Energy Sector Risk and Cost of Capital Assessment—Companies and Investors Perspective

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Abstract: This paper aims to identify the costs of capital in a group of companies from the energy sector by including an investor and market risk approach. The study also concerns the company's Weighted Average Cost of Capital (WACC) cost intra-industry analysis related to sector characteristics such as total assets, revenues, market capitalization, and companies' age. In order to assess the intergroup relationships, basic correlation relationships were compared and a nonparametric test of variance was performed. The period under study covered the years 2015–2019. The conducted research evaluates groups of companies that dedicated their activity to a particular energy intra-industry division under numerous regulations in Europe. The study contributes to assessing the level of risk among energy listed companies in European capital markets based on capital structure valuation. The study results underline the role of the cost of equity financing, which was twice as high as the cost of debt. The highest WACC was related to the Beta indicator that also expressed the political and regulatory risk over the investigated period. Across debt cost analysis, the role of effective tax rate decreased the level of WACC. The highest level of WACC was noticed among uranium and integrated oil and gas companies. The study contributes to information asymmetry theory related to the cost of capital assumptions.

Keywords: cost of capital; WACC; European energy sector; intra-industry analysis

1. Introduction

Running a business operating on an open and competitive market requires building an appropriate capital structure. All these conditions are generally the basics of corporate nature strategy challenges. Most of the research conducted in this area focuses on capital structure determinants, such as profitability, development opportunities, company size, assets, and tax shields [1]. These factors are important in assessing the effectiveness of the functioning of companies. However, the key element in assessing companies' effectiveness is the possibility of acquiring sources of financing that will not increase the cost of capital level but enhance a level of profitability. It could be assessed from two perspectives: internally by the company managers/owners and market investors, or by its competitors. From a potential investors' point of view, the decision-making process is related to selecting the most optimal investment portfolio. This process is complicated and depends on many economic factors, including the availability of financial and nonfinancial information on the market. The market's information creates positive or negative signals that impact price increase or decrease [2]. The stock market changes in a dynamic and stochastic manner, so potential investors are able to consider these risks. Therefore, the cost of capital is one of the key elements of business valuation. Another perspective of the cost of capital as a part of modern finance theory is related to investment or disinvestment decisions, economic profit prognosis, or performance efficiency [3]. The company perspective shows the cost of capital as one of the main factors influencing companies' decisions in crediting the capital structure and optimization future path of financial decisions. The cost of capital

also plays an important role in valuing the invested capital. It is a key link in transforming the stream of future expected net income into present value [4]. The other side expresses the cost capital application for evaluating investment projects to define the minimum (threshold) expected and potential accepted return rate by investors [5,6]. To calculate the capital cost, information from the financial market is necessary, with the required investment return at a given risk level. Shareholders analyze companies' financial situation and their development opportunities with the cost of the capital assessment. It can reflect the potential dividend payouts or buyback of shares for redemption that can appear on the market [7].

Each group of stakeholders has specific expectations of an above-average rate of return on the capital invested. All stakeholder groups care about the company's value because they participate in its creation and consumption. The cost of capital is affected by the risk that owners and creditors bear. This risk level determines the rates of return that these groups of investors expect from their investments. The additional risk on the market should be compensated by the risk premium and risk-free interest rate [8] and impact on the cost of capital. The level of the cost of capital depends on the method of its estimation. Thus, the authors used the Weighted Average Cost of Capital (WACC) as the most popular method to increase the study comparability. WACC is one of the direct and indirect measures that is used for investment achievement evaluation. In other words, WACC impacts the return rate on capital required over a given period by owners and creditors [9]. WACC from the company side is useful as the valuation component and indicates the return rate for assessing future company projects. Therefore, WACC is an integral part of the discount rate for the Discounted Cash Flow method (DCF) and other valuation models [10–12].

Our main contribution to the literature is the firm-level approach related to the cost of capital importance in investors' and managers' decisions. A variety of studies concern the macroeconomic factors of investors' portfolio creation on stock markets related to oil price changes. Most studies refer to the energy sector to explore capital investment's cost of capital estimation, in particular technology of implementation [13–16] or cost-related issues dedicated to maintaining or operating within specific technology of production [17–19]. Analyses of the historical approach of WACC are important for the profitability of future investors' decisions. Energy companies should pay attention to risk assessments, specifically strategic sources of risk associated with developing globalization processes related to raw materials markets trends [20]. Thus, our analyses show an ex-post approach that uses a cost of annual capital value. The conducted study verified historical data for the energy sector and risk perception by capital market investors. The market WACC valuation was also investigated in a study concerning firm age and its profitability. This paper also contributes to assessing financial markets' connections in terms of quotations and the risk management process of investment portfolios to understand the European energy sector's mechanisms.

This study covers a gap between theory and empirical research study that concerns the WACC of energy companies characterizing the economy's regulated sector. The energy sector's financial performance and development strategy are closely related to government regulation and potential liberalization of prices [21]. Entities in the energy sector operate in dynamically occurring conditions, both on the regulatory and technological levels. The obtained results underline the sector companies' diversification according to the main energy source in sub-industry classification.

This paper is organized as follows. The next section presents a literature review that concerns capital cost as a factor impacting organization and investor decisions. Section 3 describes the WACC method issues. Section 4 concerns energy sector companies on capital markets performance conditions. Section 5 presents the methods and sample, and Section 6 describes the sample and the results of the study estimation. The last two sections include the discussion and conclusion of the paper.

2. Literature Review

The capital cost is an economic category that allows for combining investment decisions with the owners' income and the creditors' benefits. It can be analyzed in several dimensions, considering the interests and requirements of the capital investors, capital buyers, and potential investors looking for the best directions for allocating their available funds [22]. Since the sixties of the twentieth-century, Modigliani and Miller presented the WACC approach that reflected its usage in capital structure decision problems. The capital cost appeared as the pricing parameter in Modigliani and Miller's theory basics [23]. Modigliani and Miller (1959) showed that debt financing positively impacted companies' value on the market due to the tax shield effect [24]. The company's capital structure can be seen as a balance between the tax benefits of debt and the costs of financial distress and bankruptcy, which can be considered due to higher obligations [25]. In this view, the tax burden on equity financing limits the extent to which firms hedge against aggregate risk. Therefore, an empirically validated framework presented secondly by the Merton–Miller model was related to trade-off theory and implied the existence of an optimal capital structure. According to Meyers [26], the trade-off theory underlines the target debt level to reach the tax benefit and to account for the low cost of capital. In addition, trade-off theory considers the possibility of searching for the optimal relationship of equity and debt capital that ensures the lowest cost of capital and the firm's highest value that enhances tax benefits. This assumption should be grounded by the positive effect of financial leverage and low bankruptcy costs [11], which was included in the optimal capital structure theory by Kraus and Litzenberger [27].

