'sinkable bonds'.[31] Applying these criteria reduced the number of possible bonds to 203. From the list of 203, we then checked that the firms were really engaged in activities that could be considered similar to the activities of the Dutch drinking water companies. Specifically, we checked that the firms were engaged in water supply or network activities. Applying this criterion reduced the number of bond issuers to 30 (8 in water and 22 network companies), and the number of bond issues to 57; 12 of these bonds were issued by drinking water companies. Appendix II gives details of the firms considered.

We include yields during the period when bonds still have 9 to 11 year maturity and calculate spreads against yields of relevant government bonds with 10-year maturity. We decide the relevant government bond based on the country where the business predominantly operates. For example, for a bond issued by Elia we use a Belgian government bond of the same outstanding maturity and of the same currency to calculate the spread. Comparing all corporate bonds to Dutch government bonds could give misleading results. This is because the difference between, for example, the yield on Elia's bonds and the yield

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[27] Including bonds issued in other, more minor currencies could introduce issues around bond liquidity and the effects of expected inflation on the yields. The major currencies in any case capture the vast majority of traded debt issued.

[28] Callable bonds can be redeemed by the issuer prior to maturity and generally attract a higher yield than bonds that mature on a fixed date. Callable bonds cannot be compared on a like-for-like basis with Government bonds that have a fixed maturity, which is why we do not use them in our analysis. Callable bonds generally attract a higher yield because bonds are more valuable if interest rates fall, but in this scenario the callable bond may be re-deemed. Hence the bond holder has an asymmetric pay-off.

[29] Putable bond gives bond holders options to sell back bonds to issuers at one or several specific dates before maturity. When interest rate arises, investors could exercise such option and use the proceeds in higher-yield investments. Bond holders are generally willing to accept a lower yield to have such option.

[30] Convertible bond is a type of bond that can be converted into equity at certain dates during its life. Convertible bond usually attracts a lower yield because investors could convert it into stocks and receive a higher yield when stock price arises.

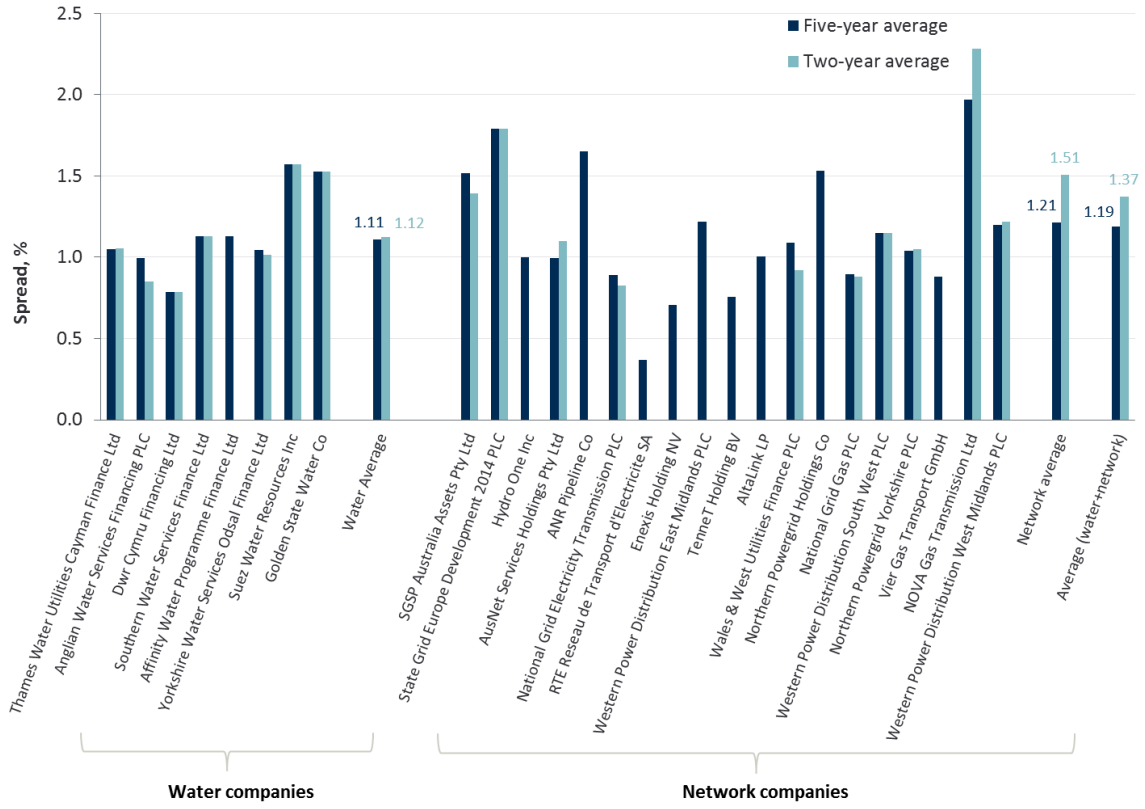
[31] Sinkable bond is a bond issue backed by sinking fund, which sets aside money on a regular basis to ensure the repayments will be made. Sinkable bond has less risk to investors and allows the issuers to offer a lower interest rate to bond holders.

