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Gender Diversity in the Norwegian Energy Sector and its Development

A descriptive and explanatory study

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Abstract

Using Norwegian register data accessed through microdata.no, this thesis seeks to provide a description of gender diversity in the Norwegian energy sector, and renewables specifically. Existing research on gender diversity in the energy sectors over the world draws a picture of a male-dominated sector with a persistent gender wage gap. The thesis is divided into two main parts trying to examine the Norwegian energy sector. The first part (chapter 3) is a descriptive analysis on how female participation has evolved from 2000-2019, along with the evolution of several other key characteristics. The second part (chapter 4) attempts to assess the gender wage gap in the Norwegian energy sector using a Blinder-Oaxaca (B-O) decomposition method for the years 2014 and 2018. The aim here is to compare traditional energy to renewable energy and investigate differences in the drivers of the gender wage gap.

The findings from the descriptive analysis show that there is little evidence of changes in the percentage of women in the energy workforce across almost all sub-sectors. For renewable energy sources, there is even a decline from 25% to 23% from 2010 to 2019. Regarding the gender wage gap investigation, the findings for the traditional and renewable energy sector are similar. Across all conducted regressions and samples, the unexplained part of the gap is large, meaning only a small part of the gap can be attributed to the observed variables such as education, experience, or occupations. In the B-O decomposition literature, the unexplained gap can often be (partly) attributed to discrimination. We argue that not all of the unexplained gap we find is due to discrimination in the energy sector directly, but could stem from discrimination elsewhere, such as education. There is no apparent pattern as to which of traditional and renewable energy that exhibits the smallest gender wage gap.

Contents

1. Introduction

Gender inequality and the transition from fossil fuels to renewable energy are topics that are widely discussed in today's modern society. Norway are front runners for gender equality, ranking third in World Economic Forum's *Global Gender Gap Index 2022* (World Economic Forum, 2022) and ranking sixth in United Nations Development Programme's *Gender Inequality Index* for 2019 (UNDP, 2020). Although, Norway is a world leader in gender equality, there is still a gender divided labor market in the country, exemplified with women having lower participation in the labor force, working more part-time than men, have lower average gross income and are underrepresented among leaders (Statistics Norway, 2017).

According to the International Energy Agency, women make up 39% of the global labor force, but only 22% of the traditional energy sector (IEA, n.d.-a). A 2019 report from the International Renewable Energy Agency investigate women labor participation in renewable energy specifically, finding that renewable energy has a female share of 32% compared to 22% for the overall energy sector (IRENA, 2019). Furthermore, the IRENA report finds that within renewables, women are more represented in administrative jobs rather than in STEM (science, technology, engineering, and mathematics) jobs. In the Nordic energy sector, a similar picture is painted. A survey from Nordic Energy Research finds that women in the responding energy companies accounts for 28% of the full-time equivalents in the sector, and 31% of the decision-making power lies with women (Nordic Energy Research, 2021).

Building on these findings, this thesis seeks to investigate female labor participation within the energy sector in Norway and whether this matches the presented findings. More specifically, we observe how the share of women in the Norwegian energy sector has evolved from 2000 to 2019, in addition to the evolution of some key mean characteristics. To achieve this, we employ register data from Statistics Norway accessed through microdata.no. The data allows for breaking employees down into sub-sectors of the energy sector and investigate key characteristics for males and females.

The thesis is divided into a descriptive part and a part with an explanatory analysis using regressions. The descriptive part is centered around describing the evolution of the Norwegian energy sector from 2000 to 2019. It mainly focuses on the share of women in different sub-sectors and how this have developed over the years. Some mean characteristics for males and females are also included and their evolution is discussed. There are not many scientific articles published that describe female participation in the Norwegian energy sector in general, and the renewables sector specifically. This thesis seeks to expand the knowledge of this development over the last 20 years.

In the descriptive part, we first divide employees into the energy sector based on the sector of the firm with which they have their main employment. We further divide employees into sub-sectors such as the oil and gas sector and renewables. Then, these employees are used as the basis for several descriptive measures of the evolution of female participation and characteristics in the Norwegian energy sector. These measures include the share of women among employees, average wages, and key characteristics such as education and part-time work. The purpose of this part is to create an overview of the labor market in the Norwegian energy sector with emphasis on gender differences.

The explanatory analysis zooms in on two cross-section years, namely 2014 and 2018. In line with the findings from Statistics Norway, telling a story of an average woman working more part time and having a lower average gross income per year than the average man, we want to investigate to which extent this is true in the Norwegian energy sector as well. Also drawing from IRENA's findings that there are more women working in administrative positions rather than in STEM positions relative to men in renewable energy, we want to investigate if this is true for Norway. Based on this, we conduct a Blinder-Oaxaca (Blinder, 1973; Oaxaca, 1973) decomposition of the gender wage gap within the energy sector and renewables sector. Where the descriptive part of the thesis provides a general overview of the labor market evolution, the Blinder-Oaxaca decomposition seeks to answer these three questions:

1. *Is there a gender wage gap in the Norwegian energy sector?*
2. *How much of this gap can be attributed to observable characteristics and how much can be attributed to unobservable characteristics or discrimination?*
3. *Is there a difference between the workforces in traditional energy sources and renewable energy sources?*

The Blinder-Oaxaca decomposition method quantifies the wage differentials between or more groups into explained and unexplained portion of a wage gap (Blinder, 1973; Oaxaca, 1973). The unexplained portion of the wage gap is often referred to as discrimination. In this thesis, we decompose the gender wage gap in the Norwegian energy sector into explained and unexplained parts. We estimate separate regressions for males and females and compare the coefficients in light of differing endowments. The explained part of the gender wage gap includes the portion of the wage gap, that is attributable to differing endowments such as more experience or more education (Blinder, 1973). The unexplained part of the wage gap comes from differences in coefficients, meaning that one group receives a different output from the same endowment. For example, if the male coefficient for years of schooling is higher than the female coefficient, males would be rewarded more per extra year of schooling they have. This is not explained by an observable characteristic; hence it is a part of the unexplained gender gap.

The findings from the descriptive part of the thesis show a lower share of women in renewables compared to the report by IRENA (2019). We observe a small increase in the share of women in energy from 2000 to 2019. However, from the time we can distinguish renewable energy from other energy sources (2010), we observe a decline in the share of women from around 25% to around 23%. On the other hand, among the top 10% of earners, the share of women shows a steady increase, from under 5% in 2000 to over 15% in 2019. Furthermore, the absolute gender gap seems to shrink over the same period. Our observations also include gender differences in education (females have more), STEM education, full-time positions, and gender share among leaders (males are in favor). We find that females are catching up and, in some cases, surpassing males in the observed key characteristics such as education. However, males have a higher share in full-time work and higher share among leaders.

Chapter 4 describes the methodology in more detail and presents findings from the explanatory analysis of the gender wage gap in the Norwegian energy sector. Six different decompositions are calculated, three on the full energy sector without renewables and three on the renewables sub-sector. Four of the decompositions is performed for 2014, while the remaining two are performed for 2018. The data collection in the register data changed somewhat in 2015 following the introduction of A-ordningen (a new reporting standard for firms, further explained in chapter 3). Therefore, the decompositions are conducted before and after this point to investigate if the new reporting scheme leads to different conclusions. The conclusions from the 2014 and 2018 decompositions are similar, indicating that there is little change in the quality of data reporting, there is little development in the attributes of the gender wage gap during those years, the additional variables available in 2018 (actual overtime worked and years spent at current firm) does not explain a big portion of the wage gap, or a combination of the explanations.

All decompositions attribute a lot of the gender wage gap to unobservable characteristics. The decomposition which explains most of the gender wage gap through observable characteristics is the one for the renewables sub-sector in 2014, not controlling for area. Here, observable characteristics explain just over 30% of the gap. The observable characteristics explaining most of the 30% of the gap is work experience, education, agreed working hours and presence in STEM positions. The high presence of unexplained gender gap could stem from gender differences in job and sector selection, this is further discussed in chapter 5. Some traits are seemingly generalizable over populations, such as women normally having more years of schooling than men (narrowing the wage gap), and men having more work experience (expanding the wage gap).

In answering the three aforementioned research questions, we find that in relation to question one, the findings exhibit a clear yes, there is a gender wage gap in the Norwegian energy sector. As for the second question, it is less clear that all the gap can be attributed to the discrimination. As mentioned, a small part of the gap is explained by observable characteristics and therefore not attributable to discrimination. We argue that not all the unexplained gap can be attributed to discrimination in the energy sector directly, but also is explained by discrimination in education or gender norms in society. Relating to the third question, the findings in 2014 indicates that there is less discrimination in the renewables sector. However, after adding a few controls in 2018, the findings are very similar. Therefore, we have little evidence that suggest there is a difference between the workforces in traditional and renewable energy.

The structure of the thesis is as follows. First, the introduction is completed with an introduction to the Norwegian energy sector. Then, chapter 2 provides a summary of relevant literature on gender and renewable energy. The descriptive analysis is performed and presented in chapter 3, with a description of the data as well as a summary of the evolution of the Norwegian energy sector. Chapter 4 presents the method and results of the Blinder-Oaxaca decomposition of the gender wage gap in the energy sector. Here, decompositions are made for both 2014 and 2018, on both traditional and renewable energy workers. After presenting methods and results, chapter 5 discusses the findings and methodology considering the relevant literature, focusing on economic significance and promotion of a gender equal society. Lastly, chapter 6 presents the conclusion drawn from the results of the thesis, including notes on further research.