Tax affects private and listed companies' debt financing decisions differently. As taxes increase in private companies, leverage increases, whereas it does not involve long-term or short-term borrowing. For listed companies, as tax increases, long-term debt financing increases while short-term decreases; however, it does not affect leverage. Thus, listed companies increase their long-term borrowing to take advantage of tax shields [28]. Tax benefits and high inflation also influence the level of a company's leverage. A tax shield is included in WACC calculation and expresses the effective tax rate, which measures the companies' tax policy's effectiveness. Properly implemented optimization solutions should contribute to lowering the effective tax rate [29–31] and consequently the cost of capital.

Inflation risk also has an impact on decisions regarding capital cost. It makes the expected cash flows from investment projects more uncertain, and hence, projects will be assessed at high discount rates [32]. As a result of such decisions, the implementation of projects will become more costly, and thus, fewer projects will be undertaken and the firm's growth will be affected [10,33].

The globalization process is progressing due to the integration of markets and faster information flow. Globalization also brings innovation in market valuation by big data support thanks to machine learning that forecasts stock return predictions with an automatic ranking list [34]. The development of financial markets allows for acceleration of the pace of assimilation of information. According to Hughes et al., information asymmetries increase the capital cost by increasing factor risk premiums [35], thus impacting mostly equity cost of capital [36]. Reducing information asymmetry helps to lower capital costs by providing less-informed investors access to information [37]. Therefore, these effects are more visible in the cost of equity capital [36]. It could also be underlined that a better-informed group of investors also appeared on the market and they could react differently from the rest [38]. Investors' information needs vary and depend on factors such as the nature of the investment knowledge and experience, and preferred method of share prices as participants of the capital market decide to buy and sell shares daily. Therefore, investors face a countless number of financial market opportunities, and using the WACC measure helps them to benchmark market alternatives [39]. Furthermore, WACC has a significant impact on the value of the firm [40]. Listed companies do not seek to optimize the capital structure by employing a leverage mechanism but seek the most available financing sources at the moment with the lowest cost.

Fernandez underlines that the capital market costs are determined by the capital market liquidity, efficiency, and risk investors [12]. However, a company's capital structure expressed by WACC level could be a cumulative result of past attempts such as issuing shares or could be affected by temporary fluctuations in equity capital cost [41]. The theoretical approach developed for the financial market efficiency level is associated with perfect and imperfect market issues. The imperfect market determinants are related to information asymmetry, transaction costs, bankruptcy costs, and administrative and legal regulations that also include tax policy. According to Harris and Raviv, the tax approach's capital structure theory could be determined by tax and non-tax theory determinants [42]. Taxation shows how companies operate, concerning which mechanisms and principles effectively manage financial activity and the tax burden [43].

3. Cost of Capital—Methods Review

The weighted average cost of capital is commonly used in models for assessing the financial efficiency of investments, business valuation, or models for estimating economic added value [44]. The WACC methodology helps to establish the level of uncertainty on financial markets (risk aversion), the cost of debt and equity capital increase, and the credit shortage issue. The optimal capital structure minimizes the value of the weighted average cost of capital and maximizes the company's value [45]. The concept of value management assumes that the company's goal is to maximize the value for owners, which can be achieved by minimizing capital cost [46]. The WACC method uses market values to express the amount of debt and equity [46]. Capital market data reflect the risk assessment for all participants and make the cost of capital calculation available.

WACC estimation is divided into two parts: debt cost and equity cost. The cost of equity capital could be investigated from multiple perspectives, given its accounting and financial research [47]. In our WACC calculation, the authors used the Capital Asset Pricing Model (CAPM) method that measures the return of an investor's portfolio. The concept of CAPM was introduced by Sharp [48], Lintner [49] and Black, and Jensen and Scholes [50] based on Markowitz portfolio theory. The main issue underlines that equity holders keep more risk than debt holders, explaining the higher equity costs. However, banks can value the increase in default risk in these countries when there is a high climate risk exposure [51]. This approach analyzes macroeconomic factors' impact base on the Arbitrage Pricing Theory (APT). The CAPM method's main difference from APT is covariance, which establishes the expected return on market portfolio statistics. The CAPM model's popularity is related to its uncomplicated structure, which allows for the relative transparency of the obtained results [52,53]. Considering this method, WACC provides a comparable capital cost valuation compared to the Gordon or APT model of assets pricing [54]. However, the Modern Portfolio Theory (MPT), CAPM, or APT models based on market efficiency assumption highlight investors' rational decisions [55]. The other perspective underlines the behavioral finance argumentation based on investors' heuristics decision on the financial market [56].

Stulz argued that the CAPM approach is the most popular model of (owner) equity valuation [57,58] and plays a central role in finance theory [59]. The cost of equity capital in the CAPM method could impact the firm differently due to industry-specific features such as revenue, profit margin, Beta, market competition, GDP industry contribution, and more [60]. Beta, based on CAPM, influences the equity cost of capital. Beta, as measured by the CAPM, is widely used for pricing stocks [61]. Beta estimation helps investors to assess the level of uncertainty and risk. Thus, the greater the risk for the investor, the higher the expected returns [32]. Thus, investors can assess risk management based on Beta and the age of the firm. The stock Beta declines with the age of the firm [62]. Young capital age companies noticed lower average returns compared with old capital age [63]. The Beta factor reflects the firm-specific systematic risk compared to the overall market risk [64]. Stock market uncertainty affects thus firms' financing costs [65]. The Beta captures stock return behavior and is time-varying among younger firms [62]. Thus, the age of companies is additionally used to assess the WACC changes. Ozcam noticed a significant

relationship between the Beta coefficients of expected macroeconomic variables and asset return [66,67]. Therefore, the profitability ratios are examined in this study to assess their impact on WACC.

Market information is essential for efficient operating decisions, and the optimal capital structure became a balance between disclosure information on the market and the low cost of capital [68]. The market risk premium as an element of CAPM calculation represents the difference between the expected market return and the risk-free return rate. This measure is important for a risk-averse investor who invests in stocks and compares debt security rates [53]. A higher risk is defined in developing capital markets characterized by lower liquidity. Beta also expresses the level of liquidity cost on the market and therefore represents systematic risk. Furthermore, Beta is one of the natural measures of sector risk used by investors [69].

