The WACC for Heat Exchangers in the Netherlands

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NOTICE

TABLE OF CONTENTS

I. Introduction and Summary 5
A. Cost of Equity 6
B. Cost of Debt and Gearing 7
C. WACC Update for 2020 and 2023-2025 WACC 8
II. The Risk-Free Rate 11
III. The Equity Risk Premium 13
IV. Selection of the Peer Group 17
A. The Systematic Risks of Heating Companies and of the Rental of Heat Exchangers .. 17
B. The Sample of Peers 19
V. Beta 22
A. Peer Groups Equity Betas 22
B. Peer Groups Gearing and Asset Betas 24
VI. Cost of Debt and Gearing 26
A. Cost of Debt 26
B. Gearing 29
VII. The WACC for the Heat Exchangers 31

TABLE OF TABLES

Table 1: Updated WACC for 2020 9
Table 2: WACC for the Rental of Heat Exchangers in the 2023-2025 Period 10
Table 3: Historic Equity Risk Premium Relative to Bonds (1900 – 2021) 14
Table 4: DMS ERP Data 2018 - 2022 15
Table 5: The Final Sample of Peers Energy Networks 20
Table 6: Equity Betas for Energy Networks 24
Table 7: Equity and Asset Beta for Energy Networks 25
Table 8: Interest Cost of Debt of the Heating Companies in the Netherlands, by Year 28
Table 9: Updated WACC for 2020 31
Table 10: WACC for the Rental of Heat Exchangers in the 2023-2025 Period 32

TABLE OF FIGURES

Figure 1: Dutch and German 20-Year Government Bond Yields (September 2012-August 2022) 12
Figure 2: Eurozone Equity Risk Premiums, by Year 16
Figure 3: Gearing of the Heating Companies in the Netherlands in 2021 30

I. Introduction and Summary

1. Since 2014, the Dutch Authority for Consumers and Markets (ACM) is responsible for setting the maximum prices that heat suppliers in the Netherlands can charge to consumers and small and medium companies with a connection up to 100 kW for the supply of heat.[1] Currently, there are about 400 heating companies and 1400 heating networks operating in the Netherlands,[2] connecting about 400,000 houses, roughly 6% of Dutch households. We further understand that heating companies differ greatly in terms of size, ownership structure, source of generation, and age of the network and profitability, with larger, older networks typically earning more profits.

2. The ACM sets the maximum heating tariffs nationally, so there is no differentiation based on the heating companies' varying characteristics.[3] As of the time of preparing this report, the ACM sets five different tariffs components for: (i) supply, (ii) metering, (iii) connection, (iv) disconnection, and (v) the rental of heat exchangers. The tariffs for supply and metering are based on the "no more than usual" principle, which entails that consumers who rely on a heating company for their heat demand shall pay no more than if they had used natural gas for heating with a domestic boiler. The ACM sets the supply and metering tariffs annually using the most recent gas prices as reference prices. The tariffs for the connection and disconnection to the heating network and for the rental of heat exchangers are instead based on the actual costs of the 20 largest heating companies.

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[1] Unlike energy networks, heating companies are required by law to be integrated, so that production, transport and delivery are all performed by one single company, due to the very local nature of heat supply.

[2] This also includes lessors, housing corporations and owner's associations.

[3] Some of the differences between heating companies reflect non-systematic risks, which would not affect the companies' cost of capital or WACC. Nevertheless, there could also be different mixes of fixed and variable costs between heating companies (operating leverage) that would affect the cost of capital. However, it would be difficult to accurately measure this (likely small) difference based on listed companies. We note that even absent differences in operating leverage between companies, estimating a beta for heating is subject to some judgement and potential error. Trying to further differentiate between different types of heating companies would not be practical. Any differences in betas that result are more likely to be driven by the statistical error for the 'comparable' companies' chosen for the analysis, rather than representing a true difference in systematic risk and beta.

3. Since 2019, due to a revision of the Heating Act in 2018, the ACM determines a nominal pre-tax WACC which is used as an estimate for the maximum return heating companies are allowed to earn on the rental of heat exchangers. In 2019, the ACM determined the WACC for the rental of heat exchangers for the period 2020-2022 based on the general ACM method. However, a recent ruling by the Trade and Industry Appeals Tribunal (CBB) has determined that the cost of debt the ACM applies in the WACC for the heating companies should be based on their actual debt costs, so that the ACM needs to recalculate the WACC for 2020. In addition, the WACC for heat exchangers needs to be calculated for the next regulatory period, 2023-2025.

4. Within this context, the ACM has commissioned The Brattle Group (Brattle) to:

   a. Update the calculation of the cost of debt, and the resulting WACC, for heat exchangers for 2020 using the actual debt costs of heating companies;

   b. Calculate the WACC for Heat exchangers for the period 2023-2025.

5. The ACM has instructed us to consider the general ACM method for calculating the cost of equity and the actual debt costs of the heating companies to calculate the cost of debt.

6. In preparing this report, we use data up to and including 31 August 2022, being the most recent data available at the time of our analysis, to calculate the WACC for 2023-2025. We calculate the cost of debt for heat exchangers for 2020 using data up to and including 31 December 2019.

A. Cost of Equity

7. **Risk-free rate**. In line with ACM's methodology, we calculate the risk-free rate as the three-year average yield on 20-year government bonds in the Netherlands and in Germany. Over the three-year period ending on 31 August 2022, yields were 0.27% on average in the Netherlands, and 0.07% on average in Germany. Taking the average between the two gives us a risk-free rate of 0.17%, which we apply to the 2023-2025 WACC.

8. **Equity Risk Premium**. We calculate the Equity Risk Premium (ERP) using long-term historical data on the excess return of shares over long-term bonds, using data from Eurozone markets. The methodology requires that the projected ERP should be based on the average of the

arithmetic and geometric realized ERP for the Eurozone, using the market capitalization of each country's stock market as weights. The methodology also requires considering whether adjustments to the final ERP need to be made based on considerations of the historical average ERP, and ERP estimates based on dividend-growth models. Based on the available data, we select an ERP of 5%, which we apply to the 2023-2025 WACC.

9. **Selection of the Peer Group**. The risk of the rental of heat exchangers is comparable to that of energy networks that do not bear volume risk. That is, networks for which the revenues do not depend on the amount of energy transported. Similar to energy networks, rental income from heat exchangers does not depend on the amount of heat transmitted. Accordingly, we estimate the beta for the rental of heat exchangers by reference to the median asset beta of energy networks.

10. To select our peer group of comparable companies, we consider the energy networks considered by the ACM in its latest determination for the energy sector. We exclude non-European companies and check that the shares of the candidate peers are sufficiently liquid to provide a reliable beta estimate. After application of these criteria we end up with six energy networks.

