Price changing factors in the European natural gas market and how does it affect the renewable energy market

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1 Introduction

Interpretation of topic

In all over Europe there was an increasing tendency in the natural gas prices in the past months as results of several events like the Covid-19 pandemic, which caused less investment and less maintenance in the gas fields, moreover countries returned to their full economic capacity which resulted in a higher demand for natural gas. These existing problems were further aggravated by the Russian-Ukrainian war and in accordance with it the fact that the Russian Gazprom decided to keep the Nord Stream pipelines shut down while in the 2019 – 2020 period Russia imported more than 40% of the natural gas to the EU market. (Euronews, 2022)
These are only some of the factors that caused sudden changes in the last few years in the gas prices, but there are other issues and factors as well that have been around for a longer time period and together with the above-mentioned recent events they caused an energy-crisis, that might lead to changes in consumer behavior after more than doubled gas prices in Denmark for example but similar changes happened in all over Europe. (Energistyrelsen, 2022) (Eurostat)

1.1 Problem statement

The prices of the European gas market are heavily affected by cycles, seasons, alternative energy prices, as well as by political and environmental factors, these changes in prices on the gas market can very negatively affect the consumers. These reasons might cause a change in the demand soon and make renewable energy even more popular.

1.2 Questions

Research question: What are the main factors in price changes in the European gas market and how can these factors increase the demand for renewable energy?
I aim to answer the research question by using peer-reviewed articles, books and statistical data to recognize price changes during different periods that are connected to the changing factors.

Working question I: How are the pricing mechanisms and the price changing factors are related?

To understand the main factors in the price changes of a product in a certain market, we have to understand the mechanisms behind the pricing strategies and prices in general and the possible connections between the mechanisms and the influencing factors.

Working question II: What is the current position of renewable energy in the European Union and what are the prospects?
By answering this question, I wish to find what percentage of the region's energy needs are covered by renewable energy and if there are any development plans by the EU to increase the renewable energy shares.

1.3 Limitations and delimitations

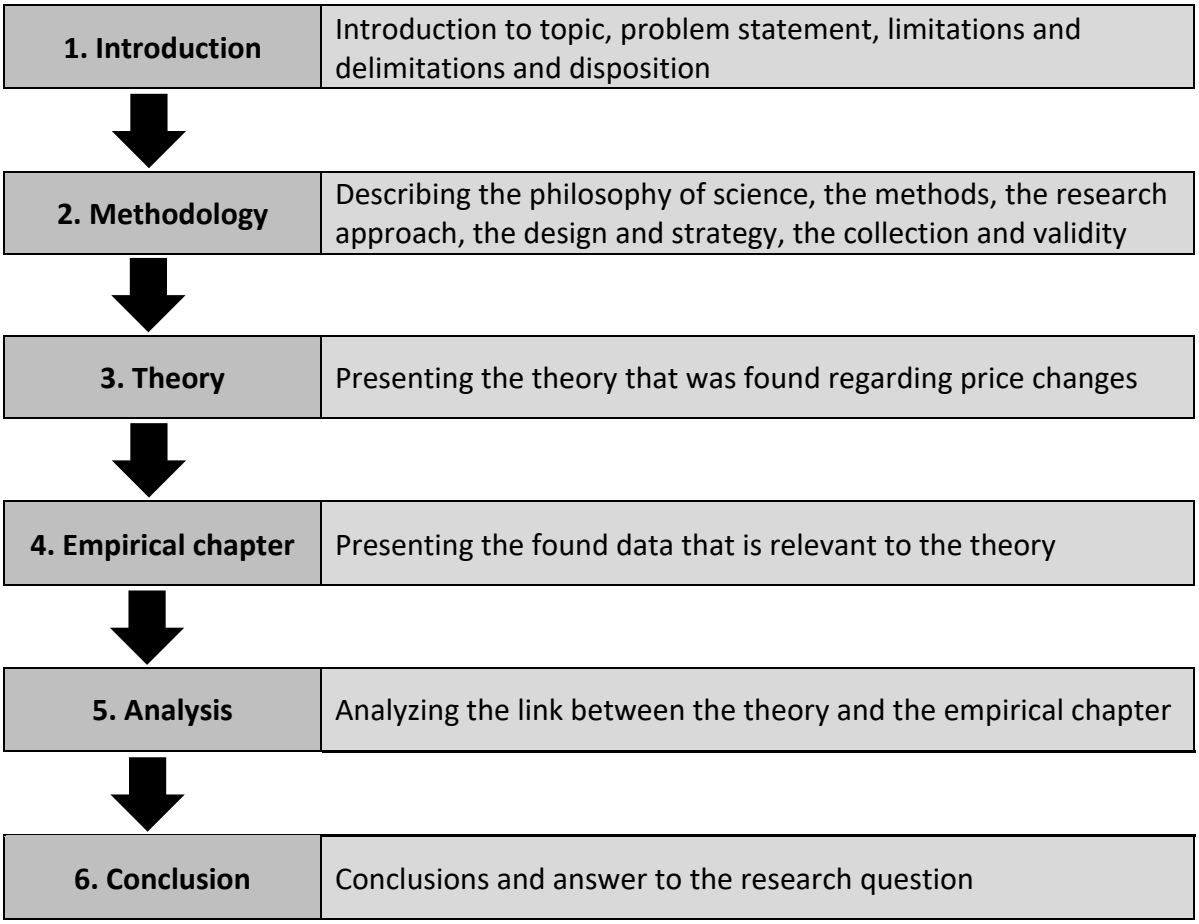
1.3.1 Limitations

One of the limitations I had while writing this report is the amount of time I had, as I was supposed to research, write and finalize this report in three months.
Another limitation was the length of the report: the maximum number of characters the report was allowed to be is 43,200 including blanks.
The third limitation was that I completely relied on articles, books and data that were written or were acquired for slightly or completely different research purposes and questions as I was only supposed to use secondary data.