A Beta that expresses market uncertainty could be static [70]. Other authors confirmed that Beta level is strongly related to the return rate from particular market investments [71]. Thus, the risk of a firm's equity depends on its contribution to stock price volatility and not on the national market portfolio situation [72]. However, the market factor impacts the WACC level, and companies do not influence and manage this value fully. Researchers also use a weighted average cost of capital for risk debt and bankruptcy assessment [11,73,74]. In WACC calculation, the debt capital is related to the cost that managers could control directly. The financial risk in this area impacts the increase in the cost of capital. An increase in foreign capital causes a decrease in free cash flow (FCF) that an enterprise may have at its disposal. The shareholder's and creditors' expectations are shaped by WACC historical data [75]. The WACC interpretation is mostly related to a nonlinear relationship. The trade-off theory used the WACC leverage pattern according to which low-level debt impacts expensive equity capital cost. When, oppositely, debt increases with distress costs, then the cost of debt becomes more expensive. According to the pecking order theory, the debt capital is preferred. Prior studies, in this case, showed the linear relationship of WACC with leverage [6]. Thus, a low WACC is determined by a high debt level, and companies benefit from higher leverage. In addition, WACC rates also include credit spreads of corporate debt [76].

4. Energy Companies on Capital Markets

Spread between equity costs and debt cost represents risk allocation [25] distinguished in each industry. Access to capital markets and investment risks differs across capital markets and industries, visible at the WACC level [15]. The WACC method is more comparable when it concerns the same segment or industry. However, younger markets with shorter histories are characterized by a higher cost of capital [77]. The WACC concept is also widely used in energy cost technology identification [78].

Another approach that also includes WACC methodology implementation is vanilla WACC for regulatory price-setting purposes [79,80]. It is a weighted average of a nominal pre-tax cost of debt and a post-tax cost of equity (reflecting the corporate tax impact). Thus, it represents only the investment side of the calculation from companies' internal decisions [81]. This issue is related to the aspect of investing in the energy sector that is associated with the involvement of high expenditure in the long-term. Maintaining the stability of investing in the energy sector is important to encourage potential investors. Among European countries' regulators, there is no uniform method of determining the cost of capital; some have a nominal WACC, WACC pre-tax, or WACC vanilla level, both in gas and electricity production. However, this approach is not included in the conducted research scope.

WACC varies between countries due to the business's specific nature and the capital employed in the long-term perspective, government policies, limited access to capital, risk perception level accepted by financial institutions, and macroeconomics parameters (inflation and demand for credit). Additionally, investors' perception of risk is different in countries where the financial industry is less competitive [6,82]. However, the energy

sector possesses some specific characteristics. Through EU institutions, the energy sector regulations impact the perception of these markets among investors. Market players and, mainly, consumers have been protected by European regulators. The energy system operates under changing working conditions, depending on weather factors and energy demand variability. WACC level is also important in a regulated industry such as the energy sector; thus, WACC determines the correct price. Investors need to take into account that several mechanisms impact energy security prices [83].

The stock return in the energy sector was investigated by analysis of macroeconomic variables such as inflation, money supply, exchange rate, industrial production, bond, export, import, foreign reserve, and unemployment rate by Zhu [67]. Korajczyk and Levy [84] shed new light on the fact that macroeconomic conditions are also crucial for capital structure. They argued that market conditions are significant for unconstrained firms when the issued shares decision is being made. Then, favorable macroeconomic conditions are important. For these market activities, an updated WACC level also plays a crucial role for managers.

WACC difference across regions and technologies in the electricity sector, depending on factors such as political stability or the business cycle [85]. In the energy sector, the firms' differential exposure to policy impacts the WACC level [65]. As is known, the amount of weighted average cost of capital depends not only on the cost of individual types of capital (equity and foreign capital) but also on the capital structure and the income tax rate. The WACC method is able to include taxpayer risk.

Industry-specific factors directly and indirectly affect a firm's capital structure choice and then the cost of capital. Companies tend to be more leveraged if they operate in economically significant industries [60], such as the energy sector. Comparing the capital costs of different energy sectors shows the investor's attitude to risk and technology acceptance. The realized return rate on capital in the weighted average cost method allows for assessing whether the company can create sufficient added value or not [86]. The market determines the cost of capital (interest rate). It does not depend on the preferences of a single investor but all investors in the market. If a company plans to raise capital on the financial market, it cannot independently (arbitrarily) determine the cost of that capital. The rate of return offered must be based on market information and must take into account the risk level of such equity investments. The higher the cost, the lower the present value of the company's future net cash flows and the lower its economic value. More aggressive investors who create a portfolio based on oil-sensitive stocks with higher returns may decide to buy these stocks that have higher betas (systematic risks) currently [87].

Knowledge of profitability, which corresponds to risk, enables the company to recalculate the amount of profit. Cost of capital determines the volume of the profits [39]. According to Pouraghajan, et al., there is a significant and positive relationship between the weighted average cost of capital (WACC) and corporate performance evaluation such as Return on Assets (ROA) and Return on Equity (ROE) [88]. Thus, a change in WACC can affect the return on assets. The higher cost of capital adversely affects the profitability position of the companies [89]. The higher WACC does not necessarily relate to increased risk but is a sign of high profitability as returns on investment [90].

The main factor that impacts the energy company sector is oil price or gas production [91]. It creates a higher risk from the perspective of market efficiency due to different price anomalies. It forces managers to use proper policy implications and investment decisions on trading activities that have energy-related tendencies on the capital market [92]. Financial markets can facilitate risk diversification and can reduce financing costs due to lower asymmetric information, which affects the lower cost of capital in case of technological innovation among the energy sector [93]. The risk could be recognized by investors from the standard deviation or/and Beta coefficient. Most of the energy sector securities have a positive Beta coefficient [94]. Financial markets (equity and credit) promote biomass and non-biomass renewable energy production in the Organisation for Economic Co-operation and Development (OECD) countries, and higher innovative economies also invest in clean

energy [93]. Renewable energy firms face the domestic stock market's impact on the global financial market due to international oil prices [95].