11. **Beta**. In line with the ACM methodology we estimate equity betas for the peer group by regressing the daily returns of individual stocks on market returns over sample periods of three years as of the relevant measurement dates. We calculate market returns using a broad Eurozone index. We calculate the gearing of each comparator as of each measurement date as the three-year average of quarterly gearing ratios obtained dividing quarterly net debt over quarterly market capitalization. We then un-lever the equity betas using the Modigliani and Miller formula. Finally, we calculate the asset beta for the rental of heat exchangers based on the median asset beta of energy networks. The methodology results in an asset beta of 0.35.

B. Cost of Debt and Gearing

12. In line with the CBB ruling, to calculate the actual cost of debt of the heating companies for 2020 and for the period 2023-2025 we use actual financial data on interest payments and interest bearing debt for 26 small and large heating companies in the Netherlands.

13. **For the 2020 WACC update**, we calculate the cost of debt for the rental of heat exchangers based on the actual cost of debt of the heating companies as of 31 December of 2019, by

taking the ratio between interest payments in 2019 and the average interest-bearing debt balance over 2018-2019. We do not consider non-interest fees for the 2020 WACC update, because the ACM has already incorporated the non-interest fees in its revised tariff decision for 2020.

14. **For the 2023-2025 WACC**, we use the actual cost of debt of the heating companies as of 31 December 2021 – being the latest available information at the time of writing this report -- by taking the ratio between interest payments plus non-interest fees in 2021 and the average interest-bearing debt balance over 2020-2021.

15. We then calculate the cost of debt for heat exchangers based on the weighted average cost of debt of the individual companies. Using the weighted average is preferable to using the mean or the median cost of debt. This is because it puts more weight on larger debt issuances with more stable interest rates. Application of this methodology results in a cost of debt of 3.04% for the 2020 WACC update (excluding non-interest fees) and 3.41% for the 2023-2025 WACC (including non-interest fees).

16. The gearing used to re-lever the asset beta and to weight the cost of equity and the cost of debt should be consistent with the actual cost of debt of the heating companies. Accordingly, we calculate the gearing of the heating companies as of 31 December 2021 as the ratio of interest bearing debt over total assets. Overall, both the mean and median gearing are both equal to approximately 40%. Accordingly, we select a gearing of 40% for the 2023-2025 WACC.[4]

C. WACC Update for 2020 and 2023-2025 WACC

17. In 2019, the ACM calculated the 2020 WACC for the rental of heat exchangers for two different tax tiers. In Table 1, below, we update the 2020 WACC calculation for the rental of heat exchangers for the two tax tiers and applying the actual cost of debt of the heating companies estimated using data as of 2019, which reflects the cost of debt which could have been estimated at the time of the decision. We do not consider non-interest fees for the 2020

[4] Unlike the cost of debt, the calculation of gearing is not affected by the timing of bond issuances because it considers the ratio of the stock of interest bearing debt and the stock of total assets both at the end of each year. Therefore, gearing is less sensitive to outliers and taking a weighted average of the gearing as we have done for the cost of debt is not necessary.

WACC update, because the ACM has already incorporated the non-interest fees in its revised tariff decision for 2020.

TABLE 1: UPDATED WACC FOR 2020

			Low Tax Tier [A]	High Tax Tier [B]
Tax Rate	[1]	See note	16.50%	25.00%
Notional Gearing (D/A)	[2]	See note	40.82%	40.82%
Gearing (D/E)	[3]	See note	68.98%	68.98%
Asset Beta	[4]	See note	0.38	0.38
Equity Beta	[5]	See note	0.60	0.58
Risk-Free Rate (Equity)	[6]	See note	0.39%	0.39%
ERP	[7]	See note	4.79%	4.79%
Cost of Equity	[8]	See note	3.26%	3.15%
Pre-tax Cost of Equity	[9]	See note	3.90%	4.20%
Cost of Debt	**[10]**	**See note**	**3.04%**	**3.04%**
Nominal WACC (After-tax)	[11]	(1-[2])x[8]+[2]x(1-[1])x[10]	2.96%	2.80%
Nominal WACC (Pre-Tax)	[12]	[11]/(1-[1])	3.55%	3.73%

Sources and notes:
[1]-[9]: See Europe Economics, "WACC calculation for heat exchangers in The Netherlands," December 2019, Tables 9.1 and 9.2.
[10]: See Section VI.

18. Table 2 details our calculation of the WACC for the rental of heat exchangers over the next regulatory period 2023-2025. In calculating the WACC, we apply the statutory corporate tax rate of 25.8%.

TABLE 2: WACC FOR THE RENTAL OF HEAT EXCHANGERS IN THE 2023-2025 PERIOD

			2023-2025
Gearing (D/A)	[1]	See note	40.00%
Gearing (D/E)	[2]	[1]/(1-[1])	66.67%
Tax rate	[3]	ACM	25.80%
Risk free rate	[4]	See note	0.17%
Asset beta	[5]	See note	0.34
Equity beta	[6]	[5]x(1+(1-[3])x[2])	0.51
Equity Risk Premium	[7]	See note	5.00%
After-tax cost of equity	[8]	[4]+[6]x[7]	2.74%
Cost of Debt	[9]	See note	3.41%
Nominal after-tax WACC	[10]	((1-[1])x[8])+([1]x(1-[3])x[9])	2.66%
Nominal pre-tax WACC	[11]	[10]/(1-[3])	3.58%

Sources and notes:

[1]: See Section VI.

[4]: See Section II.

[5]: See Section V.

[7]: See Section 0.

[9]: See Section VI.

