Europe Economics

WACC calculation for heat exchangers in The Netherlands

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1 Introduction

In the Netherlands, consumers can obtain heat (for their homes or their tap water) through a provider of heat services. To do so, consumers need to rent some equipment from their heat company: in addition to an individual meter, consumers need a heat exchanger (*afleversets*, in Dutch) to obtain the energy transferred from the heat network (although this device receives different names, including "heat interface unit" or "heat delivery set", for simplicity we use the term "heat exchanger" throughout the report). As consumers cannot choose suppliers (the heat company is the only provider), Dutch authorities regulate such services in order to protect users from potential abuse.

Since 2014, the Dutch Heating Act (*Warmtewet*) has been regulating the supply of heat in the Netherlands. Under the Act, heat providers are required to secure a reliable and affordable supply, under reasonable conditions and ensuring a good quality service. To facilitate this, the Act introduced a license obligation, as well as provisions for setting the price for the distribution of heat to consumers and small to mid-size companies with a connection up to 100 kW. In subsequent regulations, the Heat Control Regulation (*Warmteregeling*) provided figures to be used for the determination of the operating fixed costs, and the Heat Control Decree (*Warmtebesluit*) provided the formula to be used for setting the maximum price of general heat services.

As the light regulation on the rental of heat exchangers did not provide adequate consumer protection, more recently a revision of the Heating Act entrusted the ACM with the task of setting the tariff determination for the rental of heat exchangers.

The ACM has commissioned Europe Economics to determinethe of cost of capital for heat exchangers, using the ACM method for the Weighted Average Cost of Capital (WACC) analysis.

This report is organised to provide:

(i) Background to the sector and the regulatory regime,

(ii) Methodological approach,

(iii) Theoretical methodology to identify firms' risks exposure and determining factors,

(iv) A suitable peer group (using the factors identified previously) and

(v) Different parameters and final WACC results.

The results will be used to determine the nominal pre-tax WACC which is used for the tariff determination for the rental of heat exchangers. This WACC should be applicable to both individual and collective heat exchangers.

2 Background

Reflecting global environmental and climate concerns, in recent years the Dutch government has promoted a gradual phasing out of natural gas in favour of more renewable sources of energy. The Dutch heating industry has been specifically prioritised as part of this transition.[1] As a result, the Dutch heating landscape has been gradually shifting and, although natural gas is still used as a heat source for the majority of Dutch households, more sustainable sources such as biofuel and geothermal energy are increasingly used. In addition to promoting this energy transition, the Dutch government has also signalled an interest in expanding what is known as "district heating": an alternative heat supply network involving the production, transport and distribution of heat energy through a series of interconnected pipes to residential and commercial buildings.

This chapter provides some background to the study. It is devoted to setting out the core features of a district heating system and heating networks more generally (including the main components of its supply chain); an outline of the market structure of the Dutch heating industry; and a description of the regulatory regime to which this industry is subject.

2.1 Heating networks

Heating networks are systems for distributing heat generated in a centralised location for use in residential and commercial premises (for comfort heating or water heating). The heat is often obtained from a generation plant (generally burning fossil fuels, although other sources are increasingly used) and is transported as steam or hot water through a system of pipes.[2]

The delivery of heat works as a closed system where hot water is initially produced at a generating centre, and transported through insulated pipes to a substation, before being delivered to end-consumers. The supply chain of heating networks (often referred to as the "built network") can vary depending on the heating source and delivery process. However, it can generally be characterised as encompassing: production, transport and distribution of heat energy to end-users. The delivery of heat thus requires the following components: a source of heat, a system of pipes, a substation and back up boilers, and a heat exchanger.

The heat source

The delivery of heat starts from a source where the heat is generated. This can differ across providers, and, as already noted, there is a wide variety of sources that can be used. In fact, although one heating source is sometimes used to power an entire network, it is not uncommon for multiple parallel heating sources to be utilised to provide heat energy. The use of different heat sources configures different supply systems. The most common systems in the Netherlands are those that obtain heat from the following sources (the following classification and market shares are from SIRM, 2019[3]).

- **Drain water and residual heat:** In the Netherlands, the majority of the heat is generated using what is known as drain water heat (where heat is obtained from electricity plants or waste incineration plants) or residual heat (obtained from the heat released in the industrial activity, such as in chemical and petrochemical processes). These deliver heat to as much as 81 per cent of Dutch connected households (most if this comes from power plants).

[1] Cabinet of the Netherlands (2016). Energieagenda: naar een CO_2-arme energievoorziening. [online]
[2] Although both steam and hot water can be used in heat networks, at present there is no steam being used in the Netherlands.
[3] SIRM (2019): "*Tariefregulering warmtebedrijven voor kleinverbruikers*".

- **Biomass:** In this case, heat production is obtained from burning biomass (wood chips, but also manure or animal oils are being used). Biomass heat accounts for 13 per cent of connected households in the Netherlands.
- **Aquifer Thermal Energy Storage** (ATES or *warmte koude opslag*, WKO, in Dutch) uses the properties of aquifers to supply households with both cold and heat. The groundwater in the aquifer is used as a medium for storing both heat and cold energy which is then supplied to households in summer or winter. During summer, cool groundwater is extracted from a cold well and transferred to cool the building with a heat exchanger. In winter the system is reversed, and warm water is extracted to heat the households (in addition to a heat exchangers, ATES systems also need a heat pump to increase the temperature of the heat delivered). Around 5 per cent of connected households use ATES in the Netherlands.[4]
- **Collective heat pumps** use a central heating system to provide heat to multifamily buildings and apartment blocks. They account for around 1 per cent of connected households.[5]
- **Geothermal** uses energy from the lower surfaces of the earth. Water pipes are used to transport the heat from inside the earth to the households. This system provides heat to around 1 per cent of households.

The system of pipes
After its generation, heat is distributed to the customer via a network of feed-and-return insulated pipes. These are the inlet pipe (used to deliver high-temperature heat in the winter) and the outlet pipe (carrying already-used heat at lower temperature from households back to the system).

The substation, back up boilers and heat pumps
Heat is usually delivered to the substation prior to reaching end-users via the distribution heating network. As consumer demand fluctuates considerably over time, backup gas boilers are often used as a heat source to ensure supply-side flexibility. In the case of ATES, the aquifer is used for storing both heat and cold energy (and is usually backed up with a heat pump to increase the temperature of the heat delivered).

The heat exchanger
The heat exchanger is the last device needed to operationalise the transported heat into heat that can be used to warm and increase comfort of houses. In order to gain access to these networks, Dutch households must rent a heat exchanger. Heat exchangers can be individual or collective, in both cases they are used to transfer energy between a heat network and an indoor installation (or an indoor piping system) for the purpose of supplying heat to a consumer.[6]

The heat exchanger is an interface between the network and the consumer of heat. The function of a heat exchanger is to transfer heat energy from the incoming fluid originating from the network to a colder fluid which is pumped from and subsequently recycled to the household for personal use. In the case of ATES, the exchanger can also provide refrigeration (cooling down the houses).

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[4] Possemiers M, Huysmans M, Batelaan O (2014): "Influence of aquifer thermal energy storage on groundwater quality: a review illustrated by seven case studies from Belgium". Journal of Hydrology: Regional Studies.
[5] SIRM (2019) "*Tariefregulering warmtebedrijven voor kleinverbruikers*." This figure shows an increase from estimates from a 2016 study which reported heat pumps as 1-2% of all heating including gas boilers (reflecting a slight transition to pumps as a heat source and an increase in their installation since 2016). See Giebels-Westhius, Ingid (2016). "Towards a heat transition in the housing sector in the Netherlands: Roles and responsibilities of different actors."
[6] The revision of the Heating Act (4th of July 2018) defines the heat exchanger (*afleverset voor warmte*) and collective heat exchanger (*collectieve afleverset voor warmte*) as:
– *afleverset voor warmte: installatie waarmee ten behoeve van warmtelevering aan een verbruiker energieoverdracht plaatsvindt tussen een warmtenet en een binneninstallatie of een inpandig leidingstelsel;*
– *collectieve afleverset voor warmte: een afleverset voor warmte waarmee ten behoeve van warmtelevering aan verbruikers energieover-dracht plaatsvindt tussen een warmtenet en een inpandig leidingstelsel.*

2.2 Type of suppliers

The Dutch heat supply market is characterised by a large number of heat networks of relatively small scale: there are 13 large-scale heat networks and several thousand small-scale heat networks. The market has been previously characterised by ECORYS[7] as:

- Four major heat suppliers (Eneco, Nuon, Ennatuurlijk and Stadsverwarming Purmerend) providing around half of the total heat to consumers.
- Housing associations (including large housing corporations) which operate traditional gas-fired heating systems.
- Other: care institutions and associations of owners (with the objective of providing affordable heat for residents), commercial real estate (providing heat to rented buildings), energy service companies (operating as a service provider and not owning the network), and local suppliers (government and citizens initiatives with local sustainable energy goals).