1.1 The Norwegian energy sector

The Norwegian energy sector produced around 1 250 000 TJ (terajoule) of energy in 2020 (IEA, n.d.-b). The two biggest sources of energy are waterpower and energy from oil, producing just over 500 000 TJ (hydro) and around 415 000 TJ (oil) in 2020. This is followed by energy from natural gas and biofuels/waste in third and fourth, with other renewables (solar, wind power etc.) and coal accounting for the rest of the energy produced. These relative sizes have been consistent since 1990, apart from a growth in other renewables from around 2010. Of the energy, which is used for electricity consumption, waterpower produced almost all of this (137.9 TWh of the total 154.8 TWh) in 2021 (NVE, 2022).

Future expansion of renewable energy sources in Norway are increasingly profitable. The Norwegian Water Resources and Energy Directorate (NVE) provides two examples of profitable expansion of renewable energy sources. First, there has been established a joint market for electricity certificates between Norway and Sweden (NVE, 2021). This is a subsidy which causes electricity producers to receive an extra income on top of the electricity price. NVE also highlights that land-based wind power will be increasingly profitable for developers in the 2020s due to technology improvements (Weir & Østenby, 2019).

While almost all electricity consumption comes from waterpower and other renewables, energy from oil and gas are more prevalent in other sectors. Out of all final consumption of oil products in Norway by sector, the transport sector consumes around half (IEA, n.d.-b.). The industry sector has from 1990 to 2019 consumed between 10-15% of oil products and around 30% have been used for non-energy use. After the first oil discovery on Norwegian soil in 1969, the state participated heavily in petroleum operations and these activities have contributed significantly to Norway’s economic growth (Regjeringen, 2021a). The industry of production and sale of oil and gas is Norway’s biggest industry measured in turnover, followed by the petroleum service and supply industry (Regjeringen, 2021b). Given its size and its historic and economic importance in modern Norwegian history, the oil and gas sector will throughout the thesis serve as the main representative of traditional energy.

The thesis will mainly distinguish between renewable energy sources and “other” energy sources. The phrasing “traditional energy” will in general be used about these other energy sources because this is dominated by the oil and gas industry. Therefore, it is necessary to define what energy sources go into renewable energy. The UN defines renewable energy as «energy derived from natural sources that are replenished at a higher rate than they are consumed” (United Nations, n.d.). Furthermore, a special report from the Intergovernmental Panel on Climate Change (IPCC) on renewable energy sources list six different sources of renewable energy, which will be used as the basis for this thesis: bioenergy, direct solar energy, geothermal energy, hydropower (waterpower), ocean energy and wind energy (IPCC, 2011). People working in these sub-sectors will be classified as “renewable energy workers”, whereas the rest will be classified as “traditional energy workers”. It is worth mentioning that waterpower in Norway has been important and functioning for over 100 years (Regjeringen, 2016; Statkraft, n.d.), so it can be classified as a traditional energy source in the sense that it has been present and dominant for a long time. However, since the objective is to compare renewable energy sources to more polluting energy sources, waterpower is classified as renewable energy.

2. Literature on gender and renewable energy

To lay a solid foundation for the subsequent discussion of results, it is necessary with a summary of existing literature on gender and renewable energy. As mentioned, an IRENA (2019) survey found that the female share of the workforce in renewable energy was 32% compared to 22% in the traditional energy sector. This chapter further explores earlier findings like this and elaborates on research on the advantages of employing women, and literature that suggests women have different jobs than men. Lastly, some of the sources of gender wage gaps is presented.

IRENA (2018b) estimates that the number of jobs worldwide in renewable energy is going to rise from 10.3 million in 2017 to 28.8 million in 2050. This makes renewable energy an attractive opportunity to achieve gender equality in the energy sector, and jobs in renewable energy is likely attractive in terms of job security, wages, and working conditions. Comparing to the traditional energy sector the extra jobs in renewable energy does completely offset the loss of fossil fuel jobs in 2050, as estimated by IRENA (2018a). Towards 2050, a transition from fossil fuel energy to renewable energy will likely cause skill requirements to change. This increases the need for re-training of fossil fuel employees (IRENA, 2018a). Lucas, Pinnington and Cabeza (2018) argue that there is a workforce deficit and a skill gap in renewable energy industries. Also, they argue that the workforce is not easily transferable from traditional energy to renewables. Investigating online education in renewable energy, Lucas et al. (2018) finds that women appear to have a higher interest in renewable energy education compared to conventional energy education. This could be one possible explanation to why the share of women is higher in renewables.

2.1 Advantages of employing women

There are several potential upsides of increasing female participation in the renewable energy sector. First, as IRENA (2019) points out, a higher share of women itself can be a source of increased female participation. They argue that because most people in the energy sector find work through professional networks and personal connections, a higher share of female decreases women's barriers to entry. Second, women on average score better than men on complex moral reasoning tests, probably causing them to take fairer and better decisions when stakeholders with competing interests are affected (Bart & McQueen, 2013).

While analyzing a global survey of 21 980 firms (not confined to the energy sector), Noland, Moran and Kotschwar (2016) find that female presence in corporate leadership positions can improve firm performance. They argue that this improvement could be due to less discrimination or increased skill diversity. These findings are supported by Dezsö and Ross (2012), who argue that female representation in top management benefits managerial performance and therefore increases firm performance. However, they find that the improvement in firm performance from female representation is present only to the extent that the firm's strategy is focused on innovation. Where Dezsö and Ross analyzed the S&P (Standard and Poor's) 1 500 firms, a working paper from the International Monetary Fund (IMF) examined the link between gender diversity and financial performance in 2 million European companies (Christiansen et al., 2016). The findings further support the advantages of female representation in senior corporate positions, establishing two potential channels this improves firm performance. They find a more pronounced positive correlation in sectors with a larger share of women in the workforce, and in sectors where complementarities in skills and critical thinking is prevalent. Examples of the latter is high-tech and knowledge-intensive sectors (such as renewable energy arguably is).

2.2 Differences in jobs

We have found that the previous evidence shows that the share of women employed in renewable energy seems to be higher than for traditional energy sources. Another question is whether women are in similar or different types of jobs as men in the renewable energy sector. A significant amount of the higher paying jobs in renewable energy requires some form of STEM education or background (IRENA, 2019; Antoni, Janser & Lehmer, 2015). Looking at the renewable sector in Germany, renewable energy jobs pay higher wages than non-renewable companies, but women are earning less than men on average (Antoni et al., 2015).

Looking at the figures from IRENA's 2019 report, women are most represented in administrative positions. The share of women in administrative jobs is 45%, almost at gender equality in terms of people employed. However, the share falls to 35% when looking at non-STEM technical jobs and falls further to 28% for STEM jobs (IRENA, 2019). This implies a gender wage gap among respondents, although this is not explicitly investigated. When asked about beliefs about pay equity, only 29% of female respondents believe women and men are paid equally, whereas 71% think men are paid more. For all respondents, 63% think men are paid more and 37% think the pay is equal or in favor of women, suggesting a gender difference in beliefs about wage equity.

A study published by the European Parliament in 2019 provides some possible explanations for the gender gap in the (whole) energy sector (Clancy & Feenstra, 2019). These explanations include "lack of appropriate skills due to gender gaps in energy-related education", unpredictable work schedules that are hard to combine with family- or care work, and lack of mentoring programs and opportunities for promotion. This study supports IRENA's findings that while there is low female participation in all the energy sector, the renewables sector is slightly more diverse than traditional energy. Also, there are indications that women are overrepresented in part-time positions, although there is little data on this for renewable energy.

2.3 Sources of gender wage gaps

Through extensive research, there is evidence that in most regions and sectors, gender wage gap does exist. The International Labour Organization (ILO) estimates an average gender wage gap of 22% on a worldly basis when using median monthly wages (ILO, 2019). The evolution of gender inequality has also been researched, for instance Blau and Kahn (2017) found that there has been a decreasing gender wage gap in USA from 1980 to 2010. In the same study, the authors decompose the gender wage gap in 1980 and 2010 in the US. Here, they estimate regressions containing only human capital factors and a full specification. The part of the wage gap that is not explained by the included variables are quite large, but they fall substantially when including controls for industry (sector) and occupations. This infers that a lot of the gender wage gap can be attributed to selection into certain industries and occupations. Females selecting lower paying industries/occupations or face tougher barriers to entry to certain industries/occupations emerges as a source of the gender wage gap.

There are several other potential sources to gender wage gaps which can work differently in different settings and industries. First, Arulampalam, Booth and Bryan (2007) analyzed data from the European Community Household Panel and found that there were differences in the gender wage gap sizes depending on the wage distributions. They found that the gap widened at the top of the wage distribution and sometimes widened at the bottom. The authors attributed this phenomenon to the glass ceiling effect (top of distribution) and the sticky floors effect (bottom). The European Institute for Gender Equality (EIGE) defines sticky floors as “a metaphor to point to a discriminatory employment pattern that keeps workers, mainly women, in the lower ranks of the job scale, with low mobility and invisible barriers to career advancement” (EIGE, n.d.-b). The same institute defines glass ceilings as “artificial impediments and invisible barriers that militate against women’s access to top decision-making and managerial positions in an organisation, whether public or private and in whatever domain” (EIGE, n.d.-a).