Based on the identified interdependencies, we propose testing the following three hypotheses:

Hypothesis 1 (H1). *The WACC of energy companies depends more on the size of a company, equity, total revenues, and age of settlement.*

Hypothesis 2 (H2). *The factor determining the cost of equity is the risk level resulting from the companies' general situation on the market with Beta's highest impact.*

Hypothesis 3 (H3). *There is a negative relationship between the cost of capital level and companies' profitability.*

5. Materials and Methods

5.1. Sample Description

This study concerns companies listed on European stock exchanges. The primary industry is the energy sector, distinguished according to the Global Industry Classification Standard (GICS) sector classification. On the second stage of sample formation, the Thomson Reuters Business Classification (TRBC) was implemented to include the scale of obtained revenues from basic operating activity. The researched period relates to the available time-series data in Eikon Database–Thomson Reuters (TR). The WACC methodology includes a two-step calculation of equity-based cost on the capital assets pricing model and debt cost.

A company was selected for the sample if, during the research period, data for WACC, balance, and income were reported at least for two years. We excluded a company if it was missing WACC calculations. Smaller financial markets do not collect data that could be used for WACC calculation. These observations were, therefore, omitted. The research sample constituted finally 231 companies in a 4-year study period (2016–2019) for 25 countries (according to the country of exchange). The investigated companies are listed on 41 European capital markets (more information in the Appendix A).

5.2. Methods of Data Analysis

The WACC methodology includes a two-step calculation of equity-based cost on the capital asset pricing model and debt cost. According to the WACC TR methodology, each category of capital was proportionately weighted. All capital sources, including equity stock, preferred stock, and debt, were included in the cost of capital calculation. The cost of equity was calculated by multiplying the market's equity risk premium with the Beta of the stock plus an inflation-adjusted risk-free rate. The cost of debt represents the marginal cost to the company of issuing new debt. It is calculated by adding the weighted cost of short-term debt and weighted cost of long-term debt based on the one-year and ten-year appropriate credit curve. Beta used in CAPM calculation represents how much stock moves for a given move in the market (based on the covariance of the security price movement to the market's price movement). The detailed definitions of implemented measures in the study are presented in Table 1.

WACC was calculated using the following formula:

$$WACC = (E/V) \times K_E + (D/V) \times K_D \times (1 - t_c) + (P/V) \times K_p \qquad (1)$$

where E is the value of equity, D is the company's debt, P is the company's preferred stock, V = total capital ($E + D + P$), K_E is the cost of equity, K_D is the cost of debt, K_P is the cost of preferred stock, and tc is corporate tax.

Table 1. Definition of variables.

Variables	Definition
Weighted Average Cost of Capital (%)	It is calculated as an average rate that a company is expected to pay to its debt, equity, and preferred stockholders to finance its assets.
WACC Cost of Equity (%)	The cost of equity is calculated via a CAPM method.
WACC Equity Risk Premium (%)	It is the StarMine Equity Risk Premium for the company's country.
WACC Tax Rate (%)	It is the effective tax rate for the company.
WACC Cost of Debt (%)	The cost of the debt component calculates the after-tax cost of debt.
WACC Cost of Preferred (%)	The cost of preferred stock is the current preferred dividend yield on the company's preferred stock.
WACC Debt Weight (%)	It is a debt component in WACC calculation.
WACC Equity Weight (%)	It is an equity component in WACC calculation.
WACC Short-Term Debt Cost (%)	It is a short-term debt component in WACC calculation.
WACC Long-Term Debt Cost (%)	It is a long-term debt component in WACC calculation.
Beta	The Beta coefficient is calculated by considering the primary index for the country of the company's primary equity listing. The used Beta factor is calculated for a fiscal year for each company.
Age	The number of years since the company was settle
ROA	Relationship of net financial result to total assets (%)
ROE	Relationship of net financial result to share capital (%)
EBIT/Sale	EBIT (Earnings before interests and taxation) to sale ratio (%)

Source: For the Weighted Average Cost of Capital (WACC) definition, Thomson Reuters methodology; for other variables, own description.

Descriptive statistics were used to identify the WACC level in the investigated period. The distinguished groups of industries of the energy sector related to an energy company's characteristics of primary operating performance are coal, integrated oil and gas, oil and gas drilling, oil and gas exploration and production, oil and gas refining and marketing, oil and gas transportation services, oil-related services and equipment, renewable fuels, and uranium (Table 2).

Table 2. Sub-industry classification, according to TRBC (The Refinitiv Business Classification).

Sub-Industry Activity	Definition
coal (A)	Companies are primarily involved in producing and mining coal, related products, and other consumable fuels related to energy generation. Additionally, coal mining support and coal wholesale companies are in these groups.
integrated oil and gas (B)	Integrated oil companies engaged in the exploration and production of oil and gas
oil and gas drilling (C)	Drilling contractors or owners of drilling rigs that contract their services for drilling onshore or offshore

Table 2. *Cont.*

Sub-Industry Activity	Definition
oil and gas exploration and production (D)	These companies are engaged in the exploration and production of oil and gas that are not classified elsewhere.
oil and gas refining and marketing (E)	Companies engaged in the refining and marketing of oil, gas, and/or refined products: these groups also include gasoline stations and petroleum product wholesale.
oil and gas transportation services (F)	Companies engaged in the storage and/or transportation of oil, gas, and/or refined products, including diversified activities that cover pipeline transport, sea-borne tanker, and oil and gas storage
oil-related services and equipment (G)	Manufacturers of equipment and oil-related services
renewable fuels (H)	Companies that concern biodiesel production, ethanol fuels, pyrolytic and synthetic fuels, biomass and biogas fuel, and hydrogen fuels
uranium (I)	Companies for which the main activities are related to uranium mining and uranium processing

Pearson correlation was used to infer causal relationships between the WACC level of selected groups (with the highest number of observations) and basic financial market measures important for investors such as Beta, total assets, revenues, market capitalization, and company age. A similar approach was used for the identification of the most significant factor influencing the WACC level of energy companies. In empirical investigations, we also use nonparametric methods due to the nature of financial data. Nonparametric tests do not require assumptions about the type of distribution but are not without additional limitations. To examine the differences in the energy industry, nonparametric ANOVA was used (Kruskal–Wallis test). We present the ANOVA Kruskal–Wallis test and the multiple comparisons test results, with differences between energy groups of companies divided according to the TRBC classification.

6. Results

6.1. Descriptive Statistics of a Sample

Table 3 reports the descriptive statistics for the investigated companies for primary balance and income statement data as well as market capitalization value. The highest standard deviation value of a basic company's size data was noticed in the total assets value (38.79 mld EUR). The percentile analysis expresses that the market is dominated by big players in the energy sector. The rest of the companies noticed a total assets level of 0.23 mld EUR. At the same time, the mean amounted for 9.44 mld EUR. These significant differences were also repeated in the total revenues, net income, and market capitalization statistics. It reflects the dominance of big units in these sectors.