on Dutch government bonds is partly due to the additional risk that Elia has as a company (corporate risk), and partly due to country risk. If the country risk was significantly higher for Belgium relative to the Netherlands, then the spread between Elia's bonds and Dutch government bonds would exaggerate the actual corporate spread, because it would include the additional Belgian country risk which is not relevant for Dutch water companies.

The average spreads for water peers are 1.11% and 1.12% respectively over the last five years and over the last two years. Both figures are slightly lower than the average spreads for network peers, 1.21% and 1.51%. However, the number of water peers is relatively small. Therefore, the finding of a lower debt premium for that group is not statistically significant. For example, in the July 2015 report, we found that the water firms had higher debt spreads than the network peers.[32] Accordingly, we use the average spread from the larger group of all peers. Over the last five years this spread is 1.19% and over the last two years it is 1.37%. The average of these two numbers gives a spread of 1.28%.

[32] July 2015 WACC report p.16.

Figure 4: Spread of A-rated Peers over Relevant Government Bonds



IV.C. Conclusions on Debt Spreads

Table 12 summarises the debt spreads for the Generic Industry bonds, the Generic Utility bonds and the individual bonds of the comparable peers. Table 5 shows that the comparable peers have the highest spreads, followed by the Generic Utility bonds and then the Generic Industrial bonds.

Table 12: The average spreads on the generic industry and comparable bonds

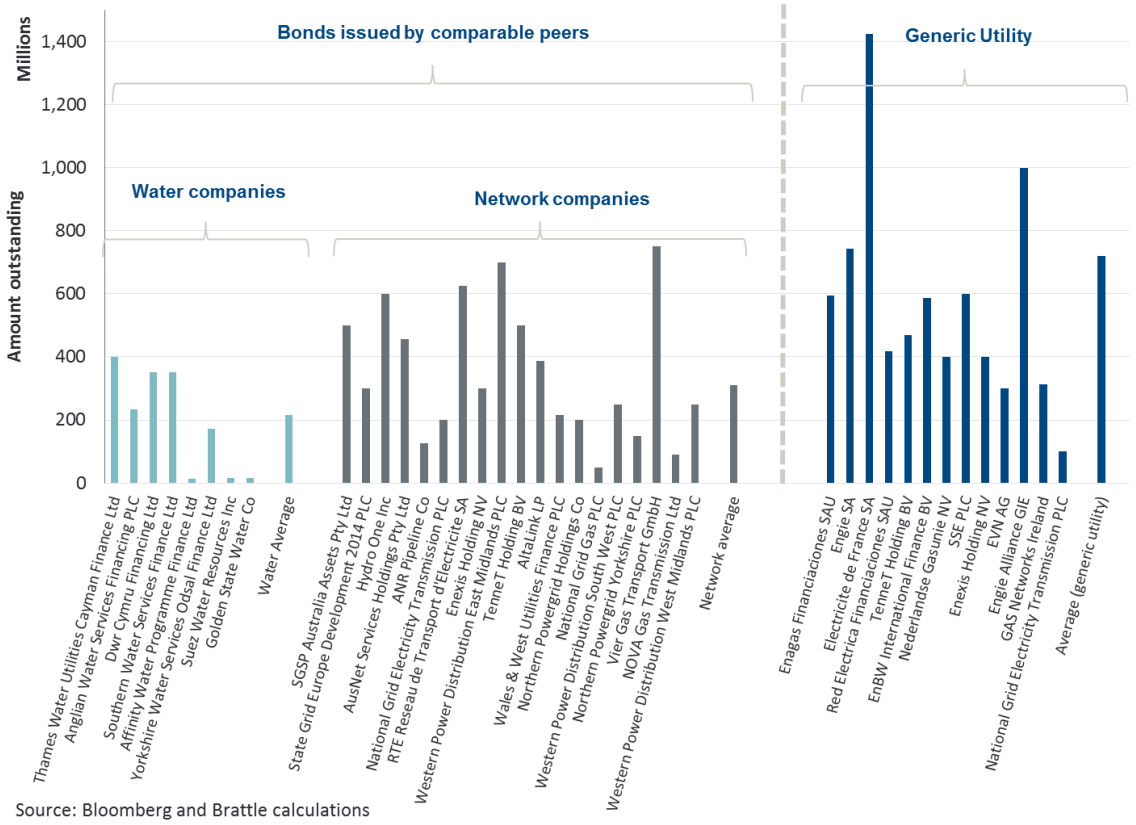
		Spreads		
			Comparables	
		Generic Industry [A]	Generic utility [B]	Individual bonds [C]
Five-year average	[1] See note	0.61%	0.74%	1.19%
Two-year average	[2] See note	0.61%	0.70%	1.37%
Average	[3] ([1]+[2])/2	0.61%	0.72%	1.28%
Average between generic industry and comparables	[4] See note		0.67%	0.95%