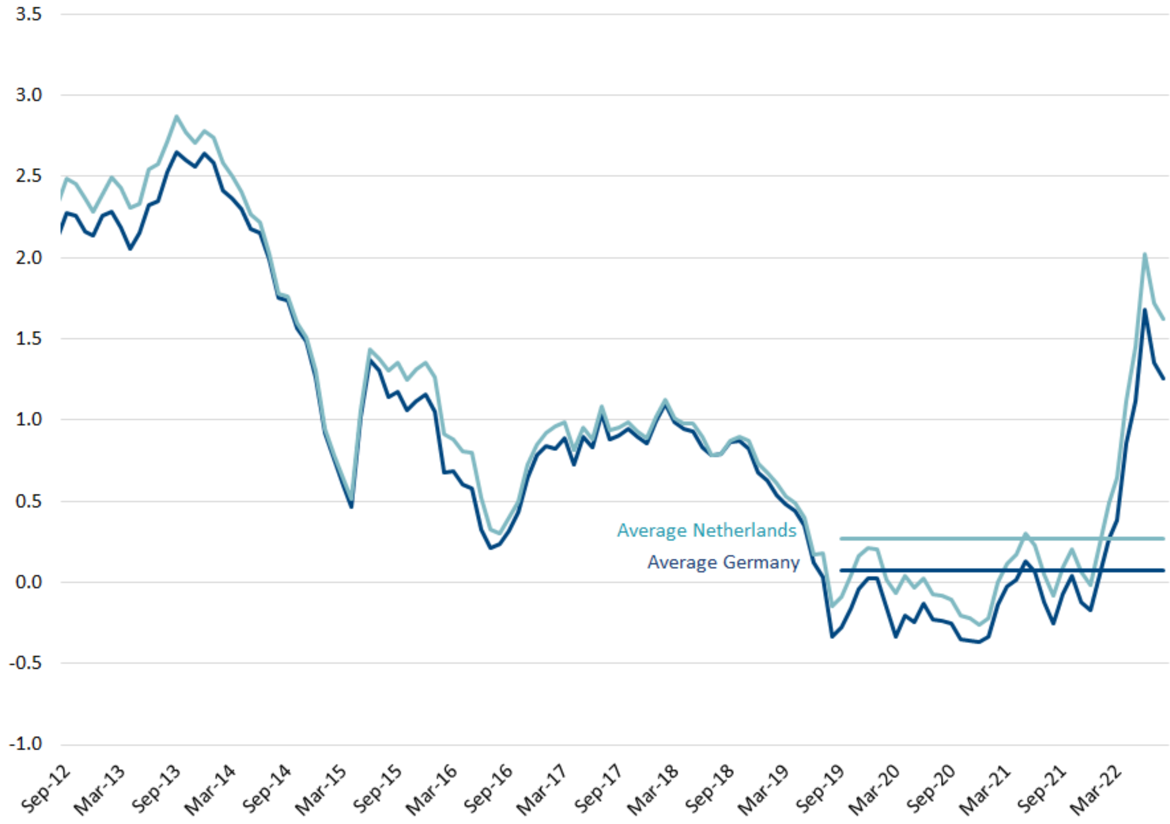
II. The Risk-Free Rate

19. ACM's methodology calculates the risk-free rate as the average yield on 20-year government bonds over the last three years in the Netherlands and in Germany.[5] Figure 1 illustrates the evolution of the yields of 20-year government bonds over the past 10 years in the Netherlands and in Germany. As a measure of the yield of 20-year government bonds, we rely on the 'GTDEM20Y Govt Generic Germany 20 Year Government Bond' index for Germany and the 'GTNLG20Y Govt Generic Netherlands 20 Year Government Bond' index for the Netherland.

20. Over the past ten years, nominal government bond yields in the Netherlands have been steadily decreasing through 2019, entering for the first time into negative territory around June of 2019. After that, bond yields fluctuated around zero through the end of 2021, when they started to increase, largely driven by the unfolding of the war in Ukraine and by an exceptionally high rate of inflation. The increase in bond yields was further accelerated by the ECB announcements that it would raise interest rates for the first time since 2011. As of August 2022, bond yields have reached again the level they had in 2014, that is before the European Central Bank (ECB) launched its first Quantitative Easing (QE) stimulus program. Over the three-year period ending on 31 August 2022, yields were 0.27% on average in the Netherlands, and 0.07% on average in Germany. Taking the average between the two gives us a risk-free rate of 0.17%, which we apply to the 2023-2025 WACC.

[5] Historically, the ACM calculated the RFR by reference to 10-year government bonds. However, the ACM recently determined to use 20-year bonds to ensure consistency between the maturity of the bonds used in the calculation of the risk-free rate and the maturity of the bonds considered in the calculation of the equity risk premium. As we explain below, we base our estimate of the ERP on historical excess returns over long-term bonds calculated by Dimson, Marsh and Staunton (DMS). On average, the long-term bonds DMS use have a maturity of about 20-years.

FIGURE 1: DUTCH AND GERMAN 20-YEAR GOVERNMENT BOND YIELDS (SEPTEMBER 2012-AUGUST 2022)



Source: Bloomberg.

III. The Equity Risk Premium

21. ACM's methodology specifies that the ERP should be based on a historical time-series of the excess return of stocks over long-term bonds for the Eurozone economies. Specifically, ACM has determined to use the simple average of the long-term arithmetic and geometric average ERP for the Eurozone as the anchor for the ERP estimate. The ERP for individual countries in the Eurozone should be weighted using the current capitalization of each country's stock market.[6] The methodology reflects an estimate of the ERP in the very long run, and notably excludes countries outside of the Eurozone. This is reasonable, because a Dutch investor is more likely to be diversified over the same currency zone, rather than to incur additional currency risks by diversifying within Europe but outside of the Eurozone.

22. Table 3, below, illustrates the realised ERP derived from one of the most widely used sources for long-run excess returns, being the data published by Dimson, Marsh and Staunton (DMS) for individual European countries taken from the 2022 DMS report.[7] This report contains ERP estimates using data up to and including 2021. The Table shows the simple and weighted averages of the ERP countries for which DMS have data. Overall, we find that the simple average between the arithmetic and geometric ERP for the period 1900 to 2021 inclusive was 5.58% for the Eurozone. Using each country's stock market capitalization to weight the averages across the Eurozone, we derive an ERP of 5.06% for 2021.

[6] Weighting based on the current market-capitalization reflects the idea that a typical investor would invest a larger share of his portfolio in countries with more investment opportunities.

[7] Credit Suisse Global Investment Returns Sourcebook 2022, Table 9.

TABLE 3: HISTORIC EQUITY RISK PREMIUM RELATIVE TO BONDS (1900 – 2021)

		Risk Premiums Relative to Bonds, 1900 - 2021			
		Geometric Mean	Arithmetic Mean	Average	Country Market Cap (2020)
		%	%	%	USD mln
		[A]	[B]	Average [A], [B]	[C]
Austria	[1]	2.80	21.00	11.90	178,642
Belgium	[2]	2.20	4.30	3.25	424,650
Finland	[3]	5.40	9.00	7.20	351,754
France	[4]	3.20	5.40	4.30	3,464,305
Germany	[5]	4.90	8.20	6.55	2,763,953
Ireland	[6]	2.70	4.70	3.70	129,865
Italy	[7]	3.00	6.30	4.65	736,545
Netherlands	[8]	3.40	5.70	4.55	1,249,391
Portugal	[9]	5.10	9.20	7.15	88,210
Spain	[10]	1.60	3.50	2.55	713,692
Average Eurozone	[11]	3.43	7.73	5.58	
Value-Weighted Average Eurozone	[12]	3.60	6.51	5.06	

Sources and notes:
[A][1]-[10], [A][13], [B][1]-[10]: Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Investment Returns Sourcebook 2022, Table 9.
[11]: Average of [1]-[10].
[12]: Average of [1]-[10], weighted by [C].