Table 3. Descriptive statistics.

Variables	N	Mean	Std Dev	25th Pctl	50th Pctl	75th Pctl
Total assets (mld EUR)	1128	9.44	39.79	0.04	0.23	2.13
Total revenues (mld EUR)	1055	6.19	27.92	0.00	0.06	0.79
Net income after taxes (mld EUR)	1131	0.32	1.79	−0.01	0.00	0.03
Market Cap (mld EUR)	1127	4.68	19.69	0.02	0.10	0.85

6.2. WACC Primary Results

The number of observations for each year was diverse due to the data availability for WACC calculations (Table 4). The average level of WACC amounts between 6.09% to 8.13%. A higher level of cost was noticed for equity capital, and its value ranged from 7.15% to 9.77%. The debt cost due to tax shield and capital structure optimization was also two-times lower than the equity capital. A tax shield's role is expressed by the WACC tax rate that presents the company's effective tax rate. Its level was in the range of 20.45% to 22.94%.

A more significant differentiation of the surveyed companies' capital cost was noted due to the classification assigned in the TR of given companies to the industry within the energy sub-industry activity (9 groups) (Table 5). The analyzed groups differ significantly in the size of the sample. The lowest WACC level was noticed in oil and gas drilling companies and amounts to 4.90%, in which the equity cost valuation was on the level of 6.75%. According to the WACC parameter, this group could be assessed by investors as being the most attractive.

Table 4. WACC, WACC equity, and WACC debt in 2015–2019.

Years	Number of Companies	WACC (%)	WACC Equity (%)	WACC Debt (%)	WACC TAX Rate (%)
2015	190	6.82	7.37	3.14	22.94
2016	198	6.09	7.15	2.56	21.62
2017	203	6.17	7.51	2.25	21.65
2018	210	8.13	9.77	3.09	20.45
2019	214	7.36	8.73	2.85	21.35

The highest level of WACC occurred in the integrated oil and gas group of companies: 9.22%. The WACC calculation is highest for effective tax rate characterized by two groups: uranium (28.38%) and integrated oil and gas companies (24.49%). The lowest tax effective rate that reflects the possibility of tax optimization was noticed in the oil and gas drilling (19.30%) and oil and gas transportation services (19.59%) groups.

Table 5. WACC, WACC equity, and WACC debt in the industry overview classification.

Industries	Number of Companies	Number of Observation	WACC (%)	WACC Equity (%)	WACC Debt (%)	WACC TAX Rate (%)
Coal (A)	10	47	8.05	8.71	4.39	20.60
Integrated Oil and Gas (B)	15	74	9.22	10.87	4.02	24.49
Oil and Gas Drilling (C)	8	38	4.90	6.75	2.83	19.30
Oil and Gas Exploration and Production (D)	99	490	7.13	7.97	2.29	20.90
Oil and Gas Refining and Marketing (E)	27	135	5.70	7.28	2.37	22.89
Oil and Gas Transportation Services (F)	20	99	6.47	7.81	3.04	19.59
Oil-Related Services and Equipment (G)	44	220	6.85	8.53	3.37	22.16
Renewable Fuels (H)	5	28	5.86	5.94	1.46	23.71
Uranium (I)	3	15	5.85	6.92	1.56	28.38

Across the presented WACC calculation elements, the WACC debt and equity weight were diverse and strongly impacted the WACC level (Figure 1). On the other hand,

significant differences in the minimum and maximum values were recorded for the tax rates and the final results' WACC calculation.
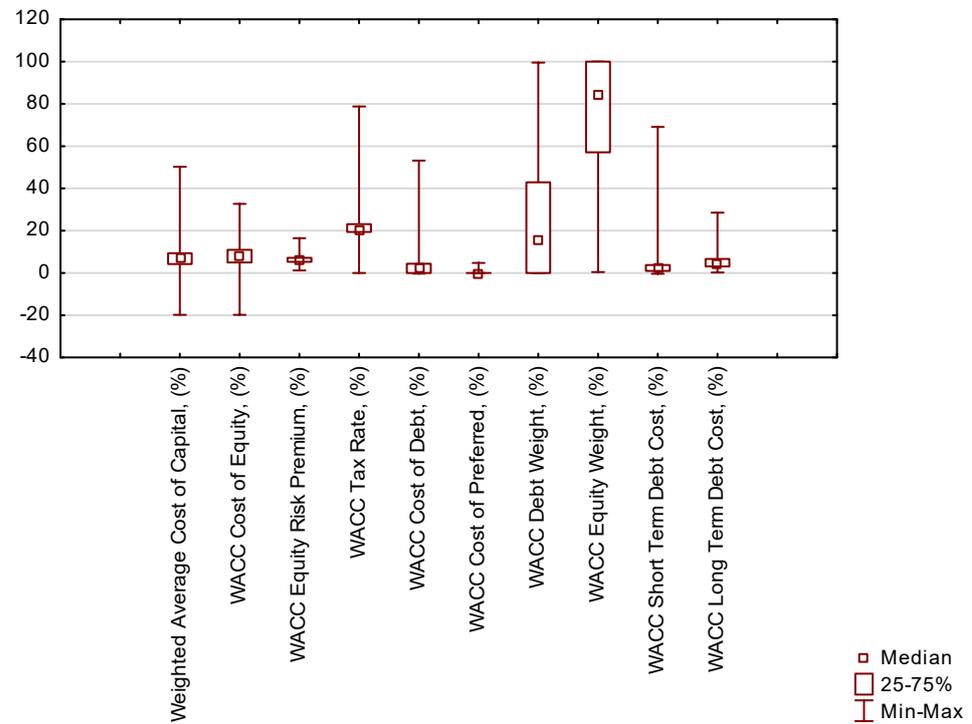

Figure 1. WACC component statistics in 2015–2019.