1.3.2 Delimitations

Although originally my plan was to write in a Danish concept, I had widened the regional scope of my report. For that one of the reasons was the fact that there was not enough available data in English language, but the more interesting and important reason was that it is such a sprawling topic that it cannot be studied in such a narrowed environment, therefore I decided to write in the European concept.
Another delimitation was that since the limitation of space, I had to narrow down the observed price changing factors, where I eventually choose three factors out of many that could have been studied, the choice was based purely on personal preferences, as I found these influences interesting in today's concept.

1.4 Disposition



2 Methodology

2.1 Philosophy of science

In the ontology and epistemology parts of a study we set up the philosophical assumption we chose to conduct our research. Ontology studies the question of how we interpret the world and its rules (Mik-Meyer and Justesen, 2012), while epistemology is how we can gain knowledge through our interpretation of the world (Ibid.).

The philosophy that describes the ontology along with the epistemology of my research is realism. The realistic approach states that there is one reality only and as the researcher of this study, I do not have any effect on the reality, it is objective and independent. (Ibid.)

2.2 Methods

2.2.1 Research approach

To make this report, I followed an inductive approach for the research and writing process: I was collecting data from different peer-reviewed sources and statistical data, and concluded a theory based on my findings. (Saunders et al., 2007)

2.2.2 Design and strategy

Qualitative research design was the original approach along which I concluded my report and the strategy I used is grounded theory as I developed a theory of the findings from several sources that involved a long process of data collection. (Creswell, 2009) However, the found data in the epistemology chapter is almost purely quantitative, as I was working with prices, but I still consider this report as a qualitative paper, as I was using inductive approach in reasoning at the analysis.

2.2.3 Collection method

The main form of the data I used is peer-reviewed article, books and statistical data. To find these I used the university's library, online research databases and statistical collections, while I trusted the university library collection of containing high-quality literature, when using the online databases, I looked up whether the article is coming from a well-known and trusted publisher, like Oxford Institute for Energy Studies or it has a DOI number.

2.2.4 Validity and reliability

I believe that the report is valid, as it studies what it promises to study, and a theory could be concluded on the results. And I also believe it is reliable as I was making conclusions based on analysis results for which I used several countries' data that discovered a whole region and gave a reliable overview of it.

3 Theory

3.1 Natural gas pricing mechanisms

To understand the price changes of natural gas that consumers are experiencing, it is crucial to understand the pricing mechanisms that are being used in the market by suppliers and traders, in its fundamentals it is the same in Europe.

In the late 1950s when the Groningen gas field was found (Whaley, 2009) the main competing fuel was oil, therefore oil indexation was set up as the pricing mechanism based on what consumers had to pay to suppliers and this led to the development of oil linked gas contracts, so the sellers could guarantee that the price of gas stays under the competing fuels in case of a growing market share. Besides that, oil has been considered as a liquid commodity for a long period by the time when in the 1960s the netback market pricing has been developed (Honoré, 2010). The netback pricing can be described as "*the price for the gas producers is derived from the end user prices for the cheapest alternative fuel*" (Siliverstovs at al., 2003).

The oil derived gas prices had three big advantage: the production companies acknowledged and approved the oil-price change related risks in the gas prices; based on oil-related revenues banks were more likely to give loan and most importantly oil-indexation worked as a preventive mechanism against the suppliers in Europe to have the chance to affect the price of gas, since "*the size and liquidity of these markets meant that they could not be manipulated by any single player or group of players, however large, and certainly not by gas exporters or importers*"(Stern, 2007). Another argument for the oil-linked gas prices is that the oil-indexation was made to increase the gas production compared to the oil production because gas is "*an unwanted complication during oil production*" (Honoré, 2010, pg. 51).

The base for the general pricing formula in case of long-term contracts is constructed with the base price and the index, which can be a plus or minus - in this case - oil-related development price. (Honoré, 2010)

In 2004 still 44.8% of long-term gas contracts' price were indexed to light fuel oil and gas oil in Europe excluding the UK, while 29.5% to heavy fuel oil, 9.8% to gas prices and the rest is to other alternative energy prices or to inflation and only 4.4% of the contracts were fixed priced. (Ibid.)

Oil-indexation was still popular in 2008 because "*customers could still hedge their oil price risks*" (Honoré, 2010, pg. 55), while power was a liberalized market and for power producers' possible investments oil-related gas prices meant a threat. (Ibid.)

After 2009 the long-term oil-derived gas pricing became unnecessary, as it was originally made because of the lack of liquid gas market, but by the time gas became a liquid market as well and also the competing oil products' range has narrowed down. (Ibid.)

By the early 2010s LNG (liquified natural gas) became a major competitor to natural gas and with this competition the long-term oil-indexed gas contracts were less and less likely to be sold as the price was double compared to spot prices. (Ibid.)

Taking into consideration the possible demand growth for gas, the high oil-linked gas prices were considered as a risk, peculiarly in case of the driver is the electricity sector. Honoré's prediction in 2010 for the transition was that the oil-based pricing would be moving towards the spot pricing following the UK's example as it based its prices to NBP and thanks to the physical connections between the British, Dutch, Belgian and German hubs, there could be a common North-Western European gas index for the gas traded on the NBP, TTF, Zeebrugge and NCG hubs and the mostly NBP delivered gas could serve as safety environment for other delivery points for further development without being controlled by major actors on the market. (Ibid.)