23. Table 4, below, further reports the average of the geometric and arithmetic average DMS ERP for the Eurozone weighted by stock market capitalisation for each of the years 2017-2021 inclusive. The weighted average of the geometric and arithmetic means of the ERP for the Eurozone ranged between 4.85% and 5.11%, averaging 4.98% over this five-year period. Based on this evidence, we find that an ERP of 5.0% seems reasonable. Selecting a stable ERP of 5.0% is also consistent with the most recent ACM decisions on the WACC for the gas and electricity networks in the Netherlands.[8]

[8] See Dan Harris and Lucrezio Figurelli, "The WACC for the Dutch Gas TSO", 27 July 2020 (https://www.acm.nl/sites/default/files/documents/rapport-the-brattle-group-the-wacc-for-the-dutch-gas-tso_0.pdf) and "The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs", 7 April 2021 (https://www.acm.nl/sites/default/files/documents/the-wacc-for-the-dutch-electricity-tso-and-electricity-and-gas-dsos.pdf).

TABLE 4: DMS ERP DATA 2018 - 2022

	Geometric Mean [A] %	Arithmetic Mean [B] %	Average [C] Average([A], [B])
2017	3.61	6.61	5.11
2018	3.45	6.46	4.95
2019	3.50	6.40	4.95
2020	3.38	6.31	4.85
2021	3.60	6.51	5.06
Average	3.51	6.46	4.98

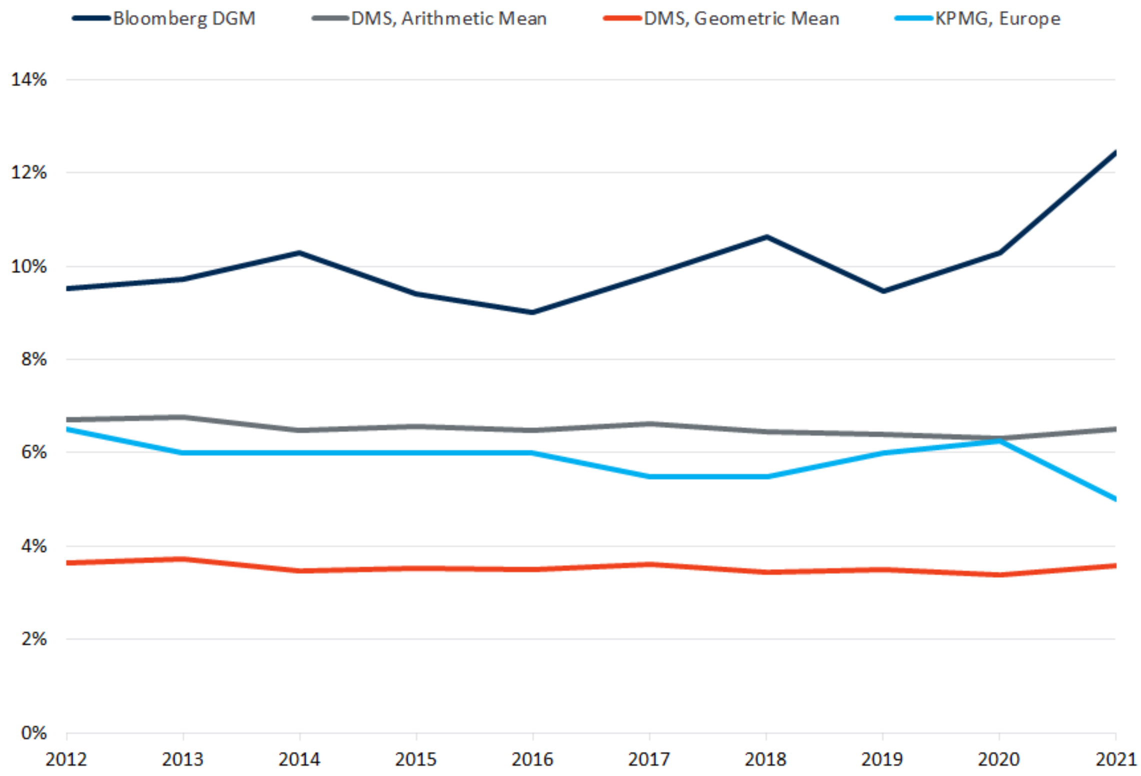
Sources and notes: Brattle calculation using data from Credit Suisse Global Investment Returns Sourcebook, 2018-2022.
[A], [B]: Value-weighted average for the Eurozone.

24. ACM's methodology requires us to look at evidence on the ERP from the dividend growth model (DGM) as a 'sanity check' on the ERP estimate based on historical data.[9] In Figure 2, below, we compare the DMS estimates of the arithmetic and geometric means of the historical ERP for the Eurozone to the forward looking estimates of the ERP based on Bloomberg's and KPMG's DGMs since 2012.[10] Both the arithmetic and geometric means based on the historical DMS data and the DGM estimates of the ERP by Bloomberg and KPMG have been relatively stable over the last ten years. Over the past two years, we further observe some divergence between the two DGM estimates, with Bloomberg's estimate increasing from 10.29% in 2020 to 12.43% in 2021, and KPMG's estimate decreasing from 6.25% in 2020 to 5.0% in 2021. Overall, we find this evidence to suggest that no adjustment is necessary or justified.

9 For example, after the 2009 financial crisis, historical data indicated a decrease in the ERP, because realised returns of stocks over bonds were very low. But the DGM indicated that the ERP had if anything increased after the crisis. The DGM result made sense, since investors would likely have perceived more risk and demanded higher returns immediately after the crisis. Hence, the results of the DGM indicated that, for this period, a downward reduction in the ERP was not justified, even though this is what the unadjusted historical data indicated.

10 KPMG provides a DGM-based estimate of the ERP for Europe based on the implied equity returns of European indices. See "Equity Market Risk Premium - Research Summary", KPMG, 30 March 2021. Bloomberg provides daily DGM-based estimates of the ERP for individual European countries under the 'Country Risk Premium' function. We use Bloomberg's DGM-based ERP estimates for individual Eurozone countries as of 31 December of each year to calculate a weighted average DGM-based ERP for the Eurozone.

FIGURE 2: EUROZONE EQUITY RISK PREMIUMS, BY YEAR



Source: Bloomberg, various DMS reports, KPMG Netherlands and Brattle calculations.

IV. Selection of the Peer Group

A. The Systematic Risks of Heating Companies and of the Rental of Heat Exchangers

25. Understanding the operations and the systematic risks of heating companies – and of the rental of heat exchangers in particular – is essential to estimate a reasonable rate of return for the rental of heat exchangers. More specifically, because the Dutch heating companies are not listed, we need to estimate beta by reference to a group of comparable companies engaged in similar activities and facing similar systematic risks. In this Section we analyse the activities and risks of heating companies and of the rental of heat exchangers in order to identify a set of comparable sectors that can be used to estimate beta for the rental of heat exchangers.