According to the group energy source classification, the WACC cost of capital noticed the most mixed results for group A, coal (Figure 2). The smallest volatility in the WACC level was characteristic of companies in the oil-related services and equipment group, where capital cost was also low.
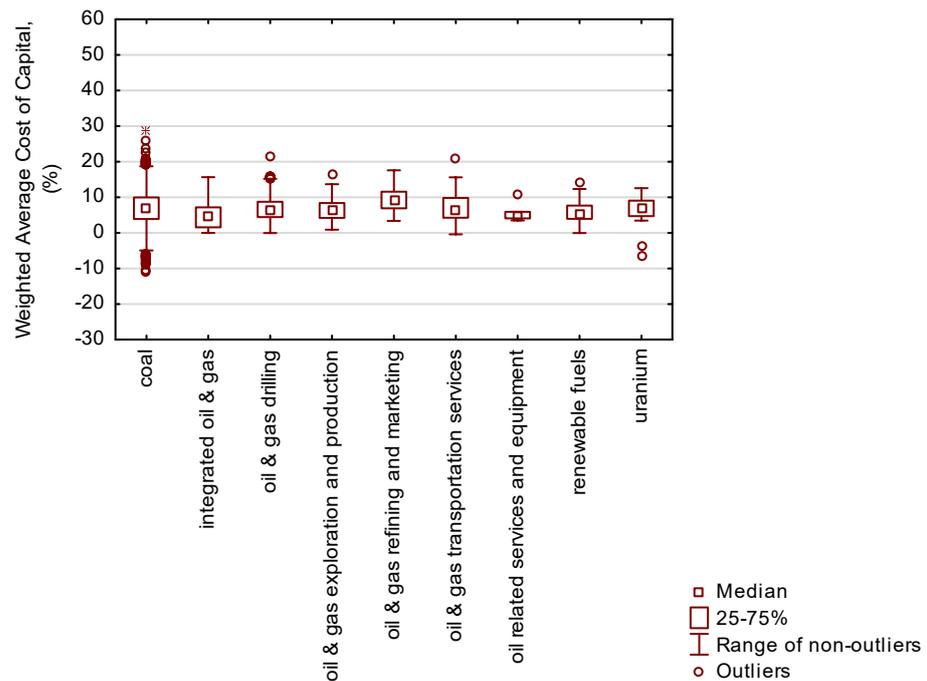

Figure 2. WACC component statistics according to intra-industry analysis.

In the next stage of the study, we excluded companies with a net loss for profitability statistics calculation (Table 6). Thus, these companies do not generate profitability. The presented results for ROE, ROA, and EBIT to sales demonstrate three levels of companies' profitability. The highest return of equity was noticed in 2015 and amounted to 36.24%, while in 2019, its value reaches the level of 11.96%. It shows high differentiation related to the return rate on equity and is associated with the high volatility of profitability in the enterprises' examined group. Lower volatility was recorded in return on assets, which, similar to ROE, also amounted to the lowest value in 2019—6.43%. However, the highest EBIT to sale relation appeared in 2016, when it amounted to 30.34%, which presents a relatively high level of operating results to reach revenues. It could be underlined that this part of the study includes only profitable companies that did not report any EBIT losses.

The average age of the company's settlement was in the investigated period between 26 and 29 years. It represents a relatively long period in which given entities operate in the energy sector, which may be the basis for assessing investors' credibility and stability. The Beta coefficient amounts between 0.88 in 2015 till 1.02. In recent years, the increased risk of doing business was noticed and underlined the investors' systematic risk measure. Regulated companies operating on the energy market reached a Beta value below 1. This means that investors assess investments in such enterprises as safer than other investments on a given capital market, which directly results in the expectation of a lower return rate on employed capital [96].

Table 6. Profitability, age, and Beta of investigated companies in 2015–2019.

Years	ROA	ROE	EBIT/Sales	Age	Beta
2015	9.20	36.24	16.54	26	0.8840
2016	6.32	12.96	30.34	27	0.9213
2017	7.96	16.69	22.72	27	0.8270
2018	8.07	21.80	20.67	28	0.9592
2019	6.43	11.96	19.71	29	1.0245

Table 7 shows the correlation dependencies of WACC in the selected groups of energy companies and parameters, indicating the market position. These variables include Beta ratio, the lower level of which is the domain of mature companies, total assets, and revenues that indicate the scale of operations and the market capitalization and age of the company calculated in years from the year of its establishment. The correlation analyses were made in a selected group of companies characterized by a higher number of observations during the investigated period. The Beta coefficient strongly impacts the WACC level in the whole group and notices a correlation relationship on the level of 0.77. This relation was even more strongly significant in the correlation analysis in selected groups in the oil and gas exploration and production group of companies (0.90) and in oil and gas refining and marketing (0.93). The total assets and revenues value do not impact so strongly on the WACC level, and this relationship was insignificant in the highlighted groups. The total assets and revenues correlation relationship was the highest in oil-related services and equipment group (0.32 and 0.33). This relation across the whole sample noticed a relatively low level of impact on WACC. It underlines that enterprises' size does not play a significant role in the valuation of listed companies' capital, resulting from the diversified scale of these companies' operations depending on a given capital commitment. A similar observation was recorded for market capitalization that noticed the highest level in the oil-related services and equipment group (0.30). In the case of the whole sample, it amounts to only 0.14. An interesting observation was noticed between company ages that across the entire sample shows a negative relationship between age and WACC, which means that the younger firm reached a higher WACC level. This indicates a more stable financial situation in the case of older companies.

Table 7. Summary statistics correlation matrix for WACC with group division and selected variables.

| Variables | WACC | | | | |
	In Total	Oil and Gas Exploration and Production (D)	Oil and Gas Refining and Marketing (E)	Oil and Gas Transporta- tion Services (F)	Oil-Related Services and Equipment (G)
Beta	0.771097 *	0.905104 *	0.934102 *	0.626490 *	0.630788 *
Total assets	0.137843 *	0.075142	0.553929 *	−0.183453	0.317630 *
Revenues	0.110416 *	0.048663	0.280272 *	−0.195659	0.331171 *
Market Cap	0.144349 *	0.076439	0.179405 *	−0.040364	0.302357 *

* values indicate significance at 5%.

Table 8 shows the correlation of individual WACC components with the horizontal WACC in the selected groups of enterprises with the highest number of observations in the analyzed period. As confirmed in the results of the descriptive statistics, the highest level of correlation was recorded in the case of WACC equity, which was on average 0.87. In entities from the oil and gas exploration and production group, it reached the level of 0.94. It shows the importance of assessing a given sector's market situation and the possibility of optimizing the WACC level. WACC cost of debt noticed a correlation relationship with WACC on the level of 0.13 for oil and gas exploration and production to 0.38 in oil-related services and equipment companies. A higher correlation relationship with WACC was noticed for short-term debt than for long-term debt costs resulting from smaller long-term engagement in the investigated sample. The highest statistical impact of the effective tax rate on WACC was noticed in oil and gas transportation services and amounted to −0.37. In the entire sample, this parameter reached the level of −0.11.