3.2 Price changing factors

After taking into consideration the pricing fundamentals, the actual factors can be studied that are affecting the prices. I am going to examine three factors that are holding a strong power over the gas prices, however there are several other factors that have similar power.

3.2.1 Availability of natural reserves – theory

The first factor that is affecting the gas prices is the availability of natural reserves: "*these can be in the form of conventional non-associated gas, associated gas in oil fields, and even unconventional gas. Europe held less than 4 percent of the world's natural gas proven reserves in 2007*" (Honoré, 2010, pg. 118). Around 70% percent of the gas reserves in Europe could be found in the Netherlands (Groningen gas field) and in Norway (Troll gas field) (Honoré, 2010).

In terms of reserves Europe is “mature” region, as it has been geologically well-explored for new gas fields and there are only a fewer number of findings since previously mentioned large-sized fields. (Cornot-Gandolphe, 1995).

Natural gas is extremely expensive to transport compared to other fossil fuels’ transportation costs: “*Roland Williams of Shell, […] calculated that 'for the cost of shipping a barrel of oil round the world, a similar quantity of gas would not even be halfway through the pipeline from Norway to the beaches of Germany'.*” (Prior, 1994, pg. 449) Furthermore, the transportation is limited to pipelines or transporting in LNG form on sea that has to arrive regasification terminals – which are rare. The immensely expensive and highly complicated transportation of natural gas together makes the natural reserves located in Europe extremely important. (Prior, 1994) “*It is easy enough to show that gas reserves well in excess of anything needed in Europe can be found in locations which lie within the range of existing supply methods*.” (Prior, 1994, pg. 449).

3.2.2 Geopolitical factors – theory

The second price changing factor is that how geopolitics can influence the gas supply and in this case what kind of impact have the Russian – Ukrainian war on the supply – in other terms: on the availability of gas in Europe. Historically Russia was one of the most significant natural gas suppliers to Europe and the distribution infrastructure was built in a way that it was expecting a large flow from Russia, however the amount of gas arriving from Russia is decreasing since the last two quarters of 2021 and in July 2022 it was only 40% of the total amount that was flowing a year before. Alternatives, such as importing from other countries or importing higher volume of LNG or changing the fuel used for generating power are not enough to replace the missing volume that used to arrive from Russia. (Di Bella et al, 2022)

Moreover, there availability of natural gas is questionable globally and “*transmission constraints limit the ability to transport gas from alternative sources across some regional distribution systems and even within some countries, leaving several countries in Central and Eastern Europe, including Germany, and Italy, which are heavily reliant on Russian gas, particularly vulnerable*”. (Di Bella et al., 2022, pg. 6) In case of the July 2022 level flow from Russia stays throughout the winter season or even decreases, then it could easily cause “*costly regional shortages, very high prices, and rationing in some countries*”. (Ibid.) (Di Bella et al., 2022)

3.2.3 Electricity prices – theory

The third factor that is influencing the gas prices are the alternative energy prices and, in this report, I chose to focus on electricity – which can be both renewable and non-renewable energy, as the production can rely on non-renewable fuels such as gas or oil and it can also rely on renewable sources like wind or geothermal energy. (OECD, 2022)

The prices of electricity and natural gas are inseparable, and they are highly influencing each other because of two main reasons: firstly, as mentioned above, the fuel used for non-renewable energy production among others can be natural gas, and secondly, because they are substitutes to each other when it comes to heating, this comes with the assumption their prices are influencing each other. In case of there would be a growth in demand for natural gas, that would mean an increase in the prices of natural gas, which would also suggest higher prices for electricity power plants that are running on natural gas and this increased price would be discoverable in the electricity prices as well. Furthermore, an increased demand in electricity would lead to a growth in the price of electricity, which would "*widen the profit margin (spark-spread) of natural-gas-fired electricity generators. This higher margin will stimulate the natural gas demand from electric power consumers, triggering an increment of natural gas prices*". (Uribe et al., 2018, pg. 1) (Uribe et al., 2018)

Nonetheless, even though the impact one has on the other is clear, the actual price changes are depending on the electricity generation sources, which can be very diverse and can greatly rely on renewable sources as well. It is also important to note that both natural gas and electricity are heavily affected by seasons as they are both used for heating for example. (Uribe et al., 2018)

3.2.4 Changes regarding renewable energy – theory

The European Union is quite dependent on energy from imported sources: among other fossil fuels, 69% of natural gas came from imports to the EU in 2015, which together with the imported gas and coal meant a 79% dependency on fossil fuels. To lower the usage of fossil fuels and to decrease its greenhouse gas emissions the EU aims to include 20% renewables in the used energy sources by 2020. The EU in 2011 created a "Low-Carbon Roadmap" that set "milestones" for how many percentages of the domestic emission should be compared to the 1990 level in each decade up until 2050, when the emission shouldn't be more than 20% of the mentioned level. The "*combination of carbon and electricity markets becomes the driver for the energy*

transition in the power generation sector. The auction prices of recent renewable energy tenders […] suggest that this transition is achievable". (Delbeke and Vis, 2019, pg. 125-126) (Delbeke and Vis, 2019)

4 Empirical chapter

For this chapter I decided to research and present statistical data that is relevant to the price changing factors I choose to study, so with the combination of the findings in the theory chapter and the data showed in the empirical chapter, I can analyze and hopefully discover actual prices changes that happened in accordance with the studied factors over time.