26. Heating companies are vertically integrated companies, responsible for the production, transport and delivery of heat to consumers. Heat is obtained from several sources – often a generation plant burning fossil fuels – and is transported as steam or hot water through a system of pipes. Steam and hot water are first delivered to a substation, before being delivered to end-consumers through the distribution heating network. Because demand fluctuates considerably over time, back-up boilers are also used at the substation to ensure stability of supply. Finally, in order to transfer heat from the heat network to their indoor system, consumers must rent a heat exchanger. The delivery of heat thus requires four main components: (i) a source of heat, (ii) a system of pipes, (iii) a substation with back up boilers, and (iv) heat exchangers.

27. As regards to the sources used to generate heat, the most commonly used sources in the Netherlands are drain water and residual heat – where the heat is obtained from electricity or waste incineration plants or from the heat released in industrial activity – accounting for over 80% of connected households in the Netherlands as of 2018. Other sources include

biomass and aquifer thermal energy, accounting for about 13% and 5% of connected households in 2019, respectively.[11]

28. In general, the risks of the heating companies can be broadly classified into one of four categories: demand risks, supply risks, buildout and take-up risks and regulatory risks.

a. **Demand risks from existing customers**. Heating companies face the risk of revenue fluctuations related to fluctuations in demand. These risks relate to changes in number of consumers and in the quantity of heat demanded by connected consumers. Demand risks from existing customers, however, are relatively low, because customers connected to a heat network have limited capacity to switch to an alternative source without incurring significant costs. As a result, the turnover of existing customers is low.

b. **Buildout and take-up risks**. Similar to investments into a new fiber telecommunications network, the development of a heating network involves a certain degree of demand risks related to buildout and take-up of the heat network. Take-up risk relates to the risk that the rate at which homes connect to the heating networks differs from what is foreseen when the investment is made. Similarly, construction risks relate to the risk of higher costs or longer lead time during the construction period.

c. **Supply risks**. Heating companies face supply risks because they are fully responsible for the generation and supply of heat. The nature and extent of these risks varies by company based on the source(s) used to generate heat and on the degree of vertical integration. In general, supply risks relate to the availability of the sources used to produce heat, which cannot be changed (easily) in the short run, and to their price relative to the price of gas. Unlike regulated transport and distribution networks, the profitability of heat networks is highly sensitive to changes in the supply and relative price of the inputs used in the generation of heat.

d. **Regulatory risk**. In addition to general regulatory risks, heating companies also face potential asymmetric regulatory risk due to the combination of the "no more than usual" clause applied to the supply and metering tariffs,[12] and the "rate of return test", which

[11] See Europe Economics, "WACC calculation for heat exchangers in The Netherlands," December 2019, page 4.

[12] As explained above, the "no more than usual" principle entails that consumers who rely on a heating company for their heat demand shall pay no more than consumers using gas.

ensures that realized returns of the heating companies do not exceed a reasonable level. Unlike demand, supply, buildout and take-up risks, which are mostly systematic risks, regulatory risks, including asymmetric risk, are mostly non-systematic. Therefore, it should not affect the beta.[13]

29. The risks involved in the rental of heat exchangers are fairly limited. This is because the tariff for the rental of heat exchangers is a fixed rental charge, which is independent from the amount of heat supplied and cost-based. Therefore most of the risks discussed above do not apply to the rental of heat exchangers.

30. In more detail, the rental of heat exchangers faces very limited demand risk, largely related to the possibility of disconnects. Supply, buildout and take-up risks are also very limited, as costs involve only the purchase and maintenance of one piece of equipment – the heat exchanger – which are only incurred when a home is connected to the heat network.

31. In this light, the risk of the rental of heat exchangers is mostly comparable to that of **energy networks** subject to revenue regulation. These networks do not face volumes risk. That is, their revenue does not vary with the amount of energy they transport. Similar to revenue-regulated energy networks, the rental income from heat exchangers only faces the risk of disconnects. Accordingly, we estimate the beta for the rental of heat exchangers by reference to the median asset beta of revenue-regulated energy networks.

B. The Sample of Peers

32. To select a sample of comparable energy networks, we start considering the peer group of companies considered by the ACM in its latest determination in the energy sector.[14] From this group we exclude TC Pipelines because the company is not European.[15] All of the candidate peers are revenue-regulated energy networks.

[13] Companies, however, make investment decisions taking non-systematic asymmetric risk into account in developing expected cash flows. In practice, however, adjusting expected cash flows for non-systematic asymmetric risk may be challenging. Determining whether there should be compensation in the WACC for asymmetric risk is outside the scope of this report.

[14] See Dan Harris and Lucrezio Figurelli, "The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs", 7 April 2021; (available at https://www.acm.nl/sites/default/files/documents/the-wacc-for-the-dutch-electricity-tso-and-electricity-and-gas-dsos.pdf).

[15] This approach is consistent with ACM's previous determination of the WACC for the heat exchangers. We have used a similar approach in the determination of the WACC for the heating sector as a whole.

33. In line we the ACM methodology, we test that the firms' shares are sufficiently liquid to obtain a reliable beta estimate. In particular, for each candidate peer we calculate the average bid-ask spread over the relevant three-year reference period for the calculation of beta as a percentage of the stock price. We then check whether the average bid-ask spread exceeds 1% of the stock price, which is the threshold we consider for exclusion.[16] As additional sanity checks, we also check that the candidate peers had annual revenues of at least € 100 million and that their shares are traded on at least 90% of the days in which the relevant market index traded over the relevant reference period. All of the candidate peers considered pass the liquidity tests.

34. We consider two additional screening test to ensure a reliable beta estimate. Specifically, we check that the credit rating of the candidate peers is not below investment grade and that the companies were not involved in substantial M&A activity.[17] All of the candidate peers considered have an investment grade rating and were not recently involved in substantial M&A activity having a noticeable effect on the daily returns of the stock price.

35. Table 5, below, reports the list of peer energy networks we consider to estimate the beta for heat exchangers.

TABLE 5: THE FINAL SAMPLE OF PEERS ENERGY NETWORKS

	Country	Rating	Bid-Ask Spread	M&A Test
Elia Group SA/NV	Belgium	BBB+	✓	✓

[16] Historically, the ACM methodology applied two criteria to test for liquidity. First, the shares of the candidate peers had to be traded on at least 90% of the days in which the relevant market index traded over the reference period (the number of trading days test). Second, the ACM methodology required that the candidate peers had annual revenues of at least € 100 million (the annual revenue requirement), on the basis that firms with larger revenues are likely to have shares that are liquidly traded. More recently, in response to a court ruling, the ACM commissioned a study to provide a recommendation on the appropriate criteria to select peers for efficient beta estimation. The study determined that the two existing criteria adopted by ACM should be modified, and that a bid-ask spread threshold of 1% should be applied instead as the primary liquidity criterion. The ACM has asked us to follow this recommendation, and to consider additional liquidity tests as 'sanity checks' on the results. We find this to be a reasonable approach to test for liquidity.