Parts of the glass ceiling effects could be attributed to women having children. In a study conducted on Norwegian data, Bütikofer, Jensen and Salvanes (2018) investigates if bearing a child comes with a larger penalty for highly qualified women. The findings suggest that the gender wage gap from having a child is higher in non-linear wage structures like for MBAs and lawyers (ca. 30%). The gap is smaller for more linear wage structures such as STEM and medicine graduates. The European Parliament (2022) also underline factors that contribute to the gender wage gap, including women doing more unpaid domestic work (causing more part-time positions), fewer and less paid female managers, and career choices influenced by family responsibilities.

3. Descriptive summary of the evolution of the energy sector

This section aims to describe the evolution of the Norwegian energy sector, with emphasis on female and male specific characteristics. Using data from Statistics Norway through microdata.no, we examine how female and male characteristics have changed from 2000 to 2019. First, some general comments are made about the available data and choices made from this. Then, an overview of the share of women in the sector is provided, broken down into sub-sectors where appropriate. The last part of the section presents some mean characteristics for males and females in the different sub-sectors, and highlights women's participation in the top 10% of the wage distribution.

3.1 Data and choices

3.1.1 Industry and sector

Statistics Norway and Microdata has data on industries and sectors going back to 2000. Therefore, we are investigating the evolution of the energy sector from 2000 to the latest available data in 2019. All characteristics and figures are drawn each five years, but since we do not have available data on industries in 2020, 2019 is chosen instead, making the last increment four years instead of five. The level of detail has changed over the years, which allows for more sub-sectors in later years. For instance, after 2010 it is possible to single out renewable energy sources.

The data for 2000 comes from the Standard Industrial Classification 1994 (SIC94), which is valid from January 1994 to January 2002 (Lightfoot, 1994). The data from 2005 comes from the Standard Industrial Classification 2002 (SIC2002), which is valid from January 2002 to January 2009 (Lightfoot, 2002). The data for 2010, 2015 and 2019 comes from the Standard Industrial Classification 2007 (SIC2007), which is valid from January 2009. SIC2007 is based on Eurostat's NACE Rev. 2 (Lightfoot, 2007; Eurostat, 2008).

The level of detail from SIC94 is used as a base for the division of the energy sector throughout the analyzed period, with some exceptions. The energy sector and sub-sectors used as a base from SIC94 is "*Extraction of crude petroleum and natural gas, service activities incidental to oil and gas extraction excluding surveying*" (hereafter "*Extraction of* *oil and gas*"), "*Manufacture of coke, refined petroleum products and nuclear fuel*", and "*Electricity, gas and water supply*" (including renewable energy production) (Lightfoot, 1994).

This level of detail does not change with SIC2002, but SIC2007 allows for a more detailed segregation between sub-sectors. From 2010 onwards in our sample, it is possible to look at the renewable energy production on its own, rather than as a part of "*Electricity, gas and water supply*". Therefore, for 2010, 2015 and 2019, more sub-sectors are included. In addition to the existing three categories that remain, we also include "*Renewables*" and "*Electricity, gas and water supply, excluding renewables*". The renewables sub-sector allows for further division into specific renewables sectors, namely electricity from waterpower, wind power, biofuel, and natural gas. Although it could be interesting to distinguish between these, table 3.2 show that there are few employees actually employed in these specific sectors. To make the descriptive statistics more meaningful and less exposed to extreme values, the renewables sector is treated as one combined sector. For all years, the descriptive statistics on the variables are displayed over the available sub-sectors, as well as for the energy sector as a whole.

3.1.2 Education variables

The data on education are more universal through the investigated years, with consistent data from 1970-2020. The education variables are based on Statistics Norway's data on highest finished education. There are three education variables created, namely bachelor's degree or equivalent, master's and PhD degrees (and equivalent), and a dummy variable for no higher education. No higher education is defined as not having completed at least a bachelor's degree or equivalent. Furthermore, two STEM education variables are included. These are dummy variables that takes the value 1 if the highest finished education is a bachelor's degree or equivalent within STEM fields, and 0 otherwise. The last variable takes the value 1 if highest finished education is master's degree or PhD (or equivalent), and 0 otherwise.

3.1.3 Part-time or full-time

Whether employees work full-time or part-time are also investigated in this chapter. From 2000 to 2014, the data from Statistics Norway are divided into three intervals of weekly hours worked. The hours are agreed working hours, which is derived from the number of hours the working contract states the employee should work during one week. Two of the intervals are defined as part-time (4 to 19.9 hours/week, and 20 to 29.9 hours/week), while the last interval is defined as full-time (more than 30 hours/week). It is important to note that the hours worked per week refers only to the main employment. If a person has several part-time jobs adding up to several hours that equal a full-time arrangement, only the hours from the biggest employment are included.

From 2015, the working hours are collected through A-ordningen, which started January 1st, 2015 (Skatteetaten, n.d.). The variable still counts agreed working hours, but this is not directly reported by firms. This is derived from the reported "percentage of full-time equivalent" and "number of hours a full-time position entail".

3.1.4 Children in households

To investigate any disparities in children per household between genders, we include statistics on this. To be counted as a child in the household, the child must be under 18 years old and be a registered resident in the household of at least one parent. Children that live with other adults than their parents are not counted as children in the household. This applies to children with foster parents, among others.

3.1.5 Occupation – leaders

From 2010 onwards, there is data available on occupations. In the descriptive part of the thesis, this is used to create descriptive statistics highlighting gender differences in leader positions. The term leaders are here used about top leaders in public administration, CEOs, leaders of administrative units, sales and research, and leaders in production of goods and service provision.

3.2 A note on confidentiality in Microdata

The descriptive statistics presented in this chapter are affected by confidentiality and safety restrictions. In the user manual of microdata.no, the actions taken to prevent misuse of register data and maintaining confidentiality are described (in Norwegian) (Microdata, 2022). Most of the data in this chapter are calculated using the commands *tabulate* or *summarize*. According to the user manual, all numbers generated with these commands includes added noise. Some of the requirements of the noise includes that the lowest positive number that is displayable, is 5. Furthermore, there should not be added more noise in counts (such as table 3.1 and 3.2) than ± 5 ($-5 \leq x \leq 5$). Some of the percentages displayed later in the chapters build on these noisy data. One can therefore experience that percentages does not always add up to exactly 100%, and this is due to the added noise.

3.3 Sector sizes

Before the presentation of gender differences along different dimensions, it is useful to investigate the absolute size of the energy sector and sub-sectors. Tables 3.1 and 3.2 show the number of employees in each sector, where table 3.2 breaks down the renewables sub-sector into even smaller fragments. Since there is no data on renewables specifically before 2010, there is no data for this or "*Electricity (excl. Renewables)*".

Table 3.1 shows that extraction of oil and gas is clearly the biggest sub-sector and is also the only sub-sector that grows substantially in terms of employees. The number of employees is doubled from 2000 to 2015, with a small decline towards 2019. Contrary to what one might expect, the number of employees in renewable energy production decline steadily from the first data available in 2010 to 2019. Much of the growth of the combined energy sector exhibits comes from the increase in the people employed in oil and gas extraction.

As previously mentioned, there are very few employees connected to the sub-sector of renewable energy production, where most employees belong to the waterpower sub-sector. The low frequency in wind power, biofuel and natural gas makes them very sensitive to outliers and extreme values, so the rest of the thesis will use renewables combined instead of the smaller sub-sectors. The big share of employees belonging to waterpower should not come as a surprise, since Norway is the largest producer of electricity from waterpower in Europe, and 90% of power generation in Norway comes from waterpower (Statkraft, n.d.).

These sector sizes are useful to keep in mind for the rest of the thesis, especially when encountering puzzling or unexpected results. Some of the variation could appear large because of a relatively small sample size.

Table 3.1

Sector size

	2000	2005	2010	2015	2019
Extraction of oil and gas	27 751	29 761	47 501	54 877	53 481
Manufacture of coke, petroleum, nuclear	1 044	1 089	1 295	1 137	1 217
Renewables			6 887	6 168	5 064
Electricity (excl. Renewables)			7 843	9 197	10 928
Electricity (incl. Renewables)	16 752	13 913	14 737	15 370	15 995
Energy total	45 551	44 766	63 520	71 375	70 691

*Due to confidentiality reasons, noise is added to these numbers from microdata.no. The numbers are not completely correct, but should not deviate by more than 5 people.

Table 3.2

Sector size, renewables

	2010	2015	2019
Water power	6 771	6 111	4 945
Wind power	50	31	101
Biofuel	12	11	10
Natural gas	53	10	N/A

*Due to confidentiality reasons, noise is added to these numbers from microdata.no. The numbers are not completely correct, but should not deviate by more than 5 people.