2.3 Regulatory Regime

The Dutch heating industry is regulated by a comprehensive regulatory regime the underlying structure of which aims to strike a balance between mitigating the risks companies face and safeguarding consumer welfare.

Industry regulation dates back to the 2008 Heat Act —ultimately implemented in 2014— which laid out the core components of the regulatory regime, including the "Maximum Price" and the "Reasonable Costs" concepts. The Heat Act was subsequently amended in 2018, with changes set to be implemented in 2020. The amendment[8] served to (a) improve the manner in which the maximum price is calculated, (b) bolster consumer protections and (c) increase contract flexibility between consumers and providers. Despite these changes, there is still discussion around the regime's regulatory framework. Potential further amendments are currently being discussed, including a revamping of the tariff system to eliminate references to natural gas reference prices.

The 2008 Heat Act[9]

The 2008 Heat Act heralded the start of the regulatory regime governing the Dutch heating industry. The regime's framework acknowledges that the scope for consumers to switch between the heating networks and gas networks is limited, meaning that heating companies have significant market power over their consumers. In order to protect consumers against exploitation of such significant market power whilst still encouraging the expansion of the district heating industry because of its sustainability, the Heat Act introduced a price ceiling calibrated around frequently-adjusted "reasonable cost" estimates. That included the following features.

- **Maximum Price:** One of the most important principles in the Heat Act sets out the maximum price that heating companies can charge end-consumers for heat. This principle (also known as "No More than Otherwise") establishes that consumers should not be charged more for heating relative to what they would have been charged using natural gas heating. The maximum price is calculated based on the average costs of a firm's total fixed and variable costs of providing gas-connected heating.

[7] ECORYS (2017) "Rendementsmonitor warmteleveranciers 2015 en 2016". Report for the ACM.

[8] The Heat Act can be found here: https://wetten.overheid.nl/BWBR0033729/2019-07-01. Effects of the 2018 amendment are summarised in English here: https://thelawreviews.co.uk/edition/the-energy-regulation-and-markets-review-edition-8/1194565/netherlands.

[9] The Heat Act was adopted by Parliament on 10 February 2009, based on a Bill that was submitted back in 2003. Due to extensive discussions and criticism of the Bill, in particular its price regulation, it took until 1 January 2014 before the Act entered into force (see Cecilia van der Weijden 2019: "Bill to amend the Dutch Heat Act". June).

- **Regular updates:** The allowed capital costs of the heat exchanger are part of the setting of the maximum price, and are updated annually reflecting the evolution of actual capital costs.

The 2018 Amendment

The Heat Act was amended in 2018 following intense parliamentary debate. Despite not resulting in any underlying structural modifications to the 2008 Heat Act, the amendments introduced an array of significant changes to the legislation, including:

- **New elements to the tariff**: The amendment aims to improve the formula for calculating the maximum price and introduces new elements to the tariff regulation that are not based on gas but on (average) actual costs: a one-off connection fee (applicable both for connecting to an existing heat network and to a new heat network), costs for disconnection and the tariffs for provision of heat exchangers.[10]
- **Improved Tariff Flexibility:** The amendment allows consumers and heat companies to negotiate tariff agreements which do not align with the annually-updated maximum price.[11]
- **Contract Cancellation:** The amendment enhanced consumers' market power by enabling households to opt out of their contracts made after the amendment.

Outlook / Future Developments

The regulatory regime is not finalised, and there are a number of aspects still under discussion. As of February 2019, additional amendments were being considered in the Dutch parliament which would entail considerable revision of the Heat Act, including:

- **Removing Natural Gas Reference Prices:** In their efforts to mitigate the impacts of climate change and accelerate the energy transition, the Dutch parliament is debating eliminating natural gas as the price of reference. Several alternative frameworks for determining optimal tariffs have been proposed, some of which would remove the maximum price component of the regulatory regime altogether. Proposals include (a) transparent tariffs determined jointly by the regulator in conjunction with industry and (b) a maximum price determined solely by the regulator taking actual heating costs into account.
- **Distinct Regulatory Regimes Based on Different Market Segments:** The Dutch heat sector is constituted by a mixture of technologies, network sizes, geographical conditions, and heat sources. According to the SIRM, because of the heterogeneity of the heat market, "there is no 'one-size-fits-all' regulation" and a more hybrid approach taking into account cost differentials across these different market segments would constitute a prudent amendment to the Heat Act.[12]

[10] van der Weijden, Cecilia (June, 2019) "Bill to amend the Dutch Heat Act".
[11] For instance, consumers and companies could potentially agree to (a) a multi-year contract stipulating a fixed, lower tariff amount or (b) a contract combining lower fixed cost fees (i.e. connection costs) with higher variable cost rates.
[12] SIRM (2019) "*Tariefregulering warmtebedrijven voor kleinverbruikers*."

3 Method

Investors in heat exchangers bear an opportunity cost, namely the potential returns they could have earned from investing in an alternative portfolio of firms with the same systematic risk exposure. Such opportunity costs are included in the total cost stack for a price control.

Assessing such costs requires an analysis of what the systematic risk exposure actually is. Some business risks are specific to the company itself and could be diversified away (using a geographic and industry-diversified portfolio). Systematic risk, on the other hand, cannot be eliminated via diversification. Absent compensation for systematic risk, investors would not provide capital for such assets. Systematic risk analysis is a central element of weighted average cost of capital (WACC) calculations.

One standard way to identify the relevant systematic risk is by study of a comparator group of firms subject to similar risks. In chapters 4 and 5 below we explain our comparator selection and analysis. The calculation of the various WACC parameters and the overall WACC is described in chapters 6 to 9.

3.1 The WACC method

The WACC is a weighted average of the costs of equity and debt, weighted by the proportions of debt (called the "gearing") and equity (one minus the gearing):

$$\text{WACC}= (1-g) * R_e + g * (1-T_C) * R_d,$$

where R_e is the return on equity; R_d is the return on debt; T_C is the percentage tax; and g is the percentage financed by debt (also known as gearing) and is defined as debt over assets.

The ACM has provided guidelines on the method to be used for the WACC calculations.

Cost of equity (R_e)
Under the ACM method the cost of equity is obtained from the capital asset pricing model (CAPM). Developed in the 1960s, the CAPM model expresses investment returns as: $R_e = r_f + (TMR - r_f) * \beta$, where R_e is the (expected) return on the asset; r_f is the return that would be required for a perfectly risk-free asset; TMR is the total market return, i.e. the return that would be delivered by a notional perfectly diversified portfolio consisting of all assets ("the whole market"). Finally, β ("beta") is a measure of the correlation between movements in the value of the asset of interest and in the value of assets as a whole.

Cost of debt (R_d)
The ACM calculates the cost of debt using a "debt premium approach", decomposing the return on debt into three components: the risk free, the debt premium and a fee: $R_d = r_f + DP + Fee$, where, R_d is the return on debt; r_f is the risk free rate, DP is the debt premium and Fee is a Non-interest fee (compensation for the transaction costs of issuing debt).

The parameters
There are 8 parameters that need to be calculated in the ACM's methodology. The explicit calculations to be used are described in the following table. All calculations use the guidelines provided by the ACM method.

Table A: Summary of WACC calculations

Parameter	#	Calculation method / Source
Tax	[1]	Parameter / Chapter 6
Gearing (D/A)	[2]	Parameter / Chapter 6
Gearing (D/E)	[3]	= [2] / (1 - [2])
Asset beta	[4]	Parameter / Chapter 7
Equity beta	[5]	= [4] * (1 + (1 - [1]) * [3])
Risk free rate (equity)	[6]	Parameter / Chapter 7
Equity risk premium	[7]	Parameter / Chapter 7
Cost of Equity	[8]	= [6] + [5] * [7]
Cost of debt	[9]	Parameter / Chapter 8
Non-interest fees	[10]	Parameter / Chapter 8
Total cost of Debt (pre-tax)	[11]	= [9] + [10]
Nominal WACC (after tax)	[12]	= (1 - [2]) * [8] + [2] * (1- [1]) * [11]
Nominal WACC (pre-tax)	[13]	= [12] / (1 - [1]) / Chapter 9

Note: D/A = Debt over Assets. D/E Debt over Equity.

3.2 Data sources and cleansing methods

We have used the Thomson Reuters Eikon financial data system to obtain daily data on all comparators for the calculation of the WACC parameters.

We note that some of the companies are not traded every day. Where liquidity is low, there is the risk that movements in the company's share value are affected by such illiquidity (for example, due to opening times and trading hours). In line with the ACM method, our approach to deal with lack of stock liquidity is to select only firms whose stocks meet certain conditions (details are provided further below).[13]

[13] There are alternative approaches to testing for and addressing low liquidity, such as the Dimson adjustment. We use that Dimson adjustment in later sections.

4 Identifying risks for heat exchangers

The CAPM framework distinguishes between two types of risks: specific and systematic.