Notes and sources:
[1] Average spreads from 01/05/2012 to 30/04/2017.
[2] Average spreads from 01/05/2012 to 30/04/2017.
[4][B]: ([3][A]+[3][B])/2.
[4][C]: ([3][A]+[3][C])/2.
[A]: Difference between Bloomberg BFV Eurozone A-rated industry 10-year and NL sovereign 10-year.
[B]: Difference between Bloomberg BFV Eurozone A-rated utility 10-year and NL sovereign 10-year.
[C]: Difference between bond yields of selected peers and sovereign bond yields.

We suspected that an important part of the difference between the spread on the Generic Utility bonds and the spread on comparable peers was to do with liquidity. Investors will generally demand a higher return for bonds that are less frequently traded and are therefore less liquid. This is known as a liquidity premium. To confirm if the difference was indeed due to a liquidity premium, we asked Bloomberg – the data provider that compiles the Generic Utility bonds data – for the firms which make up the Generic Utility bonds series. As a proxy for liquidity, we looked at the value of the bonds outstanding, the logic being that larger bond issues will tend to be more heavily traded and hence more liquid. Figure 5 shows that the average value of the outstanding bond issues for the comparable peers is less than half of that for the bonds Bloomberg used for calculating generic utility yields.[33] We conclude it is likely that the higher debt spreads for the bonds of comparable peers is because these bonds are less liquid than the bonds that make up the Generic Utility set.

[33] The bonds selected by Bloomberg change day by day. These are bonds used as of 11 May 2017.

Figure 5: Value of outstanding bond issues for various firms



Source: Bloomberg and Brattle calculations

We also understand from the ACM that the Dutch drinking water companies are relatively small, and finance their activities using bank debt rather than by issuing bonds. If the Dutch water firms were to issue bonds, they would be at the lower end of the scale in terms of the size of the issue. The bonds would also be less liquid than average, and we would expect that they would command some sort of liquidity premium.

As noted above, the *Drinkwaterregeling* in effect requires that we must estimate the cost of debt for water distribution by looking at generic industry bonds and either generic utility bonds and/or bond spreads for the comparable peers. In our view, for the reasons stated above, the comparable peers are more comparable to the Dutch drinking water companies than the utility index. Therefore, we do not consider the utility index in the cost of debt. Given this context, we think it would be appropriate to calculate the debt spread for Dutch drinking water companies using the simple average of the 0.61% spread for the generic industry bonds and the 1.28% spread for the comparable peers. This results in an average spread of 0.95%.