3.4 Share of women over time

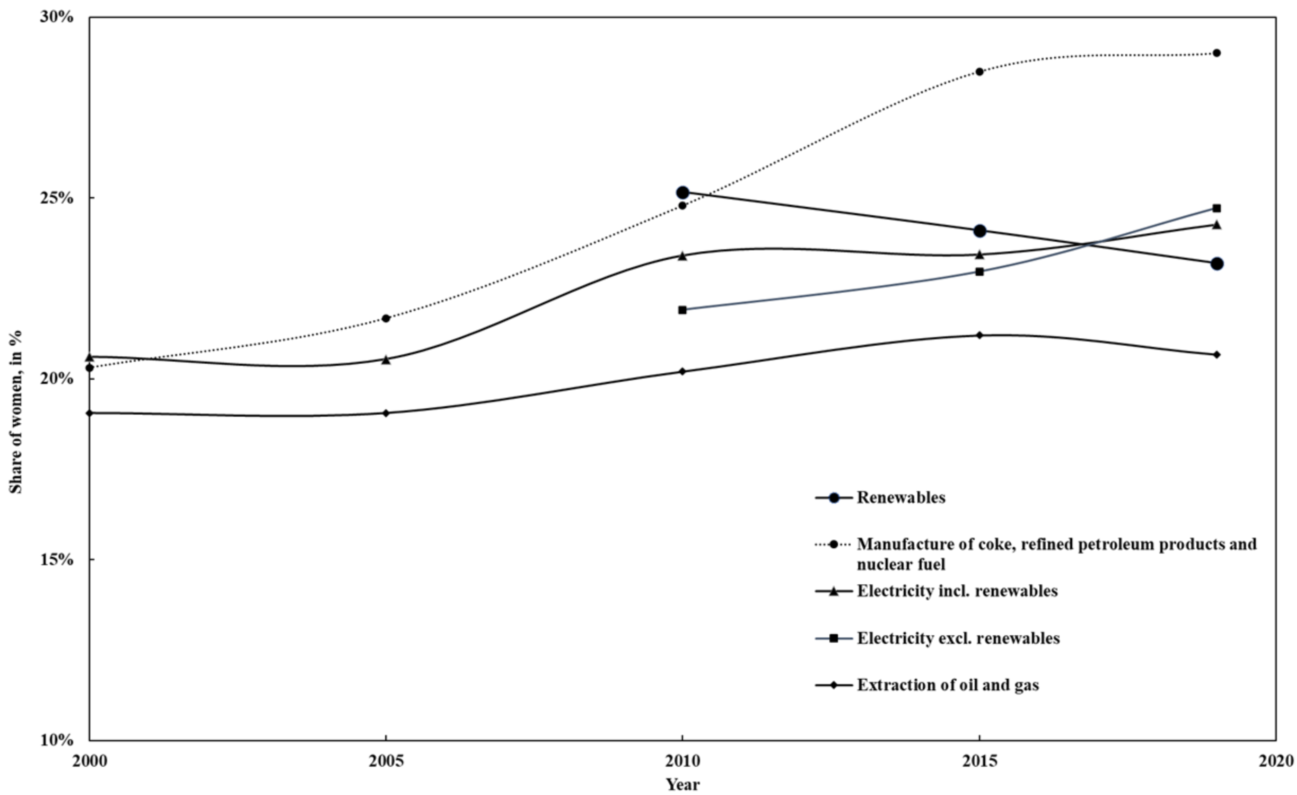
Recall that the traditional share of women in the energy sector is believed to be quite modest. IRENA (2019) finds that the share of women is 32% within renewable energy, but only 22% in the overall energy sector. Norway ranks third in the World Economic Forum's global gender gap index in 2021 (World Economic Forum, 2021). One could therefore imagine that the share of women in the energy sector in Norway would be higher than IRENA's numbers, but this is only partially true, at best.

Figure 3.1 shows the evolution of women's participation in the energy sector over time. As a baseline, the proportion of women among employed people is consistently around 47% for the whole period. Every sub-sector we have data for starts out with a women's share around

20% in 2000, with varying levels of growth over time. The smallest sub-sector, "*Manufacture of coke, refined petroleum and nuclear fuel*" exhibits the biggest increase, going from 20.31% to 29.01% over 19 years. This is certainly promising, but keeping in mind remembering that this sub-sector only accounts for just above 1,000 employees, the overall effect is modest. The biggest sub-sector, "*Extraction of oil and gas*" does on the other hand exhibit nearly no change in the share of women. Starting out at 19.06% in 2000 and peaking at 21.2% in 2015 does not paint a picture of a big evolution.

Recall also that the oil and gas extraction sector also grew quite substantially from 2005 to 2010, especially. The moderate increase in women's participation implies that the share of women among new employees in the sub-sector does not differ remarkably from the original share of women.

Figure 3.1



*This figure is made from register data on occupational sector accessed through microdata.no. Employees are divided by sub-sector and gender, and the percentages are computed in the microdata.no tool. The visualization is manually made using Excel.

Perhaps most surprising is the trend of renewable energy production. From the first data available in 2010 to 2019, the women's share falls almost two percentage points, from 25.16% to 23.2%. Findings from Lucas et al. (2018) suggest that women are more interested in renewable energy than conventional energy. Although figure 3.1 does not rule out this finding definitively, it is worth noting that the renewables sub-sector exhibits the sharpest downward trend among all sub-sectors included. Given the relatively short timeframe (nine years), it is possible that these findings are not representative for the overall trend of the renewables sector, but it is worth noting.

3.5 A summary of employees' wages

Table 3.3

Summary of wages in the energy sector between 2000-2019

	Mean	Std.dev	Observations	25 %	50 %	75 %
			2000			
Male	479673	217499	36455	320433	449213	600346
Female	327179	158155	8944	231145	300241	409395
Total	449403	214580	45400	297552	414586	571008
Female wage in % of men	68.21 %			72.14 %	66.84 %	68.19 %
			2005			
Male	623891	282658	35907	433644	582724	761983
Female	458378	220059	8751	315011	419496	580438
Total	591151	277545	44654	401171	551355	733254
Female wage in % of men	73.47 %			72.64 %	71.99 %	76.17 %
			2010			
Male	811658	401215	50084	558830	736850	976043
Female	642235	321698	13352	432518	579435	797973
Total	775661	389880	63437	526121	705995	941596
Female wage in % of men	79.13 %			77.40 %	78.64 %	81.76 %
			2015			
Male	960741	461634	55744	669317	865068	1120510
Female	807649	392848	15543	555020	724212	972746
Total	927113	450732	71279	638441	835182	1092876
Female wage in % of men	84.07 %			82.92 %	83.72 %	86.81 %
			2019			
Male	1035951	456995	55344	734850	958165	1248128
Female	912506	429304	15283	626025	836667	1115112
Total	1009250	453980	70634	707937	932838	1221993
Female wage in % of men	88.08 %			85.19 %	87.32 %	89.34 %

One measure of gender equality is the overall share of the gender among employees, which was just described for the energy sector. Another measure that is frequently discussed and researched is the gender wage gap. Table 3.3 displays the mean and median wages for males and females from 2000 to 2019, for the complete energy sector. The yearly wages include wage income, including cash wages, taxable payments in kind, sickness benefits, and parental and pregnancy benefits, all in nominal terms. From the table, it is apparent that females are consistently earning less than males. This holds for the mean wages as well as for median wages. The reason behind this gap is not clear and will be further examined in chapter 4 and 5 of this thesis. Findings from IRENA (2019) argues that some of the wage gap can be explained in differences in occupations. This will be further investigated later in the thesis. However, the wage gap shrinks steadily over the years. For mean wages, females have gone from earning 68.21% of what males are earning in 2000 to just over 88% in 2019 measured in nominal terms, narrowing the absolute wage gap to just over 10% in 2019.

The gap in median wages is consistently bigger than for median wages, however the gap differences are quite small. The small differences between mean and median gender wage gaps suggest that there are little differences in extreme outliers between the genders, that could affect the gender gap in mean wages.

3.6 Top 10% of the wage distribution

The last sub-section highlighted the mean and median wages for every employee in the complete energy sector. This sub-section will also look at the complete energy sector but will limit the sample to employees in the top 10% of the wage distribution. Table 3.4 below shows the mean and median wages for the top 10% of the wage distribution. Within this sample, the absolute gender wage gap seems to be very small. This further supports the notion that the selection into occupation plays a part in the gender wage gap, based on an assumption that the top 10% earners come from a quite small selection of occupations. Again, this will be analyzed in greater depth in chapter 4.