- **Specific risks** (also known as non- or un-systematic risks). These are risks that can be eliminated through adequate diversification.[14] Because investors need not bear such risks (they bear them only if they choose not to diversify), these imply that investors are making some "call" against the market (e.g. assessing that the market over-estimates the risks; or that if the investor owns the assets then, through such ownership, that investor can reduce these risks by more than an alternative investor could). That means that the market equilibrium cost of capital for that asset will not include such risks (since the equilibrium investor will not be bearing them).
- **Systematic risk** (also known as market or non-diversifiable risk). This is a risk that is characteristic of an entire market, and reflects the effects of economic cycles (booms and busts), technology shocks (both positive and negative), wars, or major political decisions (the setting of interest rates or the country's fiscal stance). As they cannot be avoided through diversification, the systematic risk affects a company's cost of capital. It is because of the presence of systematic risks that investors need to be compensated for their investments.

In order to understand the systematic risks that providers of heat exchanges must be compensated for, some basic characteristics of such services must be outlined. When doing so, it will be important to note that heat exchangers and heat networks operate under an inseparable link: a consumer without a heat exchanger will not be able to use the services provided, and conversely, a heat exchanger will serve no purpose if it is not connected to a heat network.

Therefore, when describing systematic risk we would indistinctively refer to heat exchangers and heat networks, and this is because of this inseparable nature of the two. This chapter reviews different factors affecting systematic risks (this is important because it can make companies more resilient to the business cycle and hence can help characterise the systematic risk of the regulated activities). But, as will be seen, we understand that most of such risks affect both the networks and exchangers. The analysis of this chapter is useful to select the companies of the peer group (which will be done in the next chapter).

4.1 Thought experiment underpinning the selection of comparators

When determining a regulated WACC, and in particular when selecting comparators from other sectors to use for assessing systematic risk, one requires a "thought experiment": a scenario for the competitive structure of the market in which the notional entity, charging the prices to be set, is operating.

Three standard experiments imply thinking of comparators in terms of: an efficient equivalent competitor (broadly equivalent in terms of business model, age of assets, legacies and other similar features); and efficient new entrant (using the latest technologies and without any legacies); or an efficiently-operating monopolist (operating and pricing at allocative, productive, technical, dynamic, social efficiency).

Although it is not necessarily to choose only one of the approaches, it is important to bear them in mind in forming an overall balanced judgement of what it is being requested from the selection of comparators.

[14] Mixing a wide variety of investments within a portfolio smooths out non-systematic risks: because specific risks are, by definition, not perfectly correlated, the positive performance of some investments within a diversified portfolio offsets the negative performance of others.

4.2 Systematic risk

Systematic risk is typically understood as reflecting risks related to revenues, operating leverage, financial leverage, the evolution of the market and other factors (such as bad debt). Some studies groups such risks focusing on demand fluctuations (often also termed as "cyclicality of revenues"), operational leverage (the cost structure of the firm) and bad debt as main determinants of risk.[15] We have used that same classification but are separating the revenue impacts due to regulation into a separate category and are including bad debt risks as part of demand fluctuation. Our methodology to identifying risks builds on the following concepts.

- **Demand and revenue fluctuations**.
- **Cost structure.**
- **Regulatory framework.**

These are reviewed below, in turn.

Demand and revenue fluctuations
Companies' revenues are derived from changes in demand. Either in the form of changes in the number of consumers, quantities demanded, quality (reliability of the service) or connections (and length of the network), the demand for services affects ultimately the sales of companies. Hence, it is not surprising that developments in the business cycle have an impact on companies' revenues. Sudden changes in demand, supply or simply the economic climate (including the optimism or pessimism of consumers or suppliers) affect the revenues and profits of companies.

However, as seen in previous chapters, heat networks services involve the price-regulated provision of a basic-need service to consumers that have limited (if any) capacity to switch to alternatives.[16] This means that the network as a whole is resilient to the influence of the business cycle: any economic fluctuations are unlikely to significantly influence the demand for such services. This is a feature common to all utility services, including the utility comparators.

The provision of heat involves the operation of a network by a single provider (it would be economically inefficient to have networks duplicated), which is deemed to have significant market power. To avoid situations of abuse, the provision of such services is regulated. This is also a feature of other utility providers, all of which operate in a regulated environment.

The economic cycle may also affect the costs related to holding bad debt. Customer's payment defaults are more likely in down-turn cycles and these affect a company's profitability. This will increase costs for companies as cash will be received later rather than sooner, either requiring companies to raise working capital to cover their cash requirements (with associated financing costs), or meaning that companies forego the opportunity to earn returns on this cash during the period of delay. This is a systematic risk that is likely to affect most utility providers, and thus, again, other utility comparators are likely to share it.

Cost structure
Changes in input costs affect the revenues of network companies. In most network industries, input costs relate to the costs of construction materials as well as the costs of staff wages. The networks may also be affected by changes in oil prices and oil-related inputs to the extent that they affect the whole economy.

Heat networks are also exposed to systematic risks from the costs of inputs, as many other network industries. However, one important difference in the business of heat service is that they do not only provide

[15] Some reports mention financial leverage (also referred to as gearing or the proportion of debt to equity). However, as the analysis is focussed on asset betas (which correct for any effect financial leverage has on the risk profile of a company) this determinant is not discussed as part of our systematic risk analysis.

[16] This limited ability for consumers to switch is a feature of short to medium term situations, In the long run switching will be possible to some extent — e.g. for the consumers, by moving to an alternative dwelling; or for urban planners, by switching to a different heating network.

the transportation and management of the service but there is also an element of supply in their operations: this is the heat itself. This is in contrast to many distribution networks (such as electricity or gas) where the production and transportation of the commodity is vertically separated and provided by different players.[17] The implications of this are that heat networks are much more sensitive to changes in the supply of the inputs (for example gas) used in heat generation (and in particular, their prices). This is a feature that differs from other networks dedicated to transportation only.

Related to costs is the firms' operational leverage (this is: the ratio between fixed and variable costs within the cost structure of a company). A high proportion of fixed to variable costs increases the sensitivity of a company to the business cycle (this is because variable costs can be reduced quickly in response to a change in demand, whereas fixed costs cannot). Operational leverage can vary between utility providers.

Regulatory risks

Under the envisaged "Maximum Price" Effect, there is a potential risk that the very close links established in the regulatory regime between the natural gas and district heating sectors could result in a fall in heat-provider revenues (and subsequently on the revenues to be granted for heat exchangers). If the price of providing the equivalent amount of natural gas to consumers (the 'maximum price' set by regulators) falls below the optimal price that could be set by heat providers revenues could suffer. This could occur following either (a) a decrease in natural gas reference prices or (b) a sudden increase in either the fixed or variable costs faced by the heat provider along the supply chain.

Another risk is the future uncertainty surrounding the fundamental nature of the regulatory regime. A decoupling of the heat supply tariff from natural gas reference prices could significantly change the regulatory landscape. The exact risks are as of yet unknown, as relevant legislation is still being discussed (in fact, such risks might be compensated by any upturn heat expansion in response to an increased in the political desire to expand the share of heat energy).

Comparator utilities may be subject to their own regulatory risks, and we should be aware of that in choosing comparators. However, such risks are not always transparent when selecting comparators and it may not be proportionate to review every comparator entity's potential regime changes in detail. Instead, a standard way to mitigate the risk that there are such regulatory risks is by not being overly-reliant upon a single comparator.

4.3 Other Sectoral Risks

Several risks can be identified for the heat industry, especially in relation to the near future. These have been identified reviewing some companies business plans and include the following: risks pertaining to a transition towards renewables, digitalisation-related disruption, improved energy efficiency of old and new dwellings, fluctuations in the average temperature and the investment climate. These are risks that are likely to be common to other network utilities.

- **Transition towards renewables:** Major energy players have been steadfast in their commitment to mitigating the impacts of climate change and to promoting a new, sustainable era of energy production. However, they have also expressed concern regarding the short-term implications of this energy transition. Not surprisingly, the recent shift away from gas-fired and CHP plants towards more renewable alternatives such as geothermal energy and biogas could dampen the profitability of the capital investments of some traditional players.

[17] Although such separation has been discussed in the House of Representatives, it has been concluded that due to technical and economical characteristics of the heat market, mandatory separation of production, transmission and grid management will not contribute to the affordability, sustainability and security of heat supply (Cecilia van der Weijden and Marcellina Rietvelt, 2019: "Netherlands announces Heat Act 2.0". February). See also SEO (2018): "Belang bij splitsing in de warmtemarkt. Effecten van splitsing op publieke belangen in de warmtemarkt".