[17] Share prices of firms with lower credit ratings tend to be more reactive to company-specific news. This will lower the measured beta, in a way that may not be representative of the Dutch heating companies. Similarly, substantial M&A activity will tend to affect a firm's share price in a way that is unrelated to the systematic risk of the business. Hence, the observed beta for a firm with substantial M&A activity will tend to underestimate the true beta for a firm with the same business activity absent M&A activity. Accordingly, we would exclude firms that have been involved in 'substantial' mergers and acquisitions (M&A) during the period for which data is used to calculate the beta.

Enagas SA	Spain	BBB	✓	✓
Red Electrica Corp SA	Spain	A-	✓	✓
REN - Redes Energeticas Nacionais	Portugal	BBB	✓	✓
Snam SpA	Italy	BBB+	✓	✓
Terna - Rete Elettrica Nazionale	Italy	BBB+	✓	✓

Source: Brattle elaboration on Bloomberg data.

V. Beta

A. Peer Groups Equity Betas

36. ACM's methodology specifies a three-year daily sampling period for the beta. Accordingly, we estimate equity betas for the peer group of firms by regressing the daily returns of individual stocks on market returns over the three year period 1 September 2019-31 August 2022.[18]

37. The systematic risk of each peer, as summarised in its beta parameter, must be measured against an index representing the overall market. A hypothetical investor in a Dutch heating company would likely diversify its portfolio within a single currency zone so as to avoid exchange rate risk. Using indices from the relevant country or currency zone avoids exchange rate movements depressing the betas, and should result in a higher beta estimate than if we estimated betas against an index derived in a different currency. Accordingly, because all peers operate in Eurozone countries, we calculate market returns using a broad Eurozone index (the Stoxx Europe 600 (SXXP)).

38. We perform a series of diagnostic tests to assess if the beta estimates satisfy the standard conditions underlying ordinary least squares regression. We test for autocorrelation using the Breusch-Godfrey test, but rely on the OLS estimate of the beta parameter even in the presence of autocorrelation.[19] We test for the presence of heteroscedasticity using the White's test and use White's-Huber robust standard errors.

39. In addition to the above diagnostic tools and adjustment procedures, we consider an adjustment for market imperfections. This adjustment requires us to use a weekly beta

[18] We measure daily returns based on dividend adjusted prices using Bloomberg's "TOT_RETURN_INDEX_GROSS_DVDS" function. This function returns stock prices adjusted to account for the issuance of dividends, gross of any applicable withholding tax. We note that Bloomberg also provides dividend adjusted prices *net* of any applicable withholding tax, also known as "cash dividends". The two fields, however, will only be different if there is tax rate information. In practice, these two measures tend to be the same for most firms. Moreover, dividend withholding taxes are not taxes to the firm, but rather taxes to the income – the dividend – of the shareholders, which governments may decide to tax directly at the source, and may differ significantly by shareholder type (individual or firm, tax resident or non-resident).

[19] We test for autocorrelation up to three lags. Note that the OLS estimator of the beta is unbiased (not systematically too high or too low) and consistent (converges to the correct value) even in the presence of autocorrelation.

instead of the daily beta, if it appears that share prices react to news the day before or the day after the market index reacts. This could occur because of differences in market opening times and trading hours, or differences in the liquidity of the firm's shares relative to the average liquidity of the market. If such an effect is present, a beta estimated using daily returns on the firm's share and on the market index may be biased. Similarly, financial market frictions caused by information asymmetries, transaction costs, limit orders, and overreaction to news may also affect the way information is incorporated in the share price. In contrast, weekly betas are less sensitive to the speed at which share prices assimilate information, because they use returns over five trading days.

40. The adjustment for market imperfections is a modified version of the Dimson adjustment. The Dimson adjustment regresses a company's daily returns using the market index returns one day before and one day after as additional repressors. If the market is perfectly efficient, all information should be dealt with on the same day. The adjustment for market imperfections considers that if the lag or the lead coefficient are either significantly different from zero or jointly significantly different from zero, this suggests that information about the true beta may be lost by considering only the simple regression. This problem can be largely resolved using weekly data to estimate the equity beta.

41. In practice, we have considered this adjustment for the firms in our peer group, but the adjustment was not significant for any of the companies. Hence we take the daily beta for all companies in the peer group.

42. Table 6 reports the equity betas of the peers. Overall, the equity betas of energy networks range between 0.40 (Elia Group SA/NV) and 0.81 (Snam SpA).

TABLE 6: EQUITY BETAS FOR ENERGY NETWORKS

	Results		
	Beta	Robust Standard Error	Beta Chosen
	[A]	[B]	[C]
Elia Group SA/NV	0.39	0.07	Daily
Enagas SA	0.61	0.10	Daily
Red Electrica Corp SA	0.47	0.10	Daily
REN - Redes Energeticas Nacion	0.42	0.06	Daily
Snam SpA	0.80	0.13	Daily
Terna - Rete Elettrica Naziona	0.70	0.09	Daily

Source: Brattle elaboration on Bloomberg data.

B. Peer Groups Gearing and Asset Betas

43. As well as reflecting the systematic risk of the underlying business, equity betas also reflect the risk of debt or financial leverage. 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 equity beta than the firm with less debt.

44. 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]

45. Consistent with the three-year reference period used to estimate the beta, we calculate the gearing of each comparator as of each measurement date as the three-year average of quarterly gearing ratios obtained dividing quarterly net debt over quarterly market capitalization.

[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.

46. Table 7 reports the equity beta, the gearing and the resulting asset betas for each peer. Overall, the asset betas range between 0.19 (REN - Redes Energeticas Nacion) and 0.49 (Snam SpA). The median asset beta of the peer energy networks is equal to 0.34. We select this value to calculate the asset beta for the rental of heat exchangers.

TABLE 7: EQUITY AND ASSET BETA FOR ENERGY NETWORKS

			Equity Beta [A]	Gearing (D/E) [B]	Tax Rate [C]	Asset Beta [D]
Elia Group SA/NV	Belgium		0.39	84.1%	26.8%	0.24
Enagas SA	Spain		0.61	81.0%	25.0%	0.38
Red Electrica Corp SA	Spain		0.47	70.6%	25.0%	0.31
REN - Redes Energeticas Nacion	Portugal		0.42	152.8%	21.0%	0.19
Snam SpA	Italy		0.80	81.1%	24.0%	0.49
Terna - Rete Elettrica Naziona	Italy		0.70	68.5%	24.0%	0.46
Median		[1]	0.54	81%		0.34

Notes:

[A], [B]: Brattle elaboration on Bloomberg data.

[C]: KPMG.

[D]: [A]/(1+(1-[C])*[B]).

VI. Cost of Debt and Gearing

A. Cost of Debt

47. In 2019, the ACM determined the cost of debt of the heating companies as the sum of a credit spread plus the risk free rate. The ACM then added 15 basis points to cover the costs of issuing debt. The methodology distinguished between existing and new debt, and calculated the credit spread based on Bloomberg's BBB-rated 10-year utility index. However, a recent ruling by the CBB has determined that the cost of debt of the heating companies should be based on their actual debt costs.