Table 8. Summary statistics correlation matrix for WACC with group division.

| WACC Components | WACC | | | | |
	In Total	Oil and Gas Exploration and Production (D)	Oil and Gas Refining and Marketing (E)	Oil and Gas Transporta- tion Services (F)	Oil-Related Services and Equipment (G)
WACC Cost of Equity	0.872811 *	0.945570 *	0.842252 *	0.810759 *	0.805891 *
WACC Cost of Debt	0.315035 *	0.135108 *	0.302357 *	0.276244 *	0.385300 *
WACC Cost of Short-Term Debt	0.314094 *	0.076126	0.289891 *	0.376047 *	0.353707 *
WACC Cost of Long-Term Debt	0.243280 *	0.079347	0.202684 *	0.255900 *	0.440429 *
WACC Tax Rate	−0.108775 *	−0.067218	−0.310043 *	−0.368650 *	−0.100062

* values indicate significance at 5%.

Table 9 presents an analysis of correlation against the specified financial data related to profitability in the selected groups of companies with the largest number of observations. ROA noticed a significant impact on WACC in the whole sample on the level of −0.1581, which expresses that higher return on assets impact lower WACC levels in energy companies. This relation was also significant in the oil and gas refining and marketing group (−0.2932). Both ROE and EBIT to sale noticed an insignificant relation to WACC level, which could be explained, but a small number of observations and more substantial impact of others not included in the study variables.

Table 9. Summary statistics correlation matrix for WACC and intra-industry activity division.

Variables	WACC				
	In Total	Oil and Gas Exploration and Production (D)	Oil and Gas Refining and Marketing (E)	Oil and Gas Transportation Services (F)	Oil-Related Services and Equipment (G)
ROA	−0.158125 *	−0.003251	−0.293192 *	−0.083323	−0.138026
ROE	−0.049386	−0.014109	−0.048931	−0.005672	0.135792
EBIT/Sale	0.044763	0.023897	0.410690 *	0.121619	−0.009494

* values indicate significance at 5%.

In order to investigate the diversity of WACC calculation, nonparametric variance was carried out among the most numerous groups of entities in the energy sector. Differences in WACC level between the investigated groups reflect changes in systematic risk [97]. Table 10 presents the summary statistics for the H Kruskal–Wallis test and post hoc test pairwise comparisons with group division and total WACC, WACC equity cost, WACC cost of debt, Beta, and tax rate. The ANOVA analysis results show a significant difference among all parameters, presenting its variation in total WACC, cost of equity, cost of debt, and tax rate. According to the intra-industry division, the level of WACC was significantly diversified in the case of companies from group D (oil and gas exploration and production) and E (oil and gas refining and marketing), which reflect the different stages of oil and gas production. These groups of companies also noticed significant mean rank differences in the case of WACC cost of equity. The level of WACC debt cost was varied significantly for mean rank in D (oil and gas exploration and production) and F (oil and gas transportation services), and D and G (oil-related services and equipment). That between D and G also noticed higher rank differences. All these energy sector activity groups underlined different characteristics of the conducted operation in this industry, impacting WACC variation to engage more debt in the capital structure.

Table 10. Summary statistics H Kruskal–Wallis test—post hoc tests pairwise comparisons with group division.

Variables	Groups	D	E	F	Chi²	H Test
WACC	E	3.322871 **			37.82999	H (8, N = 1015) = 4.92645
	F	1.209614	1.407283		df = 8	p = 0.0000
	G	0.648941	2.459835	0.666893	p = 0.0000	
WACC Cost of Equity	E	1.150129 **			31.96747	H (8, N = 991) = 39.98456
	F	0.340099	0.560647		df = 8	p = 0.0000
	G	1.529547	2.167629	1.349187	p = 0.0001	
WACC Cost of Debt	E	1.903574			49.28539	H (8, N = 1015) = 58.04512
	F	3.421469 **	1.490979		df = 8	p = 0.0000
	G	5.146366 **	2.193869	0.339302	p = 0.0000	
Beta	E	0.489634			13.43843	H (8, N = 1015) = 18.39052
	F	0.136731	0.472544		df = 8	p = 0.0185
	G	3.155637	2.815944	1.996653	p = 0.0976	
Tax rate	E	3.524048 **			69.19428	H (8, N = 1015) = 67.87653
	F	1.186811	3.571717 **		df = 8	p = 0.0000
	G	5.024795 *	0.663718	4.460214 **	p = 0.0000	

Notes: statistically significant at ** 0.05 and * at 0.10.

The Beta level was not significantly differentiated in a given group of companies. This indicates a similar relationship in terms of changes in quotations in the energy sector, impacting the WACC level. The highest difference in mean ranks (with the level of 0.05 significant) was noticed for tax rates between intra-industry company division. The rank differences were the highest between the G (oil-related services and equipment) and F groups (oil and gas transportation services) (4.4602). This reveals that tax rate implementation for WACC level tax optimization is varied and could impact company values

differently, which can also be one of the key measures used by market investor valuation. The difference in rank between group D (oil and gas exploration and production) and E (oil and gas refining and marketing) and between E and F (oil and gas transportation services) were on a similar level (accordingly 3.5240 and 3.5717).

7. Discussion

The energy sector as a regulated sector expresses the importance of WACC as it can be classified as a sector under numerous regulations. Investors require a return considering current market circumstances, irrespective of past conditions [53]. The WACC gives some insights into the utilities of the most suitable financing strategy [98]. Information on capital costs is related to assessing the company's financial management [99]. Implementing the process for reducing information asymmetry can lower capital costs [35–37,100]. Other researchers' biases of WACC level between the sub-energy sectors were also observed and underlined as different regular actions and risk reduction approaches to energy production [101].

The study's stated hypothesis assumed that the WACC of energy companies depends more on the size of a company, equity, total revenues, and settlement age. The defined size from the value of assets perspective and total revenues or market capitalization were not strong determinants of WACC level across energy companies'. This approach was also underlined by Lohani that value creation is not related directly to the company's size [102]. Market capitalization is determined by multiplying the number of outstanding shares and the current market price of one share and its relation with a size measure revealed by its sales or total assets value [40]. Market capitalization was impacted significantly by WACC level; however, this relation was not significant in the case of intra-industry analysis, and its fundamental role was relatively low. For younger firms, WACC is higher than in mature firms [103,104]. It is explained by the fact that new firms' future financial performance is more uncertain to investors. This relation also appeared in a conducted study in the case of the energy sector in Europe. The highest impact of companies position on the market regarding WACC level was noticed for total assets, which is one of the main factors impacting the capital structure [105]. Hypothesis H1 was only partially confirmed.