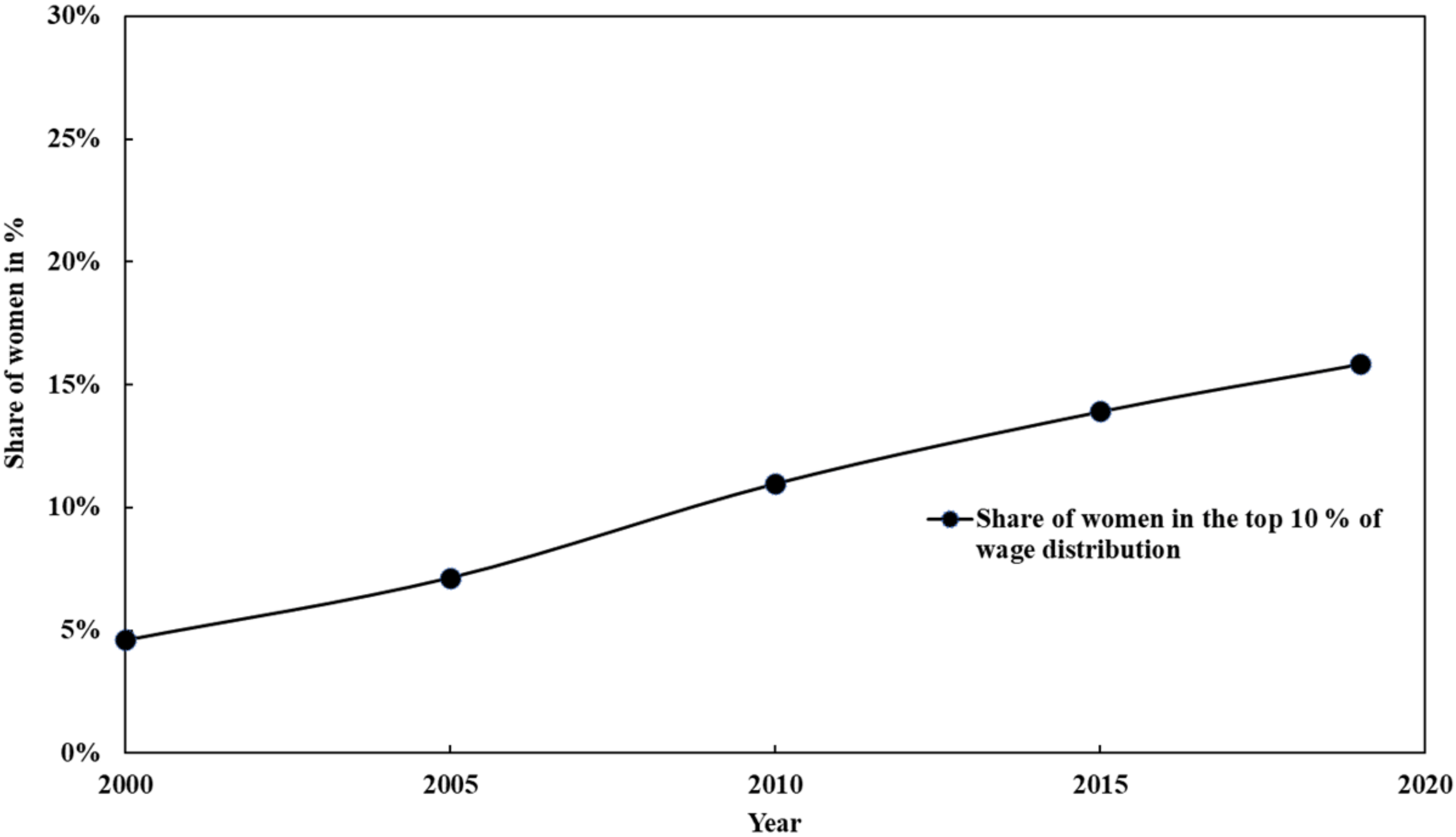
Furthermore, figure 3.2 displays the share of women in the top 10% of the wage distribution. Where the overall share of women in the energy sector shows little sign of growth over the 19 observed years, the share of women among top earners shows a more positive development. Starting out at 4.6% women in 2000, there is a steady growth to 15.84% women in 2019. The increase of women in the top of the wage distribution, along with a quite small gender wage gap within the top 10%, is likely part of the explanation behind the decrease in gender wage gap for the whole energy sector from 2000 to 2019.

Table 3.4

Summary of wages in the energy sector between 2000-2019

	Mean	Std.dev	Observations	25 %	50 %	75 %
			2000			
Male	951802	350807	4332	770633	842170	971546
Female	943458	351185	207	769327	820194	943349
Total	951445	350929	4545	770473	841003	969956
Female wage in % of men	99.12 %			99.83 %	97.39 %	97.10 %
			2005			
Male	1228877	409226	4152	988478	1087807	1273565
Female	1219817	449451	311	992836	1072165	1226535
Total	1227931	410215	4462	988766	1086398	1269520
Female wage in % of men	99.26 %			100.44 %	98.56 %	96.31 %
			2010			
Male	1723746	656679	5659	1330869	1478455	1835445
Female	1644792	494051	687	1333370	1458939	1777226
Total	1714346	636852	6340	1331023	1476393	1824367
Female wage in % of men	95.42 %			100.19 %	98.68 %	96.83 %
			2015			
Male	2053863	726485	6133	1597160	1794839	2214780
Female	1960435	546913	997	1577432	1762373	2154079
Total	2041285	705996	7132	1593725	1790409	2205740
Female wage in % of men	95.45 %			98.76 %	98.19 %	97.26 %
			2019			
Male	2094797	736897	5946	1680808	1853330	2196961
Female	2079986	612643	1112	1683995	1857144	2226099
Total	2092583	717491	7064	1681533	1853613	2202606
Female wage in % of men	99.29 %			100.19 %	100.21 %	101.33 %

Figure 3.2



*As in figure 3.1, this figure is made from register data on occupational sector accessed through microdata.no. Employees from the energy sector is included, while only keeping the wages from the top decile. The percentages are computed in the microdata.no tool. The visualization is manually made using Excel.

Tables 3.5 (left) and 3.6 (right)

Mean characteristics of employees, 2000

2000	Extraction of oil and gas		Manufacture of coke, petroleum, nuclear		Electricity (incl. Renewables)		Energy total	
	Male	Female	Male	Female	Male	Female	Male	Female
Education								
No higher education	63.74 %	57.21 %	80.43 %	65.16 %	74.97 %	79.35 %	68.25 %	65.92 %
Finished bachelor	19.39 %	24.58 %	10.92 %	19.46 %	17.32 %	17.14 %	18.47 %	21.54 %
Finished master	16.30 %	18.05 %	7.92 %	14.93 %	7.53 %	3.42 %	12.94 %	12.35 %
STEM education, bachelor	11.64 %	5.02 %	7.92 %	10.41 %	11.30 %	3.13 %	11.46 %	4.55 %
STEM education, master	14.41 %	15.56 %	6.72 %	12.67 %	6.35 %	2.49 %	11.33 %	10.50 %
Age								
Average age	41.74	38.92	43.62	35.74	44.34	43.61	42.72	40.65
Part time or full time								
Max. 20 hours per week	0.90 %	5.02 %	1.56 %	4.52 %	2.78 %	15.38 %	1.63 %	9.01 %
Max. 30 hours per week	0.26 %	3.63 %	0.84 %	7.69 %	0.74 %	9.56 %	0.44 %	6.11 %
Sum part time	1.16 %	8.65 %	2.40 %	12.21 %	3.52 %	24.94 %	2.07 %	15.12 %
Full time	98.82 %	91.31 %	97.72 %	86.88 %	96.45 %	74.80 %	97.94 %	84.83 %

*STEM education includes education within science, technology, engineering and mathematics. People are assigned based on the classification of their highest completed level of education (e.g., bachelor's, master's or PhD). The bachelor level education that are included in this sample is the following codes: between 651301 - 655110, 655201 - 657108, and 658401 - 659999. For master level or higher: between 741113 - 741115, 751404 - 751499, 752101 - 755299, 755901 - 757199, 758401 - 759999, and 851101 - 859999. All education codes are coded based on Microdata (n.d.).

Mean characteristics of employees, 2005

2005	Extraction of oil and gas		Manufacture of coke, petroleum, nuclear		Electricity (incl. Renewables)		Energy total	
	Male	Female	Male	Female	Male	Female	Male	Female
Education								
No higher education	61.63 %	49.30 %	78.45 %	69.75 %	69.44 %	67.79 %	64.40 %	55.77 %
Finished bachelor	19.43 %	26.12 %	12.72 %	18.07 %	20.26 %	23.96 %	19.50 %	25.27 %
Finished master	18.24 %	23.93 %	10.72 %	13.87 %	10.22 %	7.69 %	15.58 %	18.48 %
STEM education, bachelor	11.45 %	6.45 %	9.78 %	13.45 %	12.65 %	4.41 %	11.75 %	5.93 %
STEM education, master	15.91 %	19.83 %	10.01 %	10.08 %	8.21 %	5.14 %	13.38 %	14.74 %
Number of children								
Children in household	1.01	1.01	0.91	1.18	0.88	0.91	0.97	0.98
Age								
Average age	43.22	40.73	44.59	37.14	45.76	44.21	44.03	41.75
Part time or full time								
Max. 20 hours per week	1.88 %	3.17 %	2.36 %	4.62 %	4.11 %	12.80 %	2.56 %	6.45 %
Max. 30 hours per week	0.27 %	2.57 %	0.94 %	7.98 %	0.50 %	6.30 %	0.35 %	3.97 %
Sum part time	2.15 %	5.74 %	3.30 %	12.60 %	4.61 %	19.10 %	2.91 %	10.42 %
Full time	97.85 %	94.08 %	98.59 %	86.13 %	95.36 %	80.55 %	97.10 %	89.61 %

*STEM education includes education within science, technology, engineering and mathematics. People are assigned based on the classification of their highest completed level of education (e.g., bachelor's, master's or PhD). The bachelor level education that are included in this sample is the following codes: between 651301 - 655110, 655201 - 657108, and 658401 - 659999. For master level or higher: between 741113 - 741115, 751404 - 751499, 752101 - 755299, 755901 - 757199, 758401 - 759999, and 851101 - 859999. All education codes are coded based on Microdata (n.d.).