4.1 Availability of natural reserves – data

The International Energy Agency's Natural Gas Information report from 2008 has a very extensive table that shows the natural gas reserves in the world and what is relevant to our report is the part of the European OECD countries. It compared the state of the proven reserves in 1990, 2006 and 2007 in the mentioned countries and – except in Austria, Norway, the Slovak Republic and the United Kingdom – there is a clearly visible decrease in the amount of the remaining natural reserves. The total amount also shows that in the OECD countries in Europe there was a decline going on. (IEA, 2008)

Natural gas reserves in OECD Europe 1990, 2006, 2007 (in billion cubic meters)				
	End 1990	End 2006	End 2007	% World total 2007
Austria	18	20	20	0.01
Czech Republic	4	3	3	..
Denmark	167	120	116	0.06
France	35	7	7	..
Germany	244	155	137	0.08
Greece	9	1	1	..
Hungary	114	20	22	0.01
Ireland	46	24	24	0.01
Italy	350	94	89	0.05
Netherlands	1950	1316	1248	0.70
Norway	2353	3022	2961	1.66
Poland	126	103	102	0.06
Slovak Republic	9	14	13	..
Spain	20	..	..	..
Turkey	28	8	9	..
United Kingdom	540	684	646	0.36

Total OECD Europe	6013	5591	5398	3.02

(IEA, 2008, pg. 50 in part II)

I decided to compare natural gas prices in Germany, the Netherlands and Italy for 1990, 2006 and 2007 – as these countries all had relatively large natural reserves, all had a decline in their proven reserves, and all had available data for the selected criteria – to be able to make a comparison between the state of the natural reserves and the current actual prices for the relevant years. All prices shown in the below tables are excluding taxes and are for industry customers. The prices for 1990 are shown in European currency unit (ECU) and for 2006 and 2007 is euro. There are seven different price categories based on the used quantity – I1, I2, I3-1, I3-2, I4-1, I4-2, I5 – and I decided to represent the prices in three: the lowest (I1), the median (I3-2) and the highest (I5) consumed volume groups. (European Communities, 2003) (Eurostat)

Natural gas prices in 1990, 2006 and 2007 in the Netherlands for industry costumers I1 (418,6 GJ) (excluding taxes, in ECU/Euro)				
	1990	2006-S1	2006-S2	2007-S1
Germany	5.75	11.39	11.81	13.07
Netherlands	4.97	9.78	9.93	10.98
Italy (Rome)	8.25	8.33	9.30	10.01

(European Communities, 2003) (Eurostat)

Natural gas prices in 1990, 2006 and 2007 in the Netherlands for industry costumers I3-2 (41 860 GJ: 250 days) (excluding taxes, in ECU/Euro)				
	1990	2006-S1	2006-S2	2007-S1
Germany	4.31	9.92	10.50	11.58
Netherlands	3.32	6.37	6.73	6.64
Italy (Rome)	3.29	7.04	8.01	8.45

(European Communities, 2003) (Eurostat)

Natural gas prices in 1990, 2006 and 2007 in the Netherlands for industry costumers I5 (4 186 000 GJ: 330 days) (excluding taxes, in ECU/Euro)				
	1990	2006-S1	2006-S2	2007-S1
Germany	3.17	4.58	4.86	4.39
Netherlands	2.45	5.09	5.73	5.77
Italy (Rome)	2.70	6.09	7.07	7.17

(European Communities, 2003) (Eurostat)

4.2 Geopolitical factors – data

To see the effects of the geopolitical events, in this case, the Russian-Ukrainian war, I decided to gather prices from the 2019-S1 – 2022-S1 period of the following countries: Denmark, Germany, France, Italy, Lithuania, Hungary, Netherlands, Poland and Sweden to have a geographical coverage for Europe.

Natural gas prices 2019-2022 for non-household consumers for I3 consumption group (between 10 000 GJ – 100 000 GJ) (excluding taxes, in Euro)							
	2019-S1	2019-S2	2020-S1	2020-S2	2021-S1	2021-S2	2022-S1
Denmark	0.0243	0.0207	0.0168	0.0199	0.0250	0.0702	0.0972
Germany	0.0278	0.0253	0.0245	0.0244	0.0238	0.0297	0.0445
France	0.0306	0.0298	0.0268	0.0280	0.0271	0.0432	0.0541
Italy	0.0298	0.0264	0.0261	0.0228	0.0227	0.0374	0.0707
Lithuania	0.0281	0.0224	0.0185	0.0184	0.0260	0.0689	0.1043
Hungary	0.0272	0.0255	0.0248	0.0205	0.0208	0.0441	0.0558
Netherlands	0.0223	0.0213	0.0192	0.0192	0.0207	0.0364	0.0538
Poland	0.0337	0.0327	0.0288	0.0282	0.0271	0.0402	0.0740
Sweden	0.0315	0.0276	0.0311	0.0273	0.0447	0.0793	0.1145

(Eurostat)

4.3 Electricity prices – data

In connection with the price changing effects of alternative energy prices, it is inevitable to study the prices of these alternative sources of energy. I choose to present the prices of the "ID" consumption group, that requires that the consumption of the non-household customer has to be between 2000 MWh and 20000 MWh, to make the volumes comparable with the natural gas volumes (10 000 GJ – 100 000 GJ), as 1 MWh = 3.6 GJ, so in GJ measurement it would be between 7200 and 72 000, so there is a relatively big overlap between the two, making an acceptable base for the comparison. (Eurostat)