This study's second hypothesis expects that the factor determining the cost of equity most strongly is the Beta coefficient (H2). The main factor impacting the cost of equity in the energy sector was the Beta level. This coefficient was not significantly varied across an investigated sample of companies. It could create a higher risk from market efficiency due to different price anomalies in this industry. Thus, stock market uncertainty affects firms' financing costs. A high equity cost underlines the importance of information asymmetries on the energy market. However, the role of equity in the breakdown of aggregate risks leads to the prediction that firm dividends should vary depending on macroeconomic conditions after checking the effects of relevant variables at the firm level [106].

The third hypothesis assumed a negative relationship between the cost of capital level and companies' profitability (H3). This relation was confirmed only in the case of a few groups of companies. A negative association of profitability presents the company's return to support building a company's value in investors' decisions. The negative relationship of WACC and return on assets was confirmed by Shadab and Sattar [107]. Profitable companies finance their growth from retained earnings, while less profitable companies choose debt financing [108]. More risky investment is characterized by higher WACC, i.e., higher cost of equity and debt cost. From the investor's perspective, a higher capital cost means a higher return on their investment in the form of compensation. However, firms with higher WACC should have lower values. Thus, it has a negative effect on firm performance on the market. The highest financial results are achieved by companies that are able to maintain a low WACC level [109,110].

8. Conclusions

The cost of capital assessment methods are divided into subjective and capital market-based approaches. The expected rate of return influences the risk-adjusted cost. The data from the capital market reflects the risk assessment for all transaction participants [64]. The capital cost is generally defined as the investors' expected return rate (both owners and creditors) on the invested capital at the particular risk level [111]. Other perspectives define the cost of capital as a rate that investors use to discount a firm's future cash flows. Thus, the higher the capital cost, the lower the present value of the firm's future cash flows [112]. On the other hand, companies' capital cost is inferred from market prices with current earnings and growth forecasts [113]. Costs of capital are often considered the minimum yield or the minimum expected return rate that an investor would accept [114]. The return demand by investors determines a firm's cost of equity capital [36]. The cost of debt assesses future investments and the profitability of current operations.

The high level of WACC equity capital cost shows that the market factor impacts the WACC level on the energy sector, and companies do not fully influence that. It also pictured that increased the share of debt capital will determine the firms' higher market value. It can also be summarized that companies with a high cost of equity invest less [115] and do not have as much possibility to lower their WACC using debt increase engagement. The mechanism that minimizes the WACC companies and maximizes firms' value is limited in the case of the investigated firms. The WACC of a company will be lower with an increase in debt share till the higher cost of share and debt capital forces the average up [89]. A lower WACC is supported by reduced transaction cost and risk [116]. The debt level affects the risk of default concerning bankruptcy cost. However, debt financing is considered a more aggressive strategy that can generate higher profits [44].

Companies that maximize debt share can decrease the WACC level due to the tax shield effect [117]. The tax shield affects the choice of financing sources [47], and this approach is adopted in WACC valuation methods [118]. The highest WACC tax rate was noticed in a small group of companies for which their operating activities are related to uranium. The second group was renewable fuels companies that are able to use different tax optimization tools. It thus underlines that WACC analysis compares the risks associated with the other technologies in the energy sector [32]. The WACC analysis is more relevant for financially "distressed" companies due to the significant differences between the value of the funding sources recorded in the balance sheet and their real market price [74].

This study was designed to capture the cross-country energy sector cost of capital identification, which presents the manager's attitude towards building the capital structure and, from the other side, investor perspectives of company status assessment. This study's results contribute to the information asymmetry theory related to the higher cost of equity capital due to risk premiums on the energy market that express the political, regulation, and raw trends on the global market.

The authors are aware of the WACC methodological disadvantages. The WACC's determination of industry calculation does not include all possible risks associated with a particular company or investment. A market risk premium is retained by the WACC methodology; however, no technical or techno-economic risk is directly added [119]. According to the CAPM method, the cost of equity limits the risk factor to market beta [38]; it also does not consider the international spread and equity price [120]. Nevertheless, this measure, due to popular methods, is a comparable measure for the listed companies. The study's future direction will concern the comparison of the energy sector with other industrial sectors and will include the macroeconomic factor that impacts the WACC level.

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Appendix A

The research sample constitutes 231 companies in a 4-year study period (2016–2019) for 25 countries (country of exchange): Austria (4), Belgium (3), Bulgaria (1), Croatia (2), Cyprus (2), Denmark (3), Finland (1), France (10), Germany (7), Greece (4), Hungary (1), the Republic of Ireland (2), Italy (6), Lithuania (1), Malta (1), the Netherlands (4), Norway (39), Poland (8), Portugal (1), the Republic of Serbia (1), Romania (13), Russia (23), Spain (2), Sweden (9), Ukraine (2) and the United Kingdom (82).

The investigated companies are listed on 41 European capital markets: Ab Nasdaq Vilnius, Aim Italia—Mercato Alternativo Del Capitale, Asx—All Markets, Athens Exchange S.A. Cash Market, Belgrade Stock Exchange, Bolsa De Madrid, Budapest Stock Exchange, Bulgarian Stock Exchange, Cyprus Stock Exchange, Deutsche Boerse Ag, Euronext—Euronext Amsterdam, Euronext—Euronext Brussels, Euronext—Euronext Paris, Euronext Access Paris, Euronext Growth Paris, First North Sweden—Sme Growth Market, Hanseatische Wertpapierboerse Hamburg, Irish Stock Exchange—All Markets, London Stock Exchange, Malta Stock Exchange, Moscow Exchange—All Markets, Nasdaq Copenhagen A/S, Nasdaq Helsinki Ltd, Nasdaq Stockholm AB, Nordic Growth Market, Norwegian Over The Counter Market, Operador De Mercado Iberico de Energia—Portugal, Oslo Axess, Oslo Bors Asa, Pfts Stock Exchange, Spot Regulated Market—BVB, Spotlight Stock Market, Warsaw Stock Exchange/Equities/New Connect—Mtf, Warsaw Stock Exchange/Equities/Main Market, Wiener Boerse Ag Amtlicher Handel (Official Market), and Xetra And Zagreb Stock Exchange.

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