48. In line with the CBB ruling, we use actual financial data on interest payments and interest bearing debt for small and large heating companies to calculate the companies' actual cost of debt of the heating companies as of 31 December of each year. We then:

    a. Update the calculation of the cost of debt for heat exchangers for 2020 based on the actual cost of debt of the heating companies as of 31 December 2019.

    b. Calculate the cost of debt for heat exchangers for the period 2023-2025 based on the actual cost of debt of the heating companies as of 31 December 2021.

49. Using the actual cost of debt as of the year prior the year for which we are calculating the cost of debt is reasonable, as it relies on the most up to date information at the beginning of the relevant WACC period. In contrast, taking an average across multiple years may provide inaccurate results, because the cost of debt from prior years may reflect interest payments on debt that has reached maturity and/or exclude interest payments on more recent issuances.[21]

50. In principle, debt could be differentiated between the rental of heat exchangers and heating companies in general. For example, we may estimate a lower cost of debt for the rental of heat exchangers, because the activity is less risky than the supply of heat overall. However,

[21] We note that the recent increase in government and corporate bond rates over the past few months will likely increase the cost of new debt issued by the heating companies. Therefore, calculating the expected cost of debt for 2023-2025 based on the actual cost of debt in 2021 may underestimate the future costs of debt of these companies.

the integrated heating companies do not report separate debt for the different activities. Accordingly, we assume that the same cost of debt would apply to both heat exchangers and heating companies in general.

51. In more detail, the ACM has provided us with information on interest charges and non-interest fees, outstanding interest-bearing debt (as of 31 December) and total assets for 26 small and large heating companies in the Netherlands between 2014 and 2021.

52. **For the 2020 WACC update**, we calculate the cost of debt for the rental of heat exchangers taking the ratio between interest payments in 2019 and the average interest-bearing debt balance over 2018-2019. We do not consider non-interest fees for the 2020 WACC update, because the ACM has already incorporated the non-interest fees in its revised tariff decision for 2020.

53. **For the 2023-2025 WACC**, we use the actual cost of debt of the heating companies taking the ratio between interest payments plus non-interest fees in 2021 and the average interest-bearing debt balance over 2020-2021.[22]

54. Table 8**,** below, shows our results.[23] Overall, we observe high variability in the cost of debt values across companies and years, with the cost of debt, excluding non-interest fees, ranging between 1.3% and 6.3% in 2019 and the cost of debt, including non-interest fees, ranging between 0.5% and 8.4% in 2021. This high level variation largely reflects the effect of timing and amount of new bond issuances. Clearly, the time of the year in which new loans are issued and the amount of the new loan will dramatically affect the amount of interest the company will have to pay over the financial year.

55. Table 8 also reports the mean, median and debt-weighted average cost of debt for each year. The mean appears to be sensitive to outliers. For example, while the median and weighted average indicate a cost of debt in the range 3.05%-3.41% in 2021, the mean indicates a much

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22 In line with the CBB ruling, the ACM has asked the heating companies' total cost of debt, including non-interest fees to account for the cost of issuing debt. Non-interest fees are typically lump sum fees that are paid when new debt is issued. Ideally, we should account for these fees by annualizing them, taking into account the amount and maturity of each new bond issuance. This approach is not feasible in practice, as it requires detailed information on individual issuances that is not available to us. In practice, however, averaging of non-interest fees (as a percentage of interest bearing debt) across many companies should lead to reliable results, because the lump sum fees on new bonds paid by some firms are averaged across firms.

23 We have also calculated the cost of debt removing interest and debt attributable to intercompany and subordinated loans. Such approach led to very similar results.

higher value of 3.98%, largely driven by the high levels of cost of debt reported by a few companies. Also the median seems affected by changes in the data that do not reflect the evolution of the cost of debt of the heating companies.[24]

56. In light of the above, we propose to calculate the cost of debt for heat exchangers based on the weighted average cost of debt of the individual companies. Using the weighted average is preferable, because it puts more weight on larger debt issuances that are more reliable, as the resulting interest rates are more stable and less vulnerable to the effects of changes from year to year, making the approach less sensitive to outliers. Accordingly, we select an interest cost of debt of 3.04%, equal to the weighted average cost of debt as of 31 December 2019 (excluding non-interest fees), to update the 2020 WACC, and a value of 3.41%, equal to the weighted average as of 31 December 2021 (including non-interest fees), for the 2023-2025 WACC.

TABLE 8: INTEREST COST OF DEBT OF THE HEATING COMPANIES IN THE NETHERLANDS, BY YEAR

		Interest and Non-Interest Fees Cost of Debt	
		2019 (Excl. Non-Interest Fees)	2021 (Incl. Non-Interest Fees)
Company A	[1]	1.80%	5.58%
Company B	[2]	1.28%	1.88%
Company C	[3]	-	2.70%
Company D	[4]	1.98%	2.35%
Company E	[5]	2.32%	1.63%
Company F	[6]	3.21%	1.73%
Company G	[7]	2.94%	2.87%
Company H	[8]	5.22%	7.86%
Company I	[9]	3.88%	4.65%
Company J	[10]	5.48%	8.40%
Company K	[11]	1.43%	1.49%
Company L	[12]	5.83%	6.05%
Company M	[13]	3.69%	3.04%
Company N	[14]	-	0.50%
Company O	[15]	4.87%	7.23%
Company P	[16]	4.11%	3.07%

[24] For example, we calculate that the median cost of debt reduces from 3.65% in 2020 to 3.05% in 2021, while the cost of debt of 16 out of the 24 companies for which we are able to calculate the cost of debt in those years had actually increased. In contrast, both the mean and the weighted average cost of debt have remained stable between 2020 and 2021.