Electricity prices 2019-2022 for non-household consumers for IC consumption group (between 2000 MWh – 20 000 MWh) (excluding taxes, in Euro)							
	2019-S1	2019-S2	2020-S1	2020-S2	2021-S1	2021-S2	2022-S1
Denmark	0.0626	0.0606	0.0560	0.0633	0.0715	0.1165	0.1521
Germany	0.0717	0.0623	0.0706	0.0731	0.0734	0.0897	0.1440
France	0.0689	0.0640	0.0706	0.0667	0.0729	0.0745	0.1207
Italy	0.0903	0.0886	0.0808	0.0841	0.0876	0.1281	0.2232
Lithuania	0.0753	0.0753	0.0732	0.0745	0.0808	0.1162	0.1403
Hungary	0.0795	0.0771	0.0762	0.0781	0.0751	0.0977	0.1705
Netherlands	0.0643	0.0643	0.0627	0.0644	0.0687	0.0912	0.1383
Poland	0.0720	0.0570	0.0714	0.0691	0.0627	0.0601	0.0921
Sweden	0.0625	0.0557	0.0558	0.0537	0.0599	0.0878	0.0972

(Eurostat)

4.4 Changes regarding renewable energy – data

In the below table the renewable energy share can be seen through six years, from 2014 to 2020 in the European Union member countries that are studied in the previous sections as well. It is important to study regarding the future of renewable energy and its effects on natural gas.

Energy share from renewable sources in %							
	2014	2015	2016	2017	2018	2019	2020
Denmark	29.310	30.469	31.715	34.387	35.160	37.020	31.681
Germany	14.385	14.906	14.889	15.476	16.660	17.266	19.312
France	14.365	14.803	15.451	15.847	16.384	17.174	19.109
Italy	17.082	17.526	17.415	18.267	17.796	18.181	20.359
Lithuania	23.592	25.748	25.613	26.038	24.695	25.475	26.773
Hungary	14.618	14.495	14.377	13.556	14.549	12.634	13.850
Netherlands	5.415	5.714	5.846	6.507	7.394	8.886	13.000
Poland	11.605	11.881	11.396	11.059	14.936	15.377	16.102
Sweden	51.151	52.220	52.597	53.390	53.916	55.785	60.124

(Eurostat)

5 Analysis

In this chapter I am going to link the theory findings and the relevant data from the empirical chapter, by that making it possible to see whether the effects described at the theory are observable in the data over the years. I am hoping that this will give me the results that will help me answer the research question along with the working questions.

5.1 The effect of natural reserves

First, I am going to analyze the connection between the availability of natural reserves and the price changes through the example of three different European countries in three different years. It is important to note, that even though in this section I am studying one price changing factor, the observed time frame is almost 20 years long, therefore other factors might have occurred as well, such as inflation, that might also have an effect on the prices, so to make a conclusion for the connection, I assume that the only price changing aspect was the changing availability of natural reserves.

I decided to examine the amounts and prices in the Netherlands, as it has one of the highest volume reserves in OECD Europe and besides that Germany and Italy, as these also have relatively significant volumes among the OECD Europe countries and also relevant data was available for these countries. In Germany in 1990 the available amount of natural gas reserve was 244 billion cubic meters (bcm), while is has dropped to 155 bcm by 2006 and then even lowered to 137 bcm by 2007. The price of natural gas for industrial consumers in the lowest consumption group in Germany was 5.57 ECU/GJ in 1990, while this has increased to 11.39 EUR/GJ by the first half of 2006, then 11.81 to the second half of 2006 and it reached 13.07 EUR/GJ by the first half of 2007. The price in the median consumption volume group in 1990 was 4.31 ECU/GJ, in 2006-S1 it was 9.92 EUR/GJ, in 2016-S2 it was 10.50 EUR/GJ and in 2007-S1 it was 11.58 EUR/GJ, while the price of natural gas in the highest consumption volume group in 1990 was 3.17 ECU/GJ, in 2006-S1 it was 4.58 EUR/GJ, in 2006-S2 it was 4.86 EUR/GJ and in 2007-S1 it actually lowered to 4.39 EUR/GJ. (European Communities, 2003) (Eurostat)

In the Netherlands the available gas reserve in 1990 was 1950 bcm, by the end of 2006 it lowered to 1316 bcm and by the next year, it further decreased to 1248 bcm. In connection to these declines in the reserves, the price in 1990 for the I3 customers was 4.97 ECU/GJ, in 2006-S1 it was 9.78 EUR/GJ, in 2006-S2 it was 9.93 EUR/GJ and it 2007-S1 it was 10.98 EUR/GJ. For the I3-2 group the gas price in 1990 was 3.32 ECU/GJ, in 2006-S1 6.37 EUR/GJ, in 2006-S2 6.73 EUR/GJ and in 2007-S1 6.64 EUR/GJ. For the I5 customer group the price of natural gas in 1990 was 2.45 ECU/GJ, in 2006-S1 5.09 EUR/GJ, in 2006-S2 5.73 EUR/GJ and in 2007-S1 5.77 EUR/GJ. (European Communities, 2003) (Eurostat)

In Italy in 1990 the available gas in natural reserves was 350 bcm, but by 2006 it dropped to 94 bcm and it further lowered to 89 bcm by 2007. The gas price changed the following way for the I1 customers: in 1990 it was 8.25 ECU/GJ, in 2006-S1 8.33 EUR/GJ, in 2006-S2 9.30 EUR/GJ and in 2007-S1 10.01 EUR/GJ. For the I3-2 customer group the gas price in 1990 was 3.29 ECU/GJ, in 2006-S1 7.04 EUR/GJ, in 2006-S2 8.01 EUR/GJ and in 2007-S1 8.45 EUR/GJ, while for the I5 customers in 1990 it was 2.70 ECU/GJ, in 2006-S1 6.09 EUR/GJ, in 2006-S2 7.07 EUR/GJ and in 2007-S1 7.17 EUR/GJ.