Tables 3.7 (left) and 3.8 (right)

Mean characteristics of employees, 2010

2010	Extraction of oil and gas		Manufacture of coke, petroleum, nuclear		Renewables		Electricity (excl. Renewables)		Electricity (incl. Renewables)		Energy total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Education												
No higher education	62.05 %	41.84 %	71.46 %	64.40 %	58.85 %	56.59 %	66.32 %	57.59 %	62.93 %	57.01 %	62.46 %	46.22 %
Finished bachelor	18.74 %	28.27 %	16.02 %	20.12 %	23.48 %	28.96 %	22.25 %	30.01 %	22.77 %	29.47 %	19.59 %	28.39 %
Finished master	17.92 %	28.58 %	11.40 %	16.41 %	17.01 %	13.93 %	11.34 %	12.28 %	13.96 %	13.29 %	16.90 %	24.34 %
STEM education, bachelor	11.12 %	7.40 %	10.68 %	13.00 %	13.68 %	4.24 %	13.67 %	6.20 %	13.63 %	5.30 %	11.68 %	7.00 %
STEM education, master	14.81 %	20.64 %	10.06 %	13.00 %	11.92 %	7.37 %	8.93 %	6.72 %	10.20 %	6.72 %	13.69 %	16.93 %
Number of children												
Children in household	0.94	0.96	0.94	1.20	0.87	0.88	0.83	0.90	0.85	0.89	0.92	0.95
Age												
Average age	42.44	40.76	42.51	37.05	46.41	44.27	45.66	43.97	46.00	44.12	43.24	41.53
Part time or full time												
Max. 20 hours per week	2.25 %	3.74 %	3.18 %	7.12 %	5.60 %	12.19 %	4.66 %	10.78 %	5.08 %	11.58 %	2.91 %	5.80 %
Max. 30 hours per week	2.58 %	1.52 %	N/A	3.41 %	0.97 %	5.69 %	0.65 %	3.88 %	0.82 %	4.98 %	2.16 %	2.37 %
Sum part time	4.83 %	5.26 %	3.18 %	10.53 %	6.57 %	17.88 %	5.31 %	14.66 %	5.90 %	16.56 %	5.07 %	8.17 %
Full time	95.15 %	94.83 %	96.10 %	91.95 %	93.22 %	82.01 %	94.76 %	85.05 %	94.02 %	83.73 %	94.93 %	91.89 %
Occupation - leaders												
Percentage that are leaders	10.14 %	10.97 %	7.91 %	4.95 %	11.92 %	8.82 %	11.56 %	8.81 %	11.64 %	8.63 %	10.46 %	10.26 %
Gender distribution, leaders	78.58 %	21.59 %	84.85 %	11.11 %	80.97 %	19.82 %	81.84 %	17.81 %	81.31 %	18.69 %	79.23 %	20.74 %

*STEM education includes education within science, technology, engineering and mathematics. People are assigned based on the classification of their highest completed level of education (e.g., bachelor's, master's or PhD). The bachelor level education that are included in this sample is the following codes: between 651301 - 655110, 655201 - 657108, and 658401 - 659999. For master level or higher: between 741113 - 741115, 751404 - 751499, 752101 - 755299, 755901 - 757199, 758401 - 759999, and 851101 - 859999. All education codes are coded based on Microdata (n.d.).

Mean characteristics of employees, 2015

2015	Extraction of oil and gas		Manufacture of coke, petroleum, nuclear		Renewables		Electricity (excl. Renewables)		Electricity (incl. Renewables)		Energy total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Education												
No higher education	60.24 %	36.32 %	75.40 %	63.22 %	56.42 %	46.71 %	63.90 %	51.30 %	60.92 %	49.21 %	60.59 %	39.83 %
Finished bachelor	17.93 %	27.65 %	14.51 %	19.45 %	23.80 %	30.44 %	23.01 %	32.10 %	23.33 %	31.53 %	19.01 %	28.35 %
Finished master	20.44 %	34.59 %	8.86 %	16.11 %	19.31 %	22.31 %	12.83 %	16.55 %	15.38 %	19.02 %	19.21 %	30.58 %
STEM education, bachelor	10.79 %	8.02 %	11.07 %	15.20 %	14.03 %	4.70 %	14.11 %	6.57 %	14.14 %	6.09 %	11.49 %	7.62 %
STEM education, master	16.61 %	24.03 %	8.00 %	12.77 %	12.72 %	10.55 %	9.39 %	8.56 %	10.72 %	9.37 %	15.25 %	20.42 %
Number of children												
Children in household	0.91	0.94	0.87	0.98	0.85	0.82	0.78	0.89	0.81	0.87	0.88	0.92
Age												
Average age	43.49	42.16	42.16	38.35	46.95	45.44	45.62	43.72	46.14	44.43	44.03	42.60
Part time or full time												
Max. 20 hours per week	1.33 %	2.67 %	1.35 %	4.56 %	2.84 %	6.45 %	2.51 %	5.96 %	2.74 %	6.23 %	1.62 %	3.49 %
Max. 30 hours per week	9.98 %	3.00 %	N/A	3.34 %	1.11 %	4.37 %	1.24 %	2.36 %	1.17 %	3.31 %	7.99 %	3.09 %
Sum part time	11.31 %	5.67 %	1.35 %	7.90 %	3.95 %	10.82 %	3.75 %	8.32 %	3.91 %	9.54 %	9.61 %	6.58 %
Full time	88.61 %	94.39 %	97.91 %	90.88 %	95.49 %	89.18 %	96.19 %	91.11 %	95.86 %	90.46 %	90.29 %	93.41 %
Occupation - leaders												
Percentage that are leaders	11.76 %	10.18 %	8.12 %	5.78 %	14.65 %	11.22 %	11.83 %	10.69 %	12.91 %	10.95 %	11.96 %	10.20 %
Gender distribution, leaders	81.19 %	18.87 %	73.68 %	29.47 %	80.35 %	19.18 %	78.34 %	21.09 %	79.24 %	20.40 %	80.69 %	19.29 %

*STEM education includes education within science, technology, engineering and mathematics. People are assigned based on the classification of their highest completed level of education (e.g., bachelor's, master's or PhD). The bachelor level education that are included in this sample is the following codes: between 651301 - 655110, 655201 - 657108, and 658401 - 659999. For master level or higher: between 741113 - 741115, 751404 - 751499, 752101 - 755299, 755901 - 757199, 758401 - 759999, and 851101 - 859999. All education codes are coded based on Microdata (n.d.).

Table 3.9

Mean characteristics of employees, 2019

	2019											
	Extraction of oil and gas		Manufacture of coke, petroleum, nuclear		Renewables		Electricity (excl. Renewables)		Electricity (incl. Renewables)		Energy total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Education												
No higher education	60.35 %	33.76 %	74.31 %	64.33 %	51.80 %	35.18 %	61.17 %	45.23 %	58.15 %	42.08 %	60.09 %	36.55 %
Finished bachelor	17.53 %	26.62 %	14.40 %	18.82 %	23.42 %	30.49 %	23.76 %	34.06 %	23.59 %	33.00 %	18.82 %	28.06 %
Finished master	20.66 %	37.94 %	10.48 %	16.29 %	23.98 %	32.79 %	14.75 %	20.60 %	17.77 %	24.25 %	19.85 %	33.98 %
STEM education, bachelor	10.81 %	8.71 %	10.25 %	12.92 %	14.47 %	5.45 %	14.02 %	6.21 %	14.27 %	6.17 %	11.55 %	8.16 %
STEM education, master	16.87 %	26.48 %	7.72 %	14.33 %	16.38 %	16.70 %	10.21 %	11.39 %	12.17 %	13.05 %	15.71 %	22.77 %
Number of children												
Children in household	0.88	0.91	0.87	0.91	0.85	0.80	0.77	0.79	0.80	0.80	0.86	0.88
Age												
Average age	44.91	44.05	41.87	39.72	47.39	45.75	45.24	43.97	45.94	44.51	45.08	44.06
Part time or full time												
Max. 20 hours per week	1.12 %	2.59 %	0.69 %	3.37 %	2.67 %	5.28 %	2.49 %	4.11 %	2.59 %	4.49 %	1.44 %	3.12 %
Max. 30 hours per week	8.33 %	2.54 %	1.27 %	1.40 %	0.85 %	2.47 %	0.80 %	2.44 %	0.78 %	2.30 %	6.56 %	2.43 %
Sum part time	9.45 %	5.13 %	1.96 %	4.77 %	3.52 %	7.75 %	3.29 %	6.55 %	3.37 %	6.79 %	8.00 %	5.55 %
Full time	90.49 %	94.83 %	98.27 %	92.70 %	95.68 %	91.82 %	96.63 %	93.86 %	96.39 %	93.32 %	91.90 %	94.36 %
Occupation - leaders												
Percentage that are leaders	10.66 %	10.50 %	5.99 %	6.18 %	15.22 %	13.63 %	11.20 %	10.72 %	12.49 %	11.61 %	11.00 %	10.60 %
Gender distribution, leaders	79.69 %	20.36 %	64.56 %	31.65 %	79.10 %	20.77 %	76.53 %	23.38 %	77.52 %	22.74 %	78.98 %	21.01 %

*STEM education includes education within science, technology, engineering and mathematics. People are assigned based on the classification of their highest completed level of education (e.g., bachelor's, master's or PhD). The bachelor level education that are included in this sample is the following codes: between 651301 - 655110, 655201 - 657108, and 658401 - 659999. For master level or higher: between 741113 - 741115, 751404 - 751499, 752101 - 755299, 755901 - 757199, 758401 - 759999, and 851101 - 859999. All education codes are coded based on Microdata (n.d.).