- **Digitalisation-related disruption:** Technological change is sweeping across the economy, and the heating industry is no exception. Many utility companies have stressed the rapid insertion of data analytics and complex algorithms into the sector, noting that integrating these technological changes would be crucial if they are to remain competitive. Such developments are a risk affecting all aspects of the energy value chain: from integrating advanced forecasting algorithms for monitoring energy prices to providing customers with instant feedback on their energy consumption.
- **Improved energy efficiency of old and new dwellings:** EU and Dutch regulations pertaining to energy efficiency standards of residential buildings also appear as a concern for the industry. More stringent energy efficiency requirements for both new and old residential buildings could potentially reduce demand for energy, and therefore lower firms' profit margins.
- **Average temperature fluctuations:** Not surprisingly the fluctuating winter-summer time temperatures are still an inevitable risk for profitability of providers of energy (heat or cold).
- **Unpredictable investment climate:** Although heat providers have been cautiously optimistic about regulatory intervention in the energy markets, many have continued to stress that the spate of new legislative developments on both a Dutch and EU level have constrained firms' ability to plan for the future. Topics such as subsidies, taxes and CO2 pricing are some of the main concerns.

Obviously, there are also risks related to positive outcomes for heating companies. These might be related to the same previously identified issues. A transition towards renewables might involve a political commitment to sustainable resources (which might increase the need for heating grids), a good use of digitalisation-related disruption could end in efficiency improvements for heating providers, the improved energy efficiency of dwellings could also lead to reductions in the cost of building (new houses and renovation) and hence result in more demand for heating (or heating improvements) and the unpredictable investment climate could also go in favour of the heating firms (form example, through the taxation of heat substitutes, such as gas energy. Some of these (positive) risks that have already mentioned as part of demand and revenue fluctuations. The implications of such aspects are likely to be common to other network utilities and will be discussed as part of the criteria for selecting the well-suited peer group, below.

4.4 Selecting a well-suited peer group

Establishing an appropriate group of comparator firms is essential in WACC calculations. The overarching goal in this process is to select a set of companies which face a similar combination of systematic risks relative to district heating firms.

In order to determine relevant comparator firms, we will take into account similarities of potential firms along the risk factors identified previously. These are[18]:

[1] the nature of the service (services and type of customers),
[2] the regulated environment,
[3] costs associated with debt defaults,
[4] other sectoral risks;
[5] the risks from the costs of inputs,
[6] operational leverage risk,
[7] the "Maximum Price" rule (and links established with natural gas prices), and
[8] future regulatory uncertainty (potential decoupling of heat tariff from natural gas reference prices).

[18] Characteristics related to business and organisation of district heating networks, their consumers (mainly of households), restricted switching (heat networks enjoy certain degree of monopoly power once constructed), the essential service, and element of supply (supply of the commodity of heat) have been also recognised by Oxera (2009), "The cost of capital for heat distribution and supply", Prepared for Energiekamer. September.

The most direct approach to determining a comparator group is to simply choose other companies operating within the same industry. When these are not available the search should include those from other sectors but facing similar systematic risk. When selecting the set of comparators, we have used the following principles.

The inevitable link to the network
As already stated at the beginning of the chapter, the systematic risk of heat exchangers is unavoidably linked to heat networks. This is because each industry cannot operate without the other (the heat exchanger needs to be connected to the network).

District heating firms
Selecting other district heating firms would be a natural first step in selecting a comparator group. These firms are likely to exhibit similarities along all salient criteria, including a regulated regime, cost structure, customer profile and nature of services provided. As such, they are likely to face similar non-diversifiable, systematic risk. However, inclusion of such firms should take account of other characteristics, and most noticeably, the country in which they operate and the similarities or dis-similarities with Dutch heating services.[19]

Where these firms are not available, comparators from other sectors should be used. We decided to focus on the companies from the following sectors: utilities, gas distribution and gas-user sectors.

Utilities sector
Utilities are a good set of comparators. As typically servicing first-need services to consumers, utility companies have similar susceptibilities to business cycle fluctuations [1] and are equally exposed to consumer bill defaults [3]. As they are typically "natural monopolies", they have high operational leverage [6] and operate in an environment often regulated [2]. Some of the identified other sectoral risks are also common in the utilities [4], especially their need for a transition towards renewables, the digitalisation-related disruption (customer services), and general concerns about the unpredictable investment climate (especially, uncertainty in subsidies, taxes and CO2 pricing are common to most utilities).

Hence, the companies in the utility sector and, in particular, companies operating the network component of the service are good comparators. However, although these are useful comparators it is important to note that they will not reflect all relevant systematic risks. The categories of risks not so well reflected are [5], [7] and [8], and also some of the risks related to improved energy efficiency of old and new dwellings and average temperature fluctuations [4].

Gas distribution sector
The distribution of gas also aligns with many of the risks identified previously, but it also has similarity with some others. Firstly, it is very likely to be affected by all other sectoral risks [4], including the risks related to drop in demand for heat services following improved energy efficiency of old and new dwellings and due to changes in average temperature (especially the risk of less colder winters). Any other risks related to the potential competition from renewables also seem to be better reflected in gas-distribution than in other utility network sectors.[20]

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[19] In many ways, the heat exchanger (also known as heat interface units, HIU) is very similar to the traditional gas boiler. Given its technical similarities the inclusion of boilers manufacturers could be considered as suitable candidates. However, because of the business characteristics and regulatory environment where such manufacturers operate we decided against using "gas boilers" as comparators. Most importantly, the link of the heat exchanger with the heat network means that providers of heat exchangers do not need to suffer any risks associated with the potential sales (or not) of their exchangers: once the supply of heat is secured, this will imply the installation of a heat exchanger. This is very different from generic manufacturers and suppliers of gas boilers which need to maintain sales and marketing teams, and compete in an environment which will require constant innovation (all of which would make gas-boiler manufacturing riskier than supply of heat exchangers).

[20] The analysis of Oxera (2009) for heat distribution and supply, concluded that their risk exposure is similar to network utilities such as energy or water distribution (as these are exposed to a similar degree of construction and operating

The fact that regulation links the price of Dutch district heating industry with the natural gas sector reflects a strong link between the two sectors. This link is mainly consumer-based as it recognises that both type of services are being used by consumers. The gas distribution, however, does not recognise the inputs component of the heat services nor the fact that these are also involved in the production and supply of heat (something gas distributors do not do).

Gas-user sectors

We have explained that the supply chain for the provision of heat consists of three primary components: (a) the heat source, (b) the grid and maintenance of the network and (c) dealing with residential buildings, including the provision of rent heat exchangers from heat providers. Because at present most of the heat is produced using gas (either in gas-powered power plants or gas-fired cogeneration plants), this makes the services provided by heat networks much more sensitive to the prices of gas. This is an important characteristic that separates heat services (from traditional networks) and brings them closer to industries engaged in generation of electricity and supply of gas.

Following this argument, it would be important to check the risks of gas-fired power plants and gas-fired cogeneration plants, and to a lower extent other heat sources, including energy generators using waste incineration, biomass and biogas or geothermal (although their importance should be proportional as their contribution to heat production is still small). The consideration of firms in gas-user sectors will account for systematic risks related to the costs of inputs [5], which at present is an important component in the production process.[21]

What about the regulatory risk?

There are two risk determinants that are not reflected in the discussion above. These are [7] the "Maximum Price" rule and the links established with natural gas prices, and [8] the future regulatory uncertainty surrounding the heat-gas relationship (potential decoupling of heat tariff from natural gas reference prices). However, we believe that these last two risks are not very significant.

Firstly, if the selection of companies in the gas distribution sector and gas-user sectors can be used this will already identify companies which match *most* of the identified risks.

Secondly, it is important to note that heating and gas services are not too dissimilar and that any impact in the prices of gas delivery might also be generally reflected in the prices of delivery of heat. However, there are two situations in which the price cap can affect the profitability of heat services:

- When prices of gas delivery drop (and heating remains the same).
- When prices of heating services increase (and gas remains the same).

However, we believe these are likely to account in "rare" situations. Because of the link established in many of the other risks we would expect that the price delivery of both is correlated and hence we would expect that the maximum price bound is hardly binding (i.e. does not constraint the revenues for heat services).[22]

A further reason regulatory risk may be limited is that, to the extent that heat supply risks can be treated as belonging to the same market as gas supply risks, they are mitigated by the annual process of updating of gas prices. That means that two sources of potential regulatory risk, namely mis-calculation by the regulator and

cost risk). The exposure is also similar to heat and gas distribution networks (both types of networks may face variations in the number of connections established once the network is constructed, moreover, gas heating can be considered as potential competition for district heat networks even if it is relatively difficult for consumers to switch between the two).

[21] We note that some suppliers use sources other than gas (albeit small at present, it is expected that heat production using renewable sources to increase in the future). Although these should not be directly affected by evolutions in the supply of gas, we believe that they are likely to be affected indirectly, as the prices of all energy inputs (gas and others) are very likely to be correlated (due to substitution in the supply side of the market).

[22] Moreover, any increases in energy tax (expected for the coming years) means that the gas maximum price will be even less binding.

the regulator making a decision that though *ex ante* correct is overtaken by events and locked in, are significantly mitigated. Such adverse regulatory risks would only last a maximum of one year. To the extent that heat exchanger systematic risks match those of heat supply (and noting the intimate connection between the two that we have explained above), this also relates to the systematic risks attributable to heat exchangers.