After closely examining all the above cases, it is evident – with two exceptions – that there is a close relation between the decreasing amount of natural gas in natural reserves and the increase in prices. One of the two exceptions was the Netherlands in the I3-2 consumer group, where the price was lower in the first half of 2007, than in the second half of 2006. The other exception is Germany's I5 consumer category, where the price in the first half of 2007 did not decrease only compared to the

second half of 2006 but was also lower than in the first half of 2006. (European Communities, 2003) (Eurostat)

Based on the found data and the theory it can be concluded that natural gas prices are affected the by the availability of natural reserves, as the transportation cost of it – compared to the transportation cost of other fuels, like oil – is extremely expensive, therefore it is a great advantage for a region if it has its own natural reserve and does not heavily rely on imports – simply because the 'local' gas is cheaper because no long-distance transportation is required in any form. (Prior, 1994) However declining amounts left in reserves due to continuous production and high consumption means that the remaining natural gas is becoming more valuable, therefore its price is increasing.

5.2 The effect of geopolitical factors

Secondly, I am going to study the natural gas price changes in several European countries, to have a general overview of the effects of the Russian-Ukrainian war. In order to be able to evaluate the economic effects of such a geopolitical event, it is inevitable present the prices already before and through the incident. It is important to note in this case as well, that other events could have – and have – happened, such as the Covid-19 pandemic that had an impact on the investments and the maintenance of the gas fields (Euronews, 2022) – and by these also on the prices – but the focus of this section is the above-mentioned geopolitical incident.

I decided to examine the prices of natural gas in nine (EU) countries in Europe – Denmark, Germany, France, Italy, Lithuania, Hungary, the Netherlands, Poland and Sweden – to have the best possible overview of the changes that happened in the region. In this section all the studied prices are for non-household customers that are consuming between 10 000 GJ and 100 000 GJ natural gas and the studied time period is from the beginning of 2019, until the first half of 2022, as that is the newest available data.

In Denmark the price of natural gas in 2019-S1 was 0.0243 EUR/GJ, it had even show decreases until the beginning of 2021, however by 2021-S2 it significantly increased to 0.0702 EUR/GJ and it further rose to 0.0972 EUR/GJ by the first half of 2022. In Germany the price was under 0.03 EUR/GJ between 2019-S1 and 2021-S2, however it almost doubled to 0.0445 EUR/GJ in 2022. The natural gas prices in France did not show a radical change: in 2019-S1 it was 0.0306 EUR/GJ, which lowered to 0.0271 EUR/GJ by 2021-S1, but it started to rise again in the second half of 2021, as it almost doubled to 0.432 and then increased even more to 0.0541 EUR/GJ by 2022-S1. Italy had minor

decreases in its gas price through 2019, 2020 and even in the first half of 2021, when it was 0.0227 EUR/GJ, but then the price increased to 0.0374 EUR/GJ by 2021-S2 and in 2022-S1 it even reached 0.0707 EUR/GJ, which is a significant growth. Lithuania showed similarities with Italy, as it had decreasing prices from the beginning of 2019, until the end of 2020, when it was 0.0184 EUR/GJ, then there was a slight rise in in the first half of 2021 to 0.0260 EUR/GJ, then there was a sudden increase by 2021-S2, when the price more than doubled to 0.0689 EUR/GJ, then there was another significant rise to 0.1043 EUR/GJ by the first half of 2022. In Hungary the prices were relatively steady from the beginning of 2019, when it was 0.0272 EUR/GJ until the middle of 2021, when it was 0.0208 EUR/GJ, but in the second half of 2021 the price doubled to 0.0441 EUR/GJ and continued to rise in the first half of 2022 up to 0.0558 EUR/GJ. In the Netherlands the prices changed very similarly to the Lithuanian gas prices, it started in 2019-S1 at 0.0223 EUR/GJ and by 2020-S2 it dropped to 0.0192 EUR/GJ, but in 2021-S1 it rose to 0.0207 EUR/GJ which increased to 0.0364 EUR/GJ in 2021-S2 and then reached 0.0538 EUR/GJ in 2022-S1. Poland also showed a decreasing tendency in its prices from 2019-S1 when the natural gas price was 0.0337 EUR/GJ, until 2021-S1, when it dropped to 0.0271 EUR/GJ. But in 2021-S2 it rose to 0.0402 EUR/GJ and in the first half of 2022 it further increased to 0.740 EUR/GJ. And finally, in Sweden the gas price was between the beginning of 2019 and the end of 2020 showed slight changes: 0.0315 EUR/GJ in 2019-S1, 0.0276 EUR/GJ in 2019-S2, 0.0311 EUR/GJ in 2020-S1, 0.0273 EUR/GJ in 2020-S2, but in 2021-S1 a steep increase started as it almost doubled to 0.0447 EUR/GJ, then in 2021-S2 in rose to 0.0793 EUR/GJ and by 2022-S1 it reached 0.1145 EUR/GJ. (Eurostat)

After studying the prices of the last three years in nine different European countries, it can be stated that the decreasing amount of gas arriving to Europe from Russia already from the second half of 2021, is noticeable in the found data and as in most observed countries the natural gas prices were stagnant or even decreasing, but in the second half of 2021 an increase was already discoverable in the prices of gas in Denmark, France, Italy, Lithuania, Hungary, the Netherlands, Poland and in Sweden as well, however the significant price escalations in the observed countries happened in the first half of 2022 which is the same time period as the start of the Russian-Ukrainian war, as the geopolitical incident started in February 2022, when Russia attacked Kyiv and it is also in accordance with the 60% drop in the amount of the total flow compared to the previous year. (New York Times, 2022) (Di Bella et al., 2022)

5.3 The effect of electricity prices

To continue, in this section of the chapter I am going to analyze the connection between natural gas and electricity prices, for this I am using bi-annual electricity and natural gas prices between 2019 and 2022 that are set for the non-household customers that have similar consumption volumes.