3.7 Mean characteristics of employees

Tables 3.5 through 3.9 displays mean characteristics for males and females for different dimensions across the energy sector. These statistics argue that women within the complete energy sector in general have a higher level of education than men. The percentage of males and females that have completed at least a bachelor's degree are closest in 2000, in which there is a slight advantage for males in master's degree or higher. After this, women consistently appear to have higher education than men. The renewable sector shows a similar pattern after we have data on the sub-sector from 2010. There is a bigger share of men than women that have completed master's degrees or higher in 2010 in renewables, but this is reversed in 2015 and 2019.

However, when it comes to STEM education the data depicts a different story. There is consistently a smaller share of women with a bachelor's degree in STEM fields than the share for men over the years. This holds for both the complete energy sector and renewables sector. For master's degrees (or higher) in STEM fields, the results in the complete energy sector and renewables sub-sector differ. Apart from 2000 is the share of women with master's degrees in STEM fields bigger than the share of men, for the complete energy sector. In renewables, the male share exceeds the female share for all available years except 2019 (where the difference is very small in favor of females).

Another investigated characteristic is the number of children in the household. This is included as an indicator of domestic unpaid care work, in which women mostly take the biggest responsibility (Ferrant, Pesando, & Nowacka, 2014). Although Norway is viewed as quite a gender equal country, OECD data from 2010 shows that Norwegian women on average spend over 200 minutes per day on unpaid domestic work, whereas men only spend a little over 150 minutes each day (OECD, 2010). For the complete energy sector, the average number of children in the household goes consistently down from 2005 (earliest available data) to 2019. Women are also having more children in the household on average. In the renewables sub-sector, men have more children in the household than women in 2015 and 2019, as opposed to the complete energy sector.

Next, we look at the average age among males and females. Looking at the complete energy sector, women are consistently younger than men. The same pattern can be found in the renewable sub-sector, but the average age is higher here than in the energy sector as a whole.

Until 2015, females are more frequently employed in part-time positions than males. This gap is getting smaller, until the change in 2015. Recall that the reporting and derivation of part-time and full-time employment changed with the introduction of A-ordningen in 2015. This could possibly affect the numbers calculated here, through misreporting or slight alterations in derivation of working hours. However, the trend leading up to 2015 describes women catching up to men in terms of full-time employment, which suggest that women would lead men in full-time employment even with the old measurement method. Women being more employed in full-time positions is driven by the biggest sub-sector, extraction of oil and gas. All other sub-sectors exhibit a trend of males being more employed in full-time positions than women. This is also true for renewables, where just under 10% of women are working part-time in 2019, compared to just under 5% for men.

Lastly, we have data for occupation from 2010 onwards. In tables 3.7 through 3.9, we include data on whether an individual is a leader or not. As mentioned, leaders are here defined as top leaders in public administration, CEOs, leaders of administrative units, sales and research, and leaders in production of goods and service provision. Looking at the percentage of each gender that are leaders, a slightly bigger portion of men than women are leaders. This finding is consistent along all sub-sectors and all years. Perhaps more interesting is the gender distribution among leaders. The share of women with leadership positions are fairly consistent around 20% for the complete energy sector and renewables sub-sector. Remembering that the share of women overall was between 20%-25% for these years, the share of women among leaders is only slightly lower.

3.8 Summary

This chapter has sought to describe the overall trend in the energy sector with the main emphasis on women's labor participation and gender differences. The findings of the descriptive statistics differ somewhat regarding the evolution of the energy sector toward a more gender equal sector. The overall women labor participation in the sector shows only a small improvement over the 19-year period. The share of women in renewable energy even declines. The absolute gender wage gap on the other hand, declines from over 30% in 2000 to just over 10% in 2019. Also, the share of women in the top 10% of the wage distribution shows a steady growth. The absolute gender wage gap in the top 10% is also quite stable and small.

In the mean characteristics of workers, women are catching up with and even surpassing men in terms of education in general. The same trend does not show to the same extent for relevant education (STEM fields in this case). Women are on average younger than men, and have more children in the household, findings that are quite consistent over the period. Another measure that shows promise is the share of women and men in full-time employment. Also, here women catching up and, in some cases, surpassing men in terms of full-time employment. Lastly, the gender distribution among leaders show little sign of improvement, and are more or less following the overall trend of women's labor participation.

4. Analyzing the gender wage gap in the energy sector

Where the last chapter provided a descriptive summary of the energy sectors evolution in terms of gender differences, this chapter seeks to decompose the gender wage gap in the energy sector for a given year. To understand more about gender related challenges in the Norwegian energy sector, an in-depth analysis of the gender wage gap is helpful. The findings here rely on a Blinder-Oaxaca (Blinder, 1973; Oaxaca, 1973) decomposition of the gender wage gap, performed on four different populations. The decomposition will be performed on the full energy sector, and on the sub-sector for renewable energy only. The regressions will be performed for the years 2014 and 2018.

The chapter is structured as follows: first, a description of the Blinder-Oaxaca (B-O) decomposition method. Then, the regression function and relevant variables will be presented. A breakdown of the different samples is provided, before the decomposition results are presented and explained. The next chapter features a discussion of the results.

4.1 The Blinder-Oaxaca decomposition method

The Blinder-Oaxaca (B-O) decomposition method seeks to quantify wage differentials between two or more groups into explained and unexplained portion of a wage gap (Blinder, 1973; Oaxaca, 1973). The unexplained portion of the wage gap is often referred to as discrimination. This method is used to decompose wage gaps between different types of groups, normally between genders or races (Jann, 2008). It is also the most standard approach to decompose the gender wage gap (Kunze, 2008). The following of the method description will focus on measuring and decomposing a gender wage gap, quantifying wage differentials for males and females.

The decomposition is executed by estimating two separate OLS regressions for males and females, respectively (based on Blau & Kahn, 2017; Kunze, 2008; Kunze, 2018):

$$lnW_M = X_M \mathrm{B}_M + u_M \tag{1}$$

$$lnW_F = X_F \mathrm{B}_F + u_F \tag{2}$$

where lnW is the logarithm of wages, β is a vector of coefficients for the vector of explanatory variables, X. u is an error term, and subscripts F and M represent females and males, respectively. Using these OLS estimates, one can perform a B-O decomposition written as follows (Kunze, 2008; Kunze, 2018):

$$(3) \qquad \underbrace{\overline{\ln W_M} - \overline{\ln W_F}}_{Raw\ wage\ gap} = \underbrace{(\bar{X}_M - \bar{X}_F)\beta_M}_{Explained\ part} + \underbrace{\bar{X}_F(\beta_M - \beta_F)}_{Unexplained\ part}$$

where $\hat{\beta}_M$ and $\hat{\beta}_F$ are OLS estimates of β_M and β_F. Also, the decomposition in equation (3) is possible since OLS regressions produce residuals with a zero mean when a constant term is included (Blau & Kahn, 2017). The explained part includes the portion of the wage gap that is attributable to differing endowments (Blinder, 1973). This means that this part measures the size of the gender wage gap that is due to males having more education or work experience than females. Blau and Kahn (2017) describe the explained part as "the impact of gender differences in the explanatory variables evaluated using the male coefficients". As for the unexplained part, Blinder (1973) describes it as the portion of the wage differential attributable to differing coefficients. Together with the unexplained portion of the differential (the difference between constant terms for male and female regressions), the unexplained part is according to Blinder attributable to discrimination. Blau and Kahn (2017) denotes the unexplained part as "the average female residual from the male wage equation". This is computed by taking the difference in coefficients and multiplying it with the female mean of the respective explanatory variable (along with the difference in constant terms).

Kunze (2018) highlights several challenges with this decomposition method. First, the coefficients of explanatory variables could be biased due to omitted variable bias. Second, in most datasets it could be measurement errors, especially in calculating work experience, which in turn can bias estimates. Third, she argues that the explained part could be overstated if explanatory variables themselves are affected by (unobserved) discriminatory behavior. Since the unexplained part of the wage gap is computed as a residual value, the magnitude of the gap attributed to discrimination is likely biased if the explanatory variables themselves are biased (Kunze, 2008). She further argues that the direction of the bias is not clear.

4.2 Regression specification

In the application of the B-O decomposition, we want to estimate gender specific regressions for four samples, namely the whole energy sector (excluding renewables), and renewables itself, for the years 2014 and 2018. We want to control for several variables related to human capital, as well as other variables not directly tied to human capital. Equation (4) below describes the regression we conduct for the different samples:

$$\ln W_i^g = \beta_0 + \beta_1 edu_i^g + \beta_2 experience_i^g + \beta_3 (experience^2)_i^g + \beta_4 occupation_i^g + \beta_5 children_i^g + \beta_6 STEMedu_i^g + \beta_7 workhours_i^g + u_i^g \tag{4}$$

where subscripts g and i denote gender and each individual, respectively. Furthermore, $\ln W_i^g$ represents the logarithm of yearly wages for an individual of gender female or male. This is the outcome variable for which we will study the gap between the genders. β_x represents the coefficients belonging to the different explanatory variables.