Considerations to the size of heat suppliers

We have discussed above (in Section 2.2) the small size of some of such distribution networks (housing associations, care institutions, associations of owners, et al.). Their operation at a local level makes such networks smaller than those in other sectors (energy distribution). At issue would be whether such small scale has implications for the efficient functioning of the heating network, and in particular their access to finance (if small undertakings are not able to issue bonds or using derivatives they will have higher financing costs). However, given the structure and ownership of heat network in the Netherlands this would not seem to be a problem, as most operators are owned and operated by large groups or public associations which would have access to finance in competitive terms (including large housing corporations, care institutions and associations of owners, commercial real estate, energy service companies and local suppliers (government and citizens initiatives).[23]

[23] This has been previously identified in Oxera (2009).

5 The peer group

Our approach to the selection of a suitable peer group has been set out in previous chapters and is based on the following:

- **District heating firms:** as these firms are likely to exhibit similarities along all salient criteria, including regulatory regime, cost structure, customer profile and nature of services provided.
- **Companies in the utilities sector**: as first-need service suppliers, utility companies have similar susceptibilities to business cycle fluctuations and are equally exposed to consumer bill defaults. Because they are typically "natural monopolies", they have high operational leverage and operate in an environment with reduced competition and often regulated.
- **Companies in the gas distribution sector**: they align with many of the risks identified previously, but also has some similarity on risks derived from changes in demand (following improved energy efficiency of dwellings, changes in weather, and future potential competition from renewables).[24] The regulatory price link with the natural gas sector also imposes a strong link between the two sectors.
- **Gas-user sectors**: because most of the heat is produced using gas (either in gas-powered power plants or gas-fired cogeneration plants) this makes the services provided by heat networks much more sensitive to the prices of gas. This is an important characteristic that separates heat services (from traditional networks) and brings them closer to industries engaged in generation of electricity and supply of gas, as this will account for systematic risks related to the costs of inputs.

Hence, "District heating firms" are represented by those firms from the "Heating & Air-Conditioning Supply" sector. To include "Companies in the utilities sector" we selected firms from the following sectors: "Electric Utilities (NEC)", "Multiline Utilities" and "Water Utilities". Finally "Companies in the gas distribution sector" and "Gas-user sectors" imply using firms from the sectors "Natural Gas Distribution" and "Independent Power Producers (IPPs)", respectively.

Table 5.1 Comparators industries and sectors used

Comparators industry	Sector used
District heating firms	Heating & Air-Conditioning Supply
Utilities sector	Electric Utilities (NEC) Multiline Utilities* Water Utilities
Gas distribution	Natural Gas Distribution
Gas-user	Independent Power Producers (IPPs)

Note*: Multiline Utilities includes companies involved in at least two of the following, none being dominant: Electric Utilities, Natural Gas Utilities, Water Utilities.

The inclusion of the first four groups is consistent with the previous WACC calculation for district heat networks (Oxera 2009), however, in contrast to the previous study, we have also included IPP and excluded telecommunication companies and airports as potential comparators as we do not find them relevant (note that other network industries such as railways services are also excluded).

This gave us an initial longlist of 113 potential companies.

[24] Dutch consumers pay for their contracted capacity (in the form of capacity bands) and not directly for their usage of gas. Although there is no direct variable component, demand fluctuations can also occur if consumers change capacity bands.

5.1 Liquidity Checks

After the initial selection, we test whether these companies satisfy the two liquidity thresholds, as described by the ACM for the inclusion of listed companies in the reference group:

- Trade at least 90% of trading days (L1).
- Achieve at least €100 million in annual sales (L2).

Following guidance from ACM, we have undertaken one additional test for liquidity. This is based on the daily bid-ask spread (for days where both bid and ask price are observed, the bid-ask spread is calculated as ask price minus bid price, divided by the average of both prices). As there is no guidance on how to assess such spread, we use the threshold used in previous precedents which defined stocks as illiquid if the 3-year average of the spread is larger than 1% (L3).[25]

As a result of the liquidity checks: 49 companies failed L1, an additional 13 companies failed L2 and from the remaining, 8 companies failed L3.

5.2 Other Checks

We then shortlisted our selection by including companies that were rated investment grade.[26] This eliminated 15 companies. Annex1 lists the companies eliminated by the liquidity checks and the investment grade criteria.

We further refined our peer group on the basis of the company's activities and geography of operations.[27] Additionally we also eliminated power generation companies that only generate electricity through wind, we did this because wind energy does not have a thermal footprint.

Table 5.2 Companies eliminated because of activities and geography of operations

Company Name	Include (?)	Reason
E.ON SE	NO	Has operations in Nuclear power generation
Telecom Plus PLC	NO	Operations in the Telecommunications sector
Fortum Oyj	NO	Operations in Russia and India
Terna Energy SA	NO	Generates energy through Wind
Enel SpA	NO	Operations in the Americas
Bonheur ASA	NO	Mining/Oil and Gas extraction
EDP Energias de Portugal SA	NO	Operations in Brazil
EDP Renovaveis SA	NO	Operations in Brazil, USA and Canada
Iberdrola SA	NO	Other Business interests
Red Electrica Corporacion SA[28]	NO	Operations in Chile and Peru
Eolus Vind AB (publ)	NO	Generates energy through Wind
Veolia Environnement SA	NO	Sewerage treatment company
Athens Water and Sewerage Company SA	NO	Special Greek Factors[29]

[25] Nera (2016): "Update of the Equity Beta and Asset Beta for BT Group and Comparators: For the Office of Communications (Ofcom)". March. Also by the German Energy Regulator (BNetzA) for setting WACC allowance for gas/electricity transmission and distribution (citation from the same Nera report).

[26] Thomson Reuters Credit Combined Implied Rating used. A company is considered investment grade if its credit rating is BBB- or higher.

[27] We eliminated companies that had major business interests in sectors other than Utilities and had operations outside Western Europe.

[28] In principle, this company could be included in the final group even though 7 per cent of its revenues come from its overseas operations or operations in telecommunications — perhaps with some adjustment for the effects these foreign activities have upon its beta. However, as we shall see we have sufficient comparators without needing to include this firm and make such adjustments, and since such adjustments might be challenging to perform correctly (and so potentially introduce errors) we believe the overall results will be more robust if we exclude this firm.

[29] The Greek government owns a majority share in this company and it therefore has a different risk profile from the heat exchangers in Netherlands. In addition it has a zero debt capital structure plus a large cash holding — meaning its

5.3 Final Peer Group Selection

Our final peer group selection consists of **15** companies as potential comparators for the heat exchangers. The final composition of this peer group is:

- 5 companies from Multiline Utilities;
- 1 companies from Natural Gas Distribution;
- 1 companies from Water Utilities;
- 4 companies from Electric Power Generation;
- 4 companies from Electric Power Transmission, Control, and Distribution

The final Peer Group selection is provided in Table 5.3.

Table 5.3 Peer Group Selection

Company Name	Country	TR Sector	Revenue (mil€)	Trade (%)	Bid-Ask (%)
Engie SA	France	Multiline Utilities	60,596	98.33%	0.08%
Acea SpA	Italy	Multiline Utilities	2,930	97.69%	0.30%
Hera SpA	Italy	Multiline Utilities	6,134	97.69%	0.18%
Centrica PLC	UK	Multiline Utilities	33,020	97.18%	0.06%
National Grid PLC	UK	Multiline Utilities	5,924	97.18%	0.03%
Ascopiave SpA	Italy	Natural Gas Distribution	582	97.69%	0.47%
Severn Trent PLC	UK	Water Utilities	205	97.18%	0.06%
ERG SpA	Italy	Electric Power Generation	1,024	97.69%	0.19%
A2A SpA	Italy	Electric Power Generation	6,271	97.69%	0.14%
Endesa SA	Spain	Electric Power Generation	10,319	98.33%	0.06%
Drax Group PLC	UK	Electric Power Generation	4,704	97.18%	0.06%
EVN AG	Austria	Power Distribution*	2,073	95.26%	0.42%
Verbund AG	Austria	Power Distribution*	2,727	95.26%	0.22%
Terna Rete Elettrica Nazionale SpA	Italy	Power Distribution*	2,273	97.69%	0.10%
Ren Redes Energeticas Nacionais SGPS SA	Portugal	Power Distribution*	727	98.33%	0.22%

Note: * "Power Distribution", denotes "Electric Power Transmission, Control, and Distribution".

net debt is significantly negative. That both raises issues of interpretation and is symptomatic of its having important differences that are likely to make its systematic risk atypical.

6 Gearing and tax rate

In this section we will set out the gearing and the tax rate.

Gearing

Gearing is defined as net debt (D) over enterprise value ($D + E$) i.e. Gearing= $D/(D + E)$. For this report we have used the average of gearing daily data from Jan 2016 to Dec 2018 (provided in Thomson Reuters).[30]

For ACM decisions, gearing calculations are based on the actual gearing of comparable companies. These comparable companies must have "healthy financial positions". For the purpose of this report a company is considered to be in a healthy financial position if its credit rating was BBB+ or higher. We take the median value of **40.82** as our estimate for gearing.