Company Q	[17]	3.61%	2.00%
Company R	[18]	2.50%	2.60%
Company S	[19]	1.70%	1.91%
Company T	[20]	5.93%	6.20%
Company U	[21]	2.92%	3.55%
Company V	[22]	4.62%	8.24%
Company W	[23]	4.43%	6.66%
Company X	[24]	-	-
Company Y	[25]	-	-
Company Z	[26]	3.53%	3.40%
Mean	**[27]**	**3.51%**	**3.98%**
Median	**[28]**	**3.57%**	**3.05%**
Weighted-Average	**[29]**	**3.04%**	**3.41%**

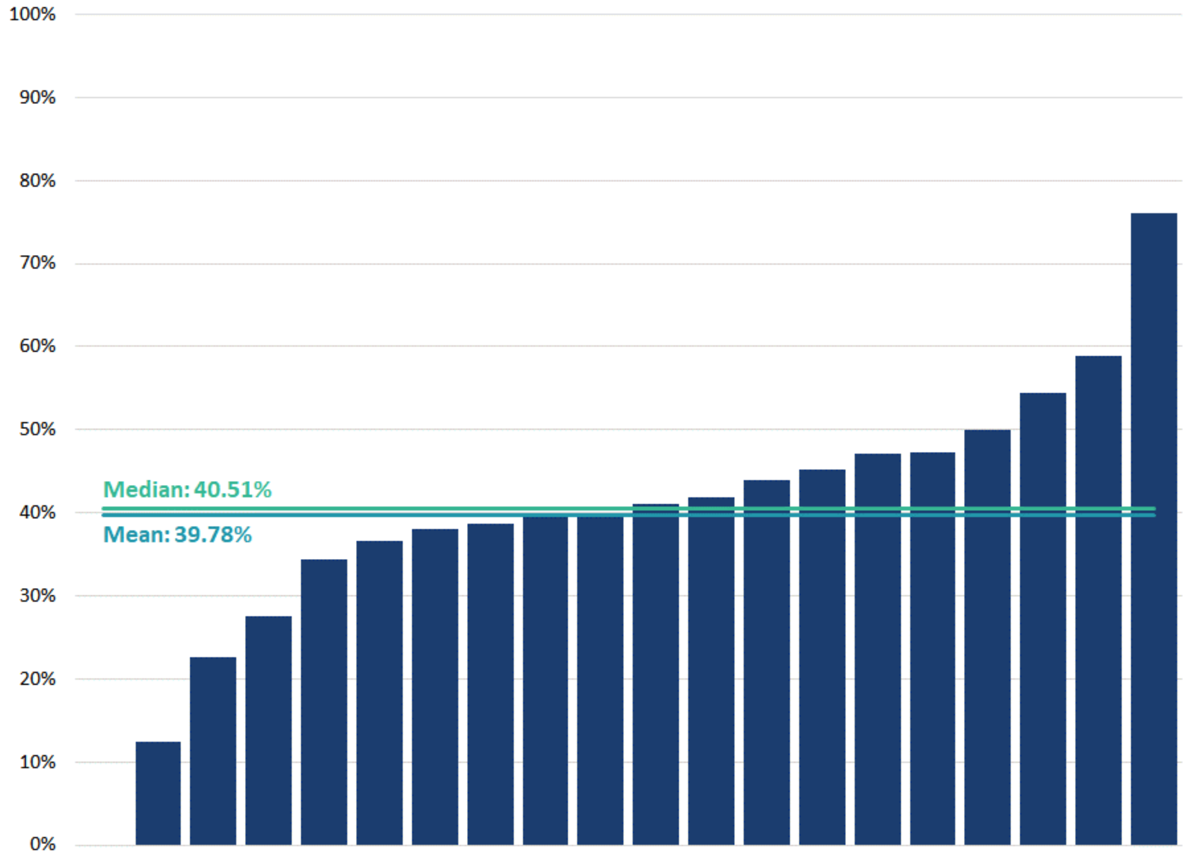
Source: Brattle elaboration on data provided by ACM on cost of debt for the heating companies.

B. Gearing

57. The gearing used to re-lever the asset beta and to weight the cost of equity and the cost of debt should be consistent with the actual cost of debt of the heating companies. Accordingly, we calculate the gearing of the heating companies as the ratio of interest bearing debt over total assets.[25] Figure 3 reports our results. Overall, both the mean and median gearing are equal to approximately 40%. Accordingly, we select a gearing of 40% for the 2023-2025 WACC.

[25] We note that 'interest bearing debt' reported by the heating companies is quite different from 'balance sheet debt' reported by the same companies for the calculation of gearing. Accordingly, to make the calculation of gearing consistent with the calculation of the cost of debt, we calculate gearing as the ratio of 'interest bearing debt' and total balance sheet assets.

FIGURE 3: GEARING OF THE HEATING COMPANIES IN THE NETHERLANDS IN 2021



Source: Brattle elaboration on data provided by ACM on gearing for the heating companies.

VII. The WACC for the Heat Exchangers

58. In Table 9, below, we report our update of the 2020 WACC calculation for the rental of heat exchangers for two tax tiers and applying the actual cost of debt of the heating companies estimated using data as of 2019, which reflects the cost of debt which could have been estimated at the time of the decision. We do not consider non-interest fees for the 2020 WACC update, because the ACM has already incorporated the non-interest fees in its revised tariff decision for 2020.

TABLE 9: UPDATED WACC FOR 2020

			Low Tax Tier [A]	High Tax Tier [B]
Tax Rate	[1]	See note	16.50%	25.00%
Notional Gearing (D/A)	[2]	See note	40.82%	40.82%
Gearing (D/E)	[3]	See note	68.98%	68.98%
Asset Beta	[4]	See note	0.38	0.38
Equity Beta	[5]	See note	0.60	0.58
Risk-Free Rate (Equity)	[6]	See note	0.39%	0.39%
ERP	[7]	See note	4.79%	4.79%
Cost of Equity	[8]	See note	3.26%	3.15%
Pre-tax Cost of Equity	[9]	See note	3.90%	4.20%
Cost of Debt	**[10]**	**See note**	**3.04%**	**3.04%**
Nominal WACC (After-tax)	[11]	(1-[2])x[8]+[2]x(1-[1])x[10]	2.96%	2.80%
Nominal WACC (Pre-Tax)	[12]	[11]/(1-[1])	3.55%	3.73%

Sources and notes:
[1]- [9]: See Europe Economics, "WACC calculation for heat exchangers in The Netherlands," December 2019, Tables 9.1 and 9.2.
[10]: See Section VI.

59. Table 10 details our calculation of the WACC for the heat exchangers in the 2023-2025 period. In calculating the WACC, we apply the statutory corporate tax rate of 25.8%.

TABLE 10: WACC FOR THE RENTAL OF HEAT EXCHANGERS IN THE 2023-2025 PERIOD

			2023-2025
Gearing (D/A)	[1]	See note	40.00%
Gearing (D/E)	[2]	[1]/(1-[1])	66.67%
Tax Rate	[3]	ACM	25.80%
Risk-Free Rate	[4]	See note	0.17%
Asset Beta	[5]	See note	0.34
Equity Beta	[6]	[5]x(1+(1-[3])x[2])	0.51
Equity Risk Premium	[7]	See note	5.00%
After-Tax Cost of Equity	[8]	[4]+[6]x[7]	2.74%
Cost of Debt	[9]	See note	3.41%
Nominal After-Tax WACC	[12]	((1-[1])x[8])+([1]x(1-[3])x[11])	2.66%
Nominal Pre-Tax WACC	[13]	[12]/(1-[3])	3.58%

Sources and notes:

[1]: See Section VI.

[4]: See Section II.

[5]: See Section V.

[7]: See Section 0.

[9]: See Section VI.