Denmark showed rises and drops in its electricity and gas prices exactly in the same periods. In Germany the electricity prices were fluctuating a bit more before 2022, than its gas prices, but in the first part of 2022 both showed a sudden increase that almost doubled the prices. In France there were some minor fluctuations before 2022, when there was a sudden increase in its electricity prices, while the gas prices were more or less stagnant until 2021-S1 and then it had an increase already in 2021-S2 that continued in 2022. Italy's electricity and gas prices followed each other well enough even in the first half of 2021, then in the second half of 2021 the gas prices had a slight increase, while the electricity prices showed a more inclined increase, moreover in 2022 both electricity and gas prices almost doubled. Lithuania had a bit more specific case when it comes to its gas prices, as it decreased in 2020, then in the second half of 2021 it more than doubled, then followed a relatively steep inclined growth, while its electricity prices were steady until the 2021-S1, where there was a slight price increase, then until the end of the first half of 2022 there was a very significant increase in its electricity prices. Hungary's electricity and gas prices are also quite stagnant between 2019-S1 and 2021-S1, but in 2021-S2 the gas price more than doubled then a relatively slight increase followed in 2022-S1, while the electricity price first showed a slight increase in 2021-S2, then it almost doubled in 2022-S1. The Netherlands' electricity and gas prices were following each other in the observed time period, by having similar periods with smaller and greater fluctuations. Poland had less fluctuating gas prices until the second half of 2021, when the price increased quite a lot and then almost doubled in 2022, while its electricity prices were less stagnant in general and showed a less significant price increase in 2022, compared to the gas prices. In Sweden the natural gas prices were slightly fluctuating until the end of 2020 and from the beginning of 2021 until mid-2022 a very significant price change is noticeable, while in its electricity prices the more relatively significant increase started only in the second half of 2022, but it showed a much less steep incline compared to the gas prices. (Eurostat)

After comparing the natural gas and electricity prices for the above-mentioned period, it is noticeable that besides a few minor differences, the changes of the prices of one energy source can be seen on the prices of the other energy source as well, therefore it can be confidently stated that the price of electricity is effecting the price of natural gas and it is a price changing factor as the growth in electricity demand would suggest a growth in demand for gas as well, as electricity production is partially based on natural gas, therefore an increase in the electricity price connected

to the growing demand, would lead to an increase in the price of gas as well as the demand would grow for that as well. (Uribe et al., 2018)

5.4 Relation between pricing mechanisms and price changing factors

After studying the chosen price changing factors and setting up conclusions for all of them, the relation between the pricing mechanisms and the observed factors can be considered.
As I found it in the analysis, alternative fuels have an effect on the price of natural gas: changes in electricity prices are showing similar changes in the natural gas prices, but alternative fuels also gave the base for the pricing formula: even in the last decade a large number of gas contracts were linked to oil prices. (Honoré, 2010)

5.5 Rising renewable energy shares in the EU

In this section I am evaluating how the countries that we studied in the 5.2 and 5.3 sections could comply with this goal and by this I am answering to my second working question: *What is the current position of renewable energy in the European Union and what are the prospects?*
The European Union set a goal for all member countries to have 20% renewable energy in their energy mix. (Delbeke and Vis, 2019). Denmark, Lithuania and Sweden had a higher than 20% renewable energy share already in 2014, that even increased by 2020. Italy was the only country in the observation that could reach the 20% level by 2020, Germany and France were both very close to reaching the EU goal, they both had 19% renewables in their energy mix. Poland and the Netherlands showed an increase in their renewable energy shares, but were far from reaching the target, while Hungary had a very fluctuating share, but compared to the 2014 level, there was a decrease in 2020 in its energy mix. (Eurostat)
In general, the studied countries were working on reaching the goal to have at least 20% of renewable energy in their used energy mix, however there is still room for development, because even though some countries already had their renewable levels in 2014 above the target, some others still could not reach it, even though they were clearly progressing. Furthermore, the Low-Carbon Roadmap plan also suggests more necessary increases in the countries' renewable energy share, as it expects the member states to lower their domestic carbon emission and to achieve that, the demand should be lowered – which is highly unlikely – or more renewable based energy should be used. (Delbeke and Vis, 2019)

6 Conclusion

In this report I decided to study three factors that I believed to be influential on the natural gas prices in Europe: the availability of natural reserves, geopolitical factors and electricity prices.

I have found that the natural gas prices are heavily influenced by the availability of natural reserves, as the transportation costs are very high, therefore a decline in the reserves would lead to a higher demand for imports, which would be more expensive than the locally available gas because of the expensive transportation. (Prior, 1994) The geopolitical factor also confirmed to be a strong influence, because as the result of the Russian-Ukrainian war, supply from Russia heavily decreased and at the same time the prices significantly increased. (Di Bella et al., 2022) The influence of electricity prices also happened to be powerful, as it was observable that whenever the price of electricity changed, a similar change was noticeable in the natural gas prices as well, and vice versa. (Uribe et al., 2018)

Based on the above findings, the – for different reasons – decreasing levels of supply and the price increases related to that could increase the demand for renewable energy besides governmental policies, such as the European Union's target to increase the level of renewable energy shares in the state's energy consumption. However, as it can be noticed through the whole report, it is an extremely broad topic, that has several different price influencing factors and it is not possible to precisely predict a future change in a qualitative report, especially with such limitations, therefore my findings should be considered as assumptions for possible reasons of future changes.