Table 6.1: Gearing

Company name	Rating	Gearing
Acea SpA	A-	45.34
Hera SpA	A-	40.79
Ascopiave SpA	AA-	9.17
Verbund AG	A-	41.07
ERG SpA	A-	40.85
A2A SpA	A	40.12
Terna Rete Elettrica Nazionale SpA	A	46.01
Ren Redes Energeticas Nacionais SGPS SA	A-	64.25
Endesa SA	A+	18.55
Drax Group PLC	A-	14.7
Average		**36.09**
Median		**40.82**

Tax

The ACM method prescribes that the tax rate is equal to the applicable rate for the regulated entities. The applicable tax rate for the heat exchangers is the Dutch corporate tax rate[31] i.e.:

- **2020:** 16.5% on the first €200,000 of taxable profits and 25.0% for those exceeding €200,000.
- **2021:** 15.0% on the first €200,000 of taxable profits and 21.70% for those exceeding €200,000.
- **2022:** 15.0% on the first €200,000 of taxable profits and 21.70% for those exceeding €200,000.

Because of this two-tier regime, our WACC calculations are reported for two situations: for firms under €200,000 taxable profits and for firms exceeding €200,000 taxable profits by large enough margin for the effective tax rate to be equivalent to the high-tax bracket.

The tax rate for the comparators is needed to convert the equity beta into an asset beta. We use the effective tax rate from KPMG's corporate tax table (the publication provides a view of corporate tax rates around the world up to 2019).

[30] Net debt calculated as the sum of [Total Debt, Redeemable Preferred Stock, Preferred Stock – Non Redeemable, Net, Minority Interest], less [Cash and Short-Term Investments]. Cash and Short-Term Investments, in turn is calculated as the sum of [Cash, Cash & Equivalents, and Short Term Investments]. Enterprise value is given by the sum of [Company Market Cap, Net Debt, Preferred Stock, and Minority Interest]. Although net debt is usually of quarterly / semi-annually or yearly frequencies, daily data for gearing are typically provided using daily enterprise value data.

[31] The Dutch corporate tax rate from 2020 onwards is explained here: https://www.rijksoverheid.nl/onderwerpen/belastingplan/belastingwijzigingen-voor-ondernemers/vennootschapsbelasting.

7 Cost of equity

In this section we set out our estimates on the cost of equity. As stated in the methodology section, the cost of equity is estimated using the CAPM, which estimates the expected return of the equity using its different components of: risk free rate, the average return of the market (the ERP) and the beta of a company. First, we will provide our estimates for the Risk Free Rate. Then we will provide the beta parameter, and finally we will provide the Equity Risk Premium.

7.1 Risk-Free Rate (RFR)

The ACM method prescribes that the risk-free rate (RFR) should be estimated on the basis of Dutch and German government bond yields. Having obtained the yields on 10 year Government bonds in both the Netherlands and Germany, the average of the most recent 3 years is taken. The RFR is then constructed as the simple average of the two. In the table below we report the results obtained for both bonds and the overall risk free rate.

The simple arithmetic average of government bonds from the Netherlands and Germany gives a Risk-free rate value of **0.39** per cent.

Table 7.1: Risk Free Rate

Region	Average (2016-2018)
Germany	0.32
The Netherlands	0.46
Average	**0.39**

Source: Thomson Reuters and Europe Economics calculations.

7.2 Beta regressions

For each peer, the equity beta is calculated from market data as the covariance of the company's returns and the returns on the market index. As in previous determinations we have used daily frequency and an estimation period of 3 years, from 01/01/2016 to 31/12/2018.

As equity betas are not directly comparable across companies asset betas are used in the WACC calculation. The Modigliani Miller equation (accounting for taxes) is used to de-leverage the equity betas.

Several tests have been undertaken to assess the robustness of the estimates.

- Test for autocorrelation and heteroscedasticity.
- Test for statistical significance of the estimates.
- Assess the betas against Dimson-corrected betas.

Test and correct for autocorrelation and heteroscedasticity

We have carried the standard autocorrelation and heteroscedasticity tests envisaged in the ACM method (Breusch-Godfrey for autocorrelation and White for heteroscedasticity, Table 7.2).

Table 7.2: Autocorrelation [A] and heteroscedasticity [H] tests (chi-squared, p-value, result)

Company name	[A] Chi2	[A] p-val	Auto-correlation?	[H] Chi2	[H] p-val	Heteroscedasticity?
Engie SA	0.14	0.71	NO	0.32	0.85	NO
Acea SpA	0.42	0.52	NO	0.68	0.71	NO
Hera SpA	1.49	0.22	NO	7.99	0.02	YES
Centrica PLC	0.03	0.87	NO	0.09	0.96	NO
National Grid PLC	0.04	0.85	NO	4.53	0.1	NO
Ascopiave SpA	18.2	0	YES	1.59	0.45	NO
Severn Trent PLC	0	0.97	NO	2.26	0.32	NO
ERG SpA	2.68	0.1	NO	1.77	0.41	NO
A2A SpA	2.28	0.13	NO	5.47	0.06	NO
Endesa SA	4.64	0.03	YES	3.07	0.22	NO
Drax Group PLC	0.1	0.75	NO	0.94	0.63	NO
EVN AG	12.43	0	YES	3.46	0.18	NO
Verbund AG	0.21	0.65	NO	0.05	0.98	NO
Terna Rete Elettrica Nazionale SpA	0.25	0.62	NO	5.9	0.05	NO
Ren Redes Energeticas Nacionais SGPS SA	4.37	0.04	YES	12.6	0	YES

Where the tests detect autocorrelation or heteroscedasticity, estimates are compared to those obtained using a GLS method which corrects for first-order autocorrelation (Prais–Winsten and Cochrane–Orcutt) with heteroscedasticity-robust variance estimates (Huber/White/sandwich estimator).

The results do not show major differences between the two methods (this shows consistency of the beta estimates under OLS and GLS, Table 7.3). We therefore use asset betas obtained with OLS. This is consistent with the ACM method which indicates that autocorrelation and heteroscedasticity should be tested and investigated only if significant differences are found (though even in that case there may be no adjustment to the results).

Table 7.3: Results of OLS and GLS beta estimates

Company name	Asset betas [OLS]	Standard error [OLS]	Asset betas [GLS]	Standard error [GLS]
Engie SA	0.68	0.04	0.67	0.04
Acea SpA	0.32	0.04	0.32	0.04
Hera SpA	0.29	0.03	0.29	0.04
Centrica PLC	0.67	0.07	0.67	0.07
National Grid PLC	0.36	0.05	0.36	0.06
Ascopiave SpA	0.39	0.04	0.42	0.04
Severn Trent PLC	0.32	0.05	0.32	0.06
ERG SpA	0.38	0.03	0.38	0.04
A2A SpA	0.45	0.03	0.45	0.04
Endesa SA	0.47	0.03	0.47	0.04
Drax Group PLC	1.00	0.09	1.00	0.09
EVN AG	0.20	0.04	0.22	0.05
Verbund AG	0.44	0.06	0.45	0.06
Terna Rete Elettrica Nazionale SpA	0.37	0.03	0.37	0.03
Ren Redes Energeticas Nacionais SGPS SA	0.24	0.03	0.24	0.04

Statistical significance

Statistical significance is the likelihood that a relationship between two or more variables is caused by something other than chance. In this case, the statistical significance of the OLS and GLS estimates shows the likelihood of there being a significant relationship between the return on the market and the return on a particular company. Table 7.4 shows that the t-statistics for all coefficients are significant with both OLS t-statistics and GLS corrected standard errors.

Table 7.4: t-test results (OLS and GLS)

Company name	t-test [OLS]	t-test [GLS]
Engie SA	24.73	23.86
Acea SpA	13.77	12.35
Hera SpA	13.04	10.45
Centrica PLC	12.76	13.35
National Grid PLC	11.52	9.32
Ascopiave SpA	11.43	11.54
Severn Trent PLC	10.79	9.53
ERG SpA	16.79	14.53
A2A SpA	21.5	17.31
Endesa SA	18.29	15.23
Drax Group PLC	13.2	12.2
EVN AG	6.17	6.2
Verbund AG	11.8	11.95
Terna Rete Elettrica Nazionale SpA	24.45	21.93
Ren Redes Energeticas Nacionais SGPS SA	19.47	15.8

Assess the betas against Dimson-corrected betas

Finally, we have also assessed the betas obtained from the Dimson correction (estimates using the same-day market index as independent variable, supplemented with the market index from one period earlier and one period later). Where the lag- and forward-variables are found jointly significant the Dimson beta is calculated as the sum of the three coefficients.