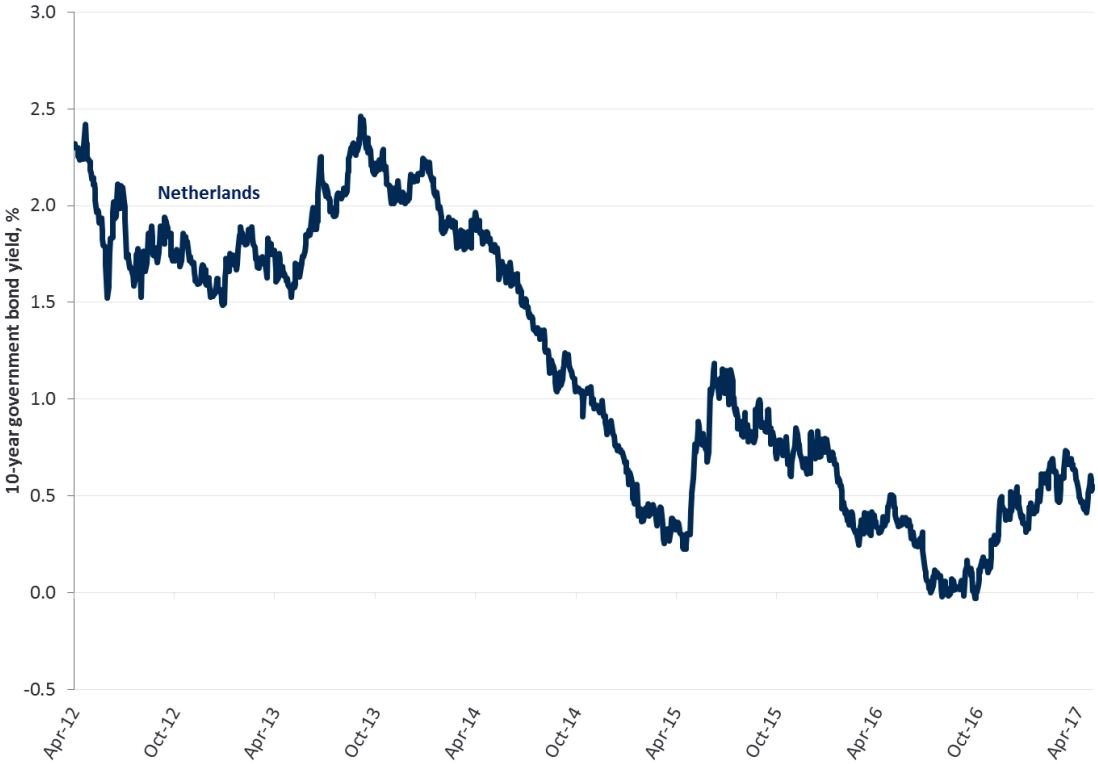
V. Risk Free Rate

The methodology specifies that to calculate the risk-free rate, we must calculate the average yield on 10-year Dutch government bonds over the last five years, and the average over the last two years. The risk-free rate is then the average of the two-year and five-year average.

Figure 6 below shows the movement of the yields on 10-year Dutch government bonds over the prior five years.

The two-year average yield is 0.52%, and the five-year average is higher at 1.15%. The average of these two numbers gives a risk-free rate of 0.83%.

Figure 6: Yield on Dutch Government 10 Year Bonds



Source: Bloomberg.

Table 13 shows that this methodology results in a pre-tax cost of debt of 1.93%. The cost of debt includes 15 basis points for the cost of issuing debt.

Table 13: Cost of Debt

Risk-free rate	[1] Section IV.D	0.83%
Debt premium	[2] Section IV.C	0.95%
Non-interest fees	[3] Assumed	0.15%
Cost of debt	[4] [1]+[2]+[3]	1.93%

Appendix I – Statistical Reliability of Beta

We detail the standard diagnostic tests to assess if the beta estimates satisfy the standard conditions underlying ordinary least squares regression, which are: that the error terms in the regression follow a normal distribution and that they do not suffer from heteroskedasticity[34] or auto-correlation.[35] Failure to meet these conditions would not invalidate the beta estimates, but would have the following consequences:

1. Although OLS is still an unbiased procedure in the presence of heteroskedasticity and/or autocorrelation, it is no longer the best or least variance estimator.
2. In the presence of heteroskedasticity and/or autocorrelation, the standard error calculated in the normal way may understate the true uncertainty of the beta estimate.
3. Heteroskedasticity and/or auto-correlation may indicate that the underlying regression is mis-specified (i.e. we have left out some explanatory variable).