7 Bibliography

Whaley, Jane. (2009). *The Groningen Gas Field*. [online] Available at: https://www.geoexpro.com/articles/2009/04/the-groningen-gas-field [Accessed 1 Nov. 2022].

Euronews. (2022). *Why is there an energy crisis in Europe?* [online] Available at: https://www.euronews.com/2022/02/03/europe-s-energy-crisis-why-are-natural-gas-prices-soaring-and-how-will-it-affect-europeans. [Accessed 16 Oct. 2022].

Energistyrelsen. (2022). *Så meget stiger priserne på el og varme*. [online] Available at: https://sparenergi.dk/forbruger/hoje-energipriser/sa-meget-stiger-priserne-pa-el-og-varme [Accessed 16 Oct. 2022].

Justesen, L. and Mik-Meyer, N. (2012). *Qualitative research methods in organisation studies*. København: Hans Reitzels Forlag.

Saunders, M., Lewis, P. and Thornhill, A. (2007). *Research methods for business students*. 4th ed. Harlow: Pearson Education Limited.

Creswell, J. (2009). *Research Design : Qualitative, Quantitative and Mixed Methods approaches.* 3rd ed. Thousand Oaks: Sage Publications, Inc.

Honoré, Anouk (2010). *European gas demand, supply and pricing : cycles, seasons and the impact of LNG price arbitrage*. Oxford: Oxford University Press For The Oxford Institute For Energy Studies.

Stern, Jonathan (2007). *Is There A Rationale for the Continuing Link to Oil Product Prices in Continental European Long-Term Gas Contracts?.* Oxford: Oxford Institute for Energy Studies. Available at: https://www.oxfordenergy.org/publications/is-there-a-rationale-for-the-continuing-link-to-oil-product-prices-in-continental-european-long-term-gas-contracts-2/ [Accessed 5 Nov. 2022].

Hégaret, G., Siliverstovs, B., Berlin, D., Neumann, A., and Von Hirschhausen, C. (2003*). International Market Integration for Natural Gas? A Cointegration Analysis of Prices in Europe, North America and Japan*. Berlin: DIW Berlin. Available at: https://www.diw.de/documents/publikationen/73/diw_01.c.41107.de/dp393.pdf [Accessed 14 Nov. 2022].

Cornot-Gandolphe, Sylvie (1995). *Changes in World Gas Reserves and Resources*. Energy Exploration & Exploitation. Volume 13, Issue 1. Available at: https://doi.org/10.1177/014459879501300102 [Accessed 14 Nov. 2022]

Prior, Michael (1994). *The supply of gas to Europe*. Energy Policy. Volume 22, Issue 6. Available at: https://doi.org/10.1016/0301-4215(94)90065-5 [Accessed 14 Nov. 2022]

Di Bella, G., Flanagan, M.J., Foda, K., Maslova, S., Pienkowski, A., Stuermer, M., Toscani, F.G. (2022). *Natural Gas in Europe: The Potential Impact of Disruptions to Supply*. IMF Working Paper No. 2022/145. Available at: https://www.imf.org/en/Publications/WP/Issues/2022/07/18/Natural-Gas-in-Europe-The-Potential-Impact-of-Disruptions-to-Supply-520934 [Accessed 14 Nov. 2022]

OECD (2022), *Electricity generation (indicator).* Available at: https://doi.org/10.1787/c6e6caa2-en [Accessed 23 Nov. 2022]

Uribe, J.M., Guillen, M., Mosquera-López, S. (2018). *Uncovering the nonlinear predictive causality between natural gas and electricity prices*. Energy Economics Volume 74. Available at: https://doi.org/10.1016/j.eneco.2018.07.025 [Accessed 24 Nov. 2022]

Delbeke, J. and Vis, P. (eds) (2019). *Towards a climate-neutral Europe – Curbing the Trend*. London, Routledge. Available at: https://doi.org/10.4324/9789276082569 [Accessed 7 Oct. 2022]

Church, K. (2016). *Energy sources for district heating and cooling*. In: Advanced District Heating and Cooling (DHC) Systems, Woodhead Publishing Series in Energy. Available at: https://doi.org/10.1016/B978-1-78242-374-4.00006-9 [Accessed 29 Nov. 2022]

International Energy Agency (2008). *Natural Gas Information 2008*. Available at: https://doi.org/10.1787/nat_gas-2008-en [Accessed: 27 Nov. 2022]

European Communities (2003). *Gas prices – Data 1990-2003*. Available at: https://ec.europa.eu/eurostat/web/products-statistical-books/-/ks-cp-03-001-3a [Accessed 27 Nov. 2022]

Eurostat. *Gas prices for industrial consumers - bi-annual data (until 2007)*. Available at: https://ec.europa.eu/eurostat/databrowser/view/NRG_PC_203_H__custom_3972809/default/table?lang=en [Accessed 27 Nov. 2022]

Eurostat. *Gas prices for non-household consumers - bi-annual data (from 2007 onwards)*. Available at:https://ec.europa.eu/eurostat/databrowser/view/NRG_PC_203__custom_3973223/default/table?lang=en [Accessed 27 Nov. 2022]

Eurostat. *Electricity prices for non-household consumers - bi-annual data (from 2007 onwards).* Available at: https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_205/default/table?lang=en [Accessed 27 Nov. 2022]

Bigg, Matthew Mpoke (2022). *Russia invaded Ukraine more than 200 days ago. Here is one key development from every month of the war*. New York Times. Available at: https://www.nytimes.com/article/ukraine-russia-war-timeline.html [Accessed 29 Nov. 2022]