The results are shown in Table 7.5. The F-test of joint significance of the lag- and forward-variables indicates that the Dimson adjustment is not needed except in four cases. For "Ascopiave SpA", "Terna Rete Elettrica Nazionale SpA", "EVN AG" and "Drax Group PLC", the F-test shows significance of the adjustment. The Dimson betas for such companies will be used to assess the sensitivity of the results.

Table 7.5: Results of OLS and Dimson betas, and results of the test (F-test p-value denotes joint significance of lag- and forward-values)

Company name	Asset betas [OLS]	Asset betas [Dimson]	F-test p-value	Correction needed?
Engie SA	0.6775	0.7247	0.16	NO
Acea SpA	0.3222	0.3792	0.09	NO
Hera SpA	0.2879	0.2999	0.77	NO
Centrica PLC	0.6671	0.6387	0.71	NO
National Grid PLC	0.3582	0.3746	0.7	NO
Ascopiave SpA	0.3862	0.5441	0	YES
Severn Trent PLC	0.3158	0.331	0.72	NO
ERG SpA	0.3764	0.4277	0.13	NO
A2A SpA	0.4513	0.448	0.92	NO
Endesa SA	0.4742	0.431	0.28	NO
Drax Group PLC	0.9996	1.2353	0.03	YES
EVN AG	0.2041	0.2966	0.04	YES
Verbund AG	0.4432	0.4425	0.95	NO
Terna Rete Elettrica Nazionale SpA	0.3719	0.2995	0	YES
Ren Redes Energeticas Nacionais SGPS SA	0.2394	0.258	0.3	NO

We note that all but one estimated coefficients have a positive sign and less than 1: the positive sign of the coefficient means that the stocks of the comparators move in the same direction as the rest of the market. The fact that the coefficients are less than 1 means that the stocks are less volatile than the market (the comparators are less risky than their corresponding market index).

For one company, Drax Group PLC, we obtained a coefficient greater than 1, which is unexpected.[32] However, its influence in the results is small because a median is used to estimate the asset betas (at the same time, this company is reflecting some disparity in the distribution of our sample in the upper end of the obtained values).

7.3 Beta results

Table 7.6, contains the asset beta estimates for each peer. Our median beta estimate is calculated with different methods in separate columns: OLS asset betas (in S1), and OLS asset betas with the Dimson correction (where needed and denoted with "[D]" in S2). In our calculations, we noted that a few companies showed a very different Dimson-adjusted beta, which might be reflecting some underlying issues with the data (this refers to company "Ascopiave SpA", "Drax Group PLC", "EVN AG" and "Terna Rete Elettrica Nazionale SpA"). As a sensitivity test, we also included calculations using a median without such observations (in S3).

At the bottom of the table, the average and median are provided for each case. To note is the fact that the medians are 0.38 across the three methods used (the median is a robust statistic and is not severely affected by outliers or other small departures from model assumptions).

32 We believe that this is because Drax Group generates electricity mostly through biomass.

Table 7.6: Asset betas

Company name	S1	S2	S3
Engie SA	0.68	0.68	0.68
Acea SpA	0.32	0.32	0.32
Hera SpA	0.29	0.29	0.29
Centrica PLC	0.67	0.67	0.67
National Grid PLC	0.36	0.36	0.36
Ascopiave SpA	0.39	0.54 [D]	
Severn Trent PLC	0.32	0.32	0.32
ERG SpA	0.38	0.38	0.38
A2A SpA	0.45	0.45	0.45
Endesa SA	0.47	0.47	0.47
Drax Group PLC	1.00	1.24 [D]	
EVN AG	0.20	0.30 [D]	
Verbund AG	0.44	0.44	0.44
Terna Rete Elettrica Nazionale SpA	0.37	0.37 [D]	
Ren Redes Energeticas Nacionais SGPS SA	0.24	0.24	0.24
Average	**0.44**	**0.47**	**0.42**
Median	**0.38**	**0.38**	**0.38**

7.4 Equity Risk Premium (ERP)

The ACM method prescribes that the ERP should:

- Be based on the weighted average of the long term arithmetic and geometric average ERP for the Eurozone based on the DMS series (weightings based on current market capitalization of each country's stock market).
- Envisage some downward adjustments of the historical averages (and sanity check with forward-looking models, like the DGM). However, it is worth noticing, that although there have been different estimates for corrections by different analysts, there is no consensus on the way these corrections should be made (results of DGM can be quite volatile and often depend on subjective estimates of financial analysts, all of which results in regulatory uncertainty around the figures). In recent ACM decisions[33], estimates have not been adjusted either.

Table 7.7 summarises are calculations for the ERP. The weighted average of these countries gives an ERP value of **4.79** per cent for the Eurozone.

[33] WACC method for design method decisions 2017-2021 (WACC-methode bij ontwerpmethodebesluiten 2017-2021) https://www.acm.nl/nl/publicaties/publicatie/15616/WACC-methode-bij-ontwerpmethodebesluiten-2017-2021.

Table 7.7: Equity Risk Premium DMS – Europe

	[1] Geometric Mean (%)	[2] Arithmetic Mean (%)	[3] Average [1] & [2] (%)	[4] Market Cap (€m)*
Austria	2.70	21.10	11.90	75,649
Belgium	2.10	4.10	3.10	287,056
Finland	5.10	8.60	6.85	235,325
France	3.00	5.30	4.15	1,295,901
Germany	4.80	8.20	6.50	877,699
Ireland	2.50	4.50	3.50	77,488
Italy	3.10	6.40	4.75	325,176
The Netherlands	3.20	5.50	4.35	594,394
Portugal	5.10	9.20	7.15	54,081
Spain	1.60	3.60	2.60	444,178
Eurozone	**3.33**	**6.25**	**4.79**	**4,266,947**

*Sources: "Credit Suisse Global Investment Returns Sourcebook 2019", Thomson Reuters EIKON, Europe Economics calculations. * Market capitalisation (in €) as of 31/12/2018.*

7.5 Conclusion

Our analysis took in consideration all the relevant variables necessary to estimate the cost of equity. We applied the ACM previous approach in the estimation of all the variables. To sum up:

- We have estimated the relevant risk free rate using the average of 10-year government bonds in the Netherlands and Germany. Our risk free rate estimate is **0.39** per cent.
- We have estimated asset betas using the peer companies. Our median asset beta estimate is **0.38**.
- We have analysed the ERP as reported by DMS. Our estimate for the ERP is **4.79** per cent.

The results and choices made during our work are reasonable and can be justified based on the following. The use of 10 year government bonds is a standard practice by regulators, therefore the 0.39 estimate for the risk free rate is an uncontroversial choice. The asset beta has been obtained using a median statistic. The value of 0.38 is consistent with different methods being used (including changing slightly the composition of the comparator list to account for Dimson adjustments). The use of ERP as reported by DMS is also a standard practice of most regulators, therefore the 4.79 per cent estimate is an uncontroversial choice.

8 Cost of Debt

The ACM calculation of cost of interest debt is calculated as a credit spread plus the risk free rate, increased by 15 basis points to cover the costs of issuing debt, for example banking, legal and agency fees.

Interest costs

The ACM calculation of cost of interest debt differentiates between existing (issued in the past) and new debt (to be issued in the next regulatory period). The allowed return is therefore based on a model which assumes a schedule for existing and new debt for each year (with the portfolio existing/new debt being evenly spread across 10 years).

Hence, in the first year of the regulatory period, new debt is assumed 20% (the remaining 80% evenly spread across the 8 previous years); in the second year new debt is assumed 30% (the remaining 70% evenly spread across the previous 7 years); in the third year the spread of new and existing debt is 40% and 60%.[34] This method is consistent with the one used for calculating the WACC of energy entities in the Netherlands.

The total cost of debt over the regulatory period is therefore constructed as a weighted average of new and existing cost of debt (with weights given as 10% for each of the periods of consideration). The cost of debt is based on the following:

- For the cost of existing debt, the returns associated with company's bonds in the Eurozone are used. Yearly averages are used for past years (2011-2018).
- For the cost of new debt, a cost forecast is used for each of the years of the regulatory period. The average of the last three years is used to get the forecast for the years of the regulatory period (2020-2022).

Our calculations are based on the following index for Europe:

- Bloomberg BBB+ rated utility (bonds) index with 10 years to maturity.[35]

The cost of debt calculations are based on 12 years of data: 8 years of historical data (2011-2018) and 4 years of forecast data (2019f, 2020f, 2021f, 2022f, estimated as the average of the years 2016-2018). The rolling average for the 10 years leading up to the regulation year is taken (i.e. the 2020 figure is the average of the historical values 2011 – 2018 and the forecast values for 2019 and 2020). The results are shown in the table below.

[34] For calculation purposes this implies that for the first year, 2020, the cost of debt is based on 80% of the cost of 2011-2018, 10% of 2019 (forecast) and 10% of 2020 (also forecast).

[35] Yearly values for this index provided by ACM for 2017 and 2018. For the years before 2017 the index was constructed as the average of the BBB-/BBB/BBB+ index and the A-rated index.