HETEROSKEDASTICITY

We apply White's test for heteroskedasticity. Table 14 illustrates the results.

Table 14: White's test for Heteroskedasticity

		White Stat	p-value	Heteroskedascity
European Water Companies				
Severn Trent PLC	United Kingdom	10.82	0.00	Yes
Pennon Group PLC	United Kingdom	5.43	0.08	No
United Utilities Group PLC	United Kingdom	25.24	0.00	Yes
Athens Water Supply & Sewerage	Greece	29.52	0.00	Yes
US Companies				
California Water Service Group	United States	5.40	0.07	No
Aqua America	United States	6.60	0.04	Yes
National Grid	United States	22.14	0.00	Yes
European Network Companies				
Snam	Italy	1.50	0.47	No
Terna Rete Elettrica Nazionale	Italy	2.88	0.28	No
REN - Redes Energeticas Nacionais	Portugal	1.90	0.39	No
Red Electrica	Spain	13.88	0.00	Yes
Enagas	Spain	10.07	0.01	Yes
Elia System Operator	Belgium	2.21	0.33	No
Fluxys Belgium	Belgium	14.84	0.00	Yes

The results indicate the presence of some heteroskedasticity in the sample.

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[34] Heteroskedasticity means that there exists sub-populations in the sample which have different variance from others.

[35] Auto-correlation means that the error terms between periods are correlated.

AUTOCORRELATION

We also apply the Durbin-Watson test for auto-correlation. The effect of auto-correlation is that standard errors will over-estimate the precision of the regression. The test indicates that there is no autocorrelation in all but one of the considered regressions. The results are presented in Table 15.

Table 15: Durbin–Watson Test for Auto-correlation

		DW Stat (Positive correlation)	DW Stat (Negative correlation)	Positive Serial Correlation	Negative Serial Correlation	Serial Correlation
European Water Companies						
Severn Trent PLC	United Kingdom	2.03	1.97	No	No	No
Pennon Group PLC	United Kingdom	2.00	2.00	No	No	No
United Utilities Group PLC	United Kingdom	2.06	1.94	No	No	No
Athens Water Supply & Sewerage	Greece	1.97	2.03	No	No	No
US Companies						
California Water Service Group	United States	2.20	1.80	No	No	No
Aqua America	United States	2.17	1.83	No	No	No
National Grid	United States	2.05	1.95	No	No	No
European Network Companies						
Snam	Italy	2.24	1.76	No	Indecisive	No
Terna Rete Elettrica Nazionale	Italy	2.12	1.88	No	No	No
REN - Redes Energeticas Nacionais	Portugal	1.97	2.03	No	No	No
Red Electrica	Spain	2.09	1.91	No	No	No
Enagas	Spain	1.90	2.10	No	No	No
Elia System Operator	Belgium	1.98	2.02	No	No	No
Fluxys Belgium	Belgium	2.54	1.46	No	Yes	Yes

CORRECTION FOR HETEROSKEDASTICITY AND AUTOCORRELATION

We correct for heteroskedasticity by using OLS estimators with robust standard errors, using the Huber/White estimators, or 'sandwich' estimators of variance. To account for the presence of autocorrelation we perform a Prais–Winsten regression, a standard statistical technique to account for the inclusion of autocorrelation. To account for the presence of both autocorrelation and heteroskedasticity, we apply an additional correction for variance estimates robust to heteroskedasticity to the Prais-Winsten regression. The results are presented in Table 16. The corrections for auto-correlation and heteroskedasticity do not have a significant impact on the results.