Table 8.1: Cost of debt (%)

Analysis	Cost of Debt (%)
2011	4.40
2012	3.50
2013	3.11
2014	2.17
2015	1.49
2016	1.05
2017	1.26
2018	1.50
2019f	1.27
2020f	1.27
2021f	1.27
2022f	1.27
2020a	2.10
2021a	1.79
2022a	1.57

Note: 2020a denotes Average (11 - 20f), 2021a denotes Average (12 - 21f) and 2022a denotes Average (13 - 22f).

Non-interest fees

The ACM method allows transaction costs are allowed on top of the interest rate surcharge. The ACM uses 15 basis points.

8.1 Conclusion

The cost of debt estimates are based on a Bloomberg index for utility companies based in Europe with 10 years to maturity. The estimate for the regulatory years 2020, 2021 and 2022 are 2.10, 1.79 and 1.57 respectively. Including other (non-interest) fees the final cost of debt estimates are **2.25 per cent** for 2020, **1.94 per cent** for 2021 and **1.72 per cent** for 2022.

9 WACC final Results

The following tables provide our summary of the WACC estimates for the relevant heat exchangers for the regulatory period 2020-2022. Because of this two-tier tax regime in the Netherlands, our WACC calculations are reported for two situations: using a low-tax bracket (for firms under €200,000 taxable profits) and using a high-tax bracket (for firms exceeding €200,000 taxable profits by such a margin that the effective tax rate is equivalent to the high-tax bracket). Firms should be placed into their relevant tax bracket, but our expectation is that the higher tax bracket is likely to be more applicable for the heat exchangers as most, if not all, of the regulated companies will have profits significantly greater than €200,000.

The sources of our calculations can be found in the following chapters of this report.

- Risk free rate (equity): Chapter 7.
- Equity risk premium (ERP): Chapter 7.
- Equity beta: Chapter 7.
- Asset beta: Chapter 7.
- Cost of Equity: Chapter 7.
- Tax rate: Chapter 6.
- Risk free rate (debt): Chapter 8.
- Non-interest fees: Chapter 8.
- Cost of Debt (pre-tax): Chapter 8.
- Gearing: Chapter 6.
- Nominal (vanilla) WACC (after tax): calculation (see page 8).
- Nominal WACC (pre-tax): calculation (see page 8).

Table 9.1: Final WACC calculations (2020-2022) using the low-tax bracket

Parameter	2020	2021	2022
Tax Rate	16.50%	15.00%	15.00%
Notional Gearing	40.82%	40.82%	40.82%
Asset Beta	0.38	0.38	0.38
Equity Beta	0.60	0.60	0.60
Risk free rate (equity)	0.39%	0.39%	0.39%
ERP	4.79%	4.79%	4.79%
Cost of Equity	**3.26%**	**3.28%**	**3.28%**
Pre-tax Cost of Equity	**3.90%**	**3.86%**	**3.86%**
Interest Cost of Debt	2.10%	1.79%	1.57%
Non-interest fees	0.15%	0.15%	0.15%
Cost of Debt	**2.25%**	**1.94%**	**1.72%**
Nominal WACC (after tax)	**2.85%**	**2.73%**	**2.64%**
Nominal WACC (pre-tax)	**3.23%**	**3.07%**	**2.98%**

Table 9.2: Final WACC calculations (2020-2022) using the high-tax bracket

Parameter	2020	2021	2022
Tax Rate	25.00%	21.70%	21.70%
Notional Gearing	40.82%	40.82%	40.82%
Asset Beta	0.38	0.38	0.38
Equity Beta	0.58	0.59	0.59
Risk free rate (equity)	0.39%	0.39%	0.39%
ERP	4.79%	4.79%	4.79%
Cost of Equity	**3.15%**	**3.19%**	**3.19%**
Pre-tax cost of equity	**4.20%**	**4.08%**	**4.08%**
Interest Cost of Debt	2.10%	1.79%	1.57%
Non-interest fees	0.15%	0.15%	0.15%
Cost of Debt (pre-tax)	**2.25%**	**1.94%**	**1.72%**
Nominal WACC (after tax)	**2.78%**	**2.68%**	**2.59%**
Nominal WACC (pre-tax)	**3.41%**	**3.20%**	**3.11%**

For comparison purposes we assess these in relation to the WACC estimates from Oxera (2009). In their report for heating networks their nominal low and high estimates were 6.7 and 9.5, respectively. However, such high values can be attributed to the risk free rate used: in that report this was estimated as 3.9 and 4.2, whereas these have been reduced significantly in recent times (in this report we estimate a RFR of 0.39).

10 Annex 1: Liquidity Checks

Table 10.1: Companies that failed L1

Company Name	Country	Revenue (mil€)
Iren SpA	Italy	0
Compagnie des Eaux de Royan SA	France	36
Itn Nanovation AG	Germany	5
Thessaloniki Water and Sewage Co SA	Greece	73
Fernheizwerk Neukoelln AG	Germany	38
Burgenland Holding AG	Austria	0
Etrion Corp	Canada	17
Selected Energy SA	Cyprus	3
R Energy 1 SA	Cyprus	3
Athena Investments A/S	Denmark	52
Hydro Exploitations SA	France	2
Futuren SA	France	67
Velcan Holdings SA	France	3
Energie Europe Service SA	France	0
Elektrische Licht und Kraftanlagen AG	Germany	1
7C Solarparken AG	Germany	40
ABO Invest AG	Germany	26
CARPEVIGO Holding AG	Germany	0
Elliniki Technodomiki Anemos SA	Greece	60
Holding Company ADMIE IPTO SA	Greece	0
Greencoat Renewables PLC	Ireland	58
Alerion Clean Power SpA	Italy	56
Fintel Energia Group SpA	Italy	24
Frendy Energy SpA	Italy	2
Agatos SpA	Italy	7
Societe Electrique de l'Our SA	Luxembourg	33
DGB Group NV	Netherlands	16
New Sources Energy NV	Netherlands	0
EAM Solar ASA	Norway	4
Photon Energy NV	Poland	13
Solaria Energia y Medio Ambiente SA	Spain	34
Solarpack Corporacion Tecnologica SA	Spain	0
Trention AB	Sweden	6
EnergyO Solutions Russia AB	Sweden	-13
Arise AB	Sweden	0
Skanska Energi AB	Sweden	37
Minesto AB	Sweden	3
Energiedienst Holding AG	Switzerland	0
Adev Wasserkraftwerk AG	Switzerland	

Edisun Power Europe AG	Switzerland	12
Aventron AG	Switzerland	82
BKW AG	Switzerland	0
Jersey Electricity PLC	UK	0
Rurelec PLC	UK	0
Aggregated Micro Power Holdings PLC	UK	49
Fandango Holdings PLC	UK	0
Clean Invest Africa PLC	UK	
Bettwork Industries Inc	USA	0
Finaxo Environnement SA	France	

Table 10.2: Companies that failed L2

Company Name	Country	Trade (%)
Orsted A/S	Denmark	82.69
Mainova AG	Germany	32.69
Enbw Energie Baden Wuerttemberg AG	Germany	77.18
Uniper SE	Germany	74.49
Gelsenwasser AG	Germany	58.33
Italgas SpA	Italy	69.87
Lechwerke AG	Germany	68.85
Enercity AG	Germany	7.18
EnviTec Biogas AG	Germany	85.51
Innogy SE	Germany	72.18
Fjordkraft Holding ASA	Norway	24.74
KSK Power Ventur PLC	UK	29.49
ContourGlobal PLC	UK	36.92

Table 10.3: Companies that failed L3

Company Name	Country	Bid-Ask (%)
Mvv Energie AG	Germany	1.14
Acsm Agam SpA	Italy	1.08
Electricite de Strasbourg SA	France	1.12
Energiekontor AG	Germany	1.21
Audax Renovables SA	Spain	1.19
Romande Energie Holding SA	Switzerland	1.18
Good Energy Group PLC	UK	3.67
OPG Power Ventures PLC	UK	2.76

Table 10.4: Companies that failed the Investment Grade criteria

Company Name	Country	TR Rating
Electricite de France SA	France	B+
RWE AG	Germany	BB+
Edison SpA	Italy	BB
Alpiq Holding AG	Switzerland	BB
Pennon Group PLC	UK	BB
Elia System Operator SA	Belgium	BB+
Albioma SA	France	BB+
Voltalia SA	France	BB
Encavis AG	Germany	BB
Public Power Corporation SA	Greece	B-
Falck Renewables SpA	Italy	BB+
Scatec Solar ASA	Norway	BB
SSE PLC	UK	BB+
Atlantica Yield PLC	USA	BB
United Utilities Group PLC	UK	BB+

Note that these are ratings for the groups, via strict application of the ACM method. There are a number of cases — including in particular Pennon and United Utilities, where the regulated entity does indeed have a credit rating high enough and these firms do have betas that are often used in utilities comparator analysis. However, strict application of the ACM method implies excluding them and we do not need to include extra firms to meet the "10 or more" comparators requirement. Hence we exclude them.