Table 16: Prais-Winsten Regressions Results

		Test for		OLS			GLS (Prais - Winsten)		
	Country	Heteroske-dasticity	Serial Corrlation	Beta	Standard error	Robust standard error	Beta	Standard error	Robust standard error
European Water Companies									
Severn Trent PLC	United Kingdom	Yes	No	0.68	0.04	0.04			
Pennon Group PLC	United Kingdom	No	No	0.67	0.04				
United Utilities Group PLC	United Kingdom	Yes	No	0.71	0.04	0.05			
Athens Water Supply & Sewerage	Greece	Yes	No	0.71	0.09	0.13			
US Companies									
California Water Service Group	United States	No	No	0.62	0.07				
Aqua America	United States	Yes	No	0.58	0.05	0.05			
National Grid	United States	Yes	No	0.32	0.04	0.06			
European Network Companies									
Snam	Italy	No	No	0.81	0.03				
Terna Rete Elettrica Nazionale	Italy	No	No	0.78	0.03				
REN - Redes Energeticas Nacionais	Portugal	No	No	0.51	0.03				
Red Electrica	Spain	Yes	No	0.64	0.03	0.04			
Enagas	Spain	Yes	No	0.61	0.03	0.04			
Elia System Operator	Belgium	No	No	0.34	0.03				
Fluxys Belgium	Belgium	Yes	Yes	0.04	0.03	0.04	0.03		0.04

Appendix II – Bonds Issued by Firms Engaged in Similar Activities to Drinking Water Distribution

Table 17: Bonds Issued by Firms Engaged in Similar Activities to Drinking Water Distribution

Company	Maturity date	Currency	Bond yield (%)		10-year sovereign (%)		Bond spread (%)		Amount outstanding
			5 yr	2 yr	5 yr	2 yr	5 yr	2 yr	
	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]
SGSP Australia Assets Pty Ltd	29/07/2026	USD	3.50	3.50	2.11	2.11	1.39	1.39	500,000,000
SGSP Australia Assets Pty Ltd	09/04/2023	USD	3.96		2.32		1.64	1.64	500,000,000
State Grid Europe Development 2014 PLC	26/01/2027	EUR	1.95	1.95	0.16	0.16	1.79	1.79	300,000,000
Hydro One Inc	13/01/2022	CAD	2.80		1.80		1.00	1.00	600,000,000
Thames Water Utilities Cayman Finance Ltd	19/06/2025	GBP	3.09	2.95	1.96	1.82	1.13	1.13	500,000,000
Thames Water Utilities Cayman Finance Ltd	25/02/2028	GBP	2.13	2.13	1.15	1.15	0.98	0.98	300,000,000
AusNet Services Holdings Pty Ltd	26/02/2027	EUR	1.26	1.26	0.16	0.16	1.10	1.10	560,000,000
National Grid Electricity Transmission PLC	02/02/2024	GBP	3.47		2.52		0.95	0.95	146,487,000
RTE Reseau de Transport d'Electricite SA	28/06/2022	EUR	2.62		2.19		0.43	0.43	750,000,000
Anglian Water Services Financing PLC	05/10/2027	GBP	2.15	2.15	1.30	1.30	0.85	0.85	250,000,000
Enexis Holding NV	26/01/2022	EUR	2.48		1.78		0.71	0.71	300,000,000
Western Power Distribution East Midlands PLC	17/01/2023	GBP	3.44		2.23		1.22	1.22	700,000,000
TenneT Holding BV	21/02/2023	EUR	2.64		1.90		0.75	0.75	500,000,000
Dwr Cymru Financing Ltd	31/03/2028	GBP	1.87	1.87	1.09	1.09	0.79	0.79	350,000,000
RTE Reseau de Transport d'Electricite SA	12/09/2023	EUR	2.35		2.04		0.30	0.30	500,000,000
National Grid Electricity Transmission PLC	08/06/2027	GBP	1.97	1.97	1.15	1.15	0.82	0.82	251,259,000
Anglian Water Services Financing PLC	21/08/2023	GBP	3.44		2.46		0.98	0.98	200,000,000
AusNet Services Holdings Pty Ltd	13/02/2024	EUR	1.99		1.10		0.89	0.89	350,000,000
AltaLink LP	28/11/2022	CAD	3.44		2.44		1.00	1.00	275,000,000
AltaLink LP	06/11/2023	CAD	3.35		2.35		1.00	1.00	500,000,000
Anglian Water Services Financing PLC	30/07/2022	GBP	3.14		1.98		1.16	1.16	250,000,000
Wales & West Utilities Finance PLC	13/12/2023	GBP	3.48		2.54		0.94	0.94	250,000,000
Southern Water Services Finance Ltd	31/03/2026	GBP	2.68	2.67	1.55	1.54	1.13	1.13	350,000,000
Northern Powergrid Holdings Co	15/12/2022	GBP	3.71		2.18		1.53	1.53	200,000,000
Affinity Water Programme Finance Ltd	30/09/2022	GBP	3.48		2.36		1.13	1.13	14,204,000
Wales & West Utilities Finance PLC	30/11/2021	GBP	3.20		1.80		1.40	1.40	250,000,000
National Grid Gas PLC	27/06/2025	GBP	2.86	2.70	1.94	1.81	0.91	0.91	16,281,000
TenneT Holding BV	09/02/2022	EUR	2.54		1.77		0.76	0.76	500,000,000
Yorkshire Water Services Odsal Finance Ltd	28/05/2027	GBP	2.17	2.17	1.16	1.16	1.01	1.01	135,476,000
Western Power Distribution South West PLC	25/03/2027	GBP	2.37	2.37	1.22	1.22	1.15	1.15	250,000,000
Wales & West Utilities Finance PLC	07/03/2028	GBP	2.07	2.07	1.15	1.15	0.92	0.92	150,000,000
Northern Powergrid Yorkshire PLC	01/04/2025	GBP	2.91	2.94	1.87	1.89	1.04	1.04	150,000,000
Vier Gas Transport GmbH	10/07/2023	EUR	2.54		1.66		0.88	0.88	750,000,000
Yorkshire Water Services Odsal Finance Ltd	21/02/2023	GBP	3.34		2.26		1.08	1.08	210,692,000
NOVA Gas Transmission Ltd	01/12/2027	CAD	3.87	3.87	1.73	1.73	2.15	2.15	77,500,000
National Grid Gas PLC	16/12/2024	GBP	3.15	2.86	2.28	1.99	0.87	0.87	82,141,000
Western Power Distribution West Midlands PLC	09/05/2025	GBP	3.23	3.08	2.04	1.86	1.20	1.20	250,000,000
ANR Pipeline Co	15/02/2024	USD	4.09		2.44		1.65	1.65	125,000,000
NOVA Gas Transmission Ltd	01/04/2023	USD	3.50		2.17		1.33	1.33	200,000,000
NOVA Gas Transmission Ltd	16/12/2024	CAD	3.54	3.43	1.90	1.58	1.64	1.64	100,000,000
NOVA Gas Transmission Ltd	27/05/2025	CAD	3.33	3.87	1.46	1.29	1.88	1.88	87,000,000
Suez Water Resources Inc	09/02/2028	USD	3.97	3.97	2.40	2.40	1.57	1.57	15,000,000
NOVA Gas Transmission Ltd	27/05/2026	CAD	3.81	3.81	1.41	1.41	2.39	2.39	45,000,000
NOVA Gas Transmission Ltd	20/08/2026	USD	4.45	4.45	2.02	2.02	2.43	2.43	32,500,000
Golden State Water Co	23/03/2028	USD	3.85	3.85	2.33	2.33	1.53	1.53	15,000,000

Notes and sources:

Mid yields to maturity reported by Bloomberg. Government bond yields from Bank of Canada, Bank of England, Federal Reserve and De Nederlandsche Bank.
[C]: Average yields from 01/05/2012 until 30/04/2017 (included) if the yields are in the date range of 9 to 11 years from the maturity date.
For example, if a bond matures on the 18/07/2025, only yields reported between 18/07/2014 and 18/07/2016 are considered in the average.
[D]: Average yields from 01/05/2015 until 30/04/2017 (included) if the yields are in the date range of 9 to 11 years from the maturity date.
[E], [F]: Average 10 year government bond yields in the same period as that of the bond yields included. Government bond yields are assigned based on the currency.
[G]: [C]-[E]. [H]: [D]-[F].