In addition to estimating equation (4), we want to investigate if the inclusion of area and sub-sector dummies affect the decompositions. The area and sub-sector dummies will be further described in the following sub-section. Including these dummy variables, we also estimate the following equation:

$$\ln W_i^g = \beta_0 + \beta_1 edu_i^g + \beta_2 experience_i^g + \beta_3 (experience^2)_i^g + \beta_4 occupation_i^g + \beta_5 children_i^g + \beta_6 STEMedu_i^g + \beta_7 workhours_i^g + \delta area_i^g + \lambda subsector_i^g + u_i^g \tag{5}$$

where δ is a vector of area coefficients and λ is a vector of sub-sector coefficients. In other aspects is (5) equal to (4). However, since there are no sub-sectors at a more detailed level than renewables, for the sample investigating gender gap in renewables *subsector* is removed. For the renewables sample, (6) is estimated.

$$\ln W_i^g = \beta_0 + \beta_1 edu_i^g + \beta_2 experience_i^g + \beta_3 (experience^2)_i^g + \beta_4 occupation_i^g + \beta_5 children_i^g + \beta_6 STEMedu_i^g + \beta_7 workhours_i^g + \delta area_i^g + u_i^g \tag{6}$$

Lastly, we want to control for any overtime and experience within a company where the data allows for it. Statistics Norway has these data in 2018, so for that year we estimate the following:

$$\ln W_i^g = \beta_0 + \beta_1 edu_i^g + \beta_2 experience_i^g + \beta_3 (experience^2)_i^g + \beta_4 Exp\_intern_i^g + \beta_5 occupation_i^g + \beta_6 children_i^g + \beta_7 STEMedu_i^g + \beta_8 workhours_i^g + \beta_9 overtime_i^g + \delta area_i^g + u_i^g \quad (7)$$

In the following sub-section, the variables will be explained in further detail.

4.3 Description of variables, 2014

All data on variables comes from Norwegian register data through the microdata.no platform.

4.3.1 Yearly wages

The yearly wages include wage income, including cash wages, taxable payments in kind, sickness benefits, and parental and pregnancy benefits for the year 2014. Since the dependent variable is the logarithm of wages, the coefficients should be interpreted as the percentage change in wages for every unit the explanatory variables increase (Wooldridge, 2019).

4.3.2 Education

The education (*edu*) variable is created by utilizing the education dummies described in chapter 3 on descriptive statistics. These are now extended to take four values, describing no higher education, bachelor’s degree as highest, master’s degree as highest, and PhD as highest. These are subsequently transformed into years of schooling, based on nominal length of study for the respective education level. E.g., a person with a bachelor's degree as their highest education would be assigned the nominal length of education up to and including high school plus the nominal length of a bachelor's degree as their years of schooling.

The variable *STEMedu* is also included in the regression. This is a dummy variable that takes the value zero if the employee has not finished a bachelor's degree or higher in STEM fields and takes the value one if he or she has a STEM degree from at least bachelor's level.

4.3.3 Experience

Using the years of education variable mentioned above, the labor market experience variable is created. This variable is also measured in years. *Experience* is created by subtracting years of schooling from each individuals' age, as well as subtracting six for the years before entering elementary school. The square of *experience*, $experience^2$, is also included. This is included to allow for a non-linear relationship between logarithmic wages and experience and capture any increasing or decreasing marginal effects (Wooldridge, 2019).

4.3.4 Occupation

The *occupation* variable is a set of dummy variables that take one of four values. The base category is *other*, meaning every individual that do not fall into one of the three other categories. The second category is the previously described *leader* category, described in chapter 3. Third is a category for whether the occupation is a typical STEM job or not, called *stem_work*. Since the IRENA (2019) survey found that the share of women was substantially higher in administrative position than STEM positions, we also want to include a category for administrative occupations, *admin*. This category includes accountants, auditors, office employees and more.

4.3.5 Children

The variable *children* is the same variable as the variable used to compute children in households in chapter 3. Recall that to be counted as a child in the household, the child must be under 18 years old and be a registered resident in the household of at least one parent. Children that live with other adults than their parents are not counted as children in the household.

4.3.6 Hours worked

Utilizing register data on the exact hours worked, we create the variable *workhours*. The hours are agreed working hours, which is derived from the number of hours the working contract states the employee should work during one week. As was the case for the classification into full-time and part-time workers in chapter 3, it is important to note that the hours worked per week refers only to the main employment. If a person has several part-time jobs adding up to several hours that equal a full-time arrangement, only the hours from the biggest employment are included.

4.3.7 Area dummy variables

The area dummy variables are created using employees' registered addresses according to the National Population Register. The addresses are connected to municipalities, which is used to group employees into different regions (Western, Eastern, Northern, Southern, and Trøndelag). For the energy sector, the biggest region is the Western region, which is therefore used as the base category in regressions.

4.3.8 Sub-sector dummy variables

The sub-sector dummy variables are computed the same way as the sub-sectors used in the descriptive analysis. Here, the categories included are "*Extraction of oil and gas*", "*Manufacture of coke, refined petroleum products and nuclear fuel*", and "*Electricity, gas and water supply, excluding renewables*". The biggest sector, "*Extraction of oil and gas*", is used as the base category.

4.4 Description of variables, 2018

This sub-section includes a presentation of the new variables used in the B-O decomposition for the 2018 cross-section. The previously described variables are also included in the 2018 decomposition.

4.4.1 Experience

As for the decompositions in 2014, *experience* and $experience^2$ is included and created in the same way as mentioned. After the introduction of A-ordningen in 2015, some additional employment related variables were made available. Therefore, we can control for tenure inside each company using the registered start date. *exp_intern* is created by subtracting the start year from this year (2018). This variable does only cover experience within the specific firm they are employed at in 2018, and therefore we do not use it to create actual total work experience. Work experience is still approximated like in the 2014 samples.

4.4.2 Overtime

In 2014, there was no data available on the amount of overtime worked by each employee. For 2018, however, Microdata provide data collected through A-ordningen on total hours of overtime worked during the year. The variable created, *overtime*, includes all reported overtime hours that are used as basis for overtime pay. Overtime hours that are exchanged in time off are not included. In the event that the overtime hours are both exchanged in time off and paid out as salary, the hours are included in the variable.

4.5 Breakdown of samples

The four samples for which we will decompose the gender wage gap are as mentioned the full energy sector (without renewables), and on the sub-sector for renewable energy only, for the years 2014 and 2018. All samples include only employees between ages 25 and 64, in line with the study of Blau and Kahn (2017).

4.5.1 2014

Starting out with people in this age interval and keeping only those who are employed in the energy sector, we have 72 346 employees. For the first of two 2014 samples, we want to exclude people working in renewables, so these are omitted from the sample. 5 886 employees are removed, leaving the sample size for the first sample at 66 460 observations.

As for the second sample, this is also restricted into the age interval from 25 to 64. Here, we keep only those who belong to the renewables sub-sector. This gives a sample size of 5 886.

4.5.2 2018

The methodology for the breakdown of samples in 2018 is identical to the method used in 2014. First, keeping only those employed in the energy sector limits the population to 62 248. After removing the 4 744 employed in the renewables sector, the full energy sector sample includes 57 504 employees. Conversely, the 2018 renewables sample contain 4 744 employees.

4.6 Summary statistics of samples

Tables 4.1 and 4.2 provides a summary of characteristics within the samples used in the decomposition. The average age for each sub-division of samples ranges from 42.3 (females in the full sector, 2014) to 48 (males in renewables, 2018). Both males and females are on average older in 2018 than 2014 across both the full sector and the renewables sector. Regarding wages, the average wages are higher in the full sector than in the renewables sector for both years. In fact, although there is a quite clear gender wage gap across all dimensions and the average age is higher in renewables, females in the full sector earn on average more than males in renewables in both years. Recall that the full sector is dominated by people in the traditionally lucrative oil and gas sector.

Table 4.1, summary statistics of samples 2014

2014

Full sector

Male

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	43.940	10.5112	52124	35	44	53
Year of birth	1970.060	10.5112	52124	1961	1970	1979
Wages	992313.608	451799.6796	52124	696694.5	892049	1149421
Log of wages	13.722	0.4059	52124	13.4541	13.7013	13.9548

Female

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	42.335	9.7349	14341	34	42	50
Year of birth	1971.665	9.7349	14341	1964	1972	1980
Wages	811222.023	383114.9614	14341	559682.5	722446	967052
Log of wages	13.508	0.4420	14341	13.2351	13.4904	13.7820

Renewables

Male

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	47.728	10.3556	4383	40	49	56
Year of birth	1966.272	10.3556	4383	1958	1965	1974
Wages	781080.029	333465.6843	4383	584100.5	704843	892598
Log of wages	13.486	0.4189	4383	13.2778	13.4657	13.7019

Female

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	45.703	10.1741	1492	38	47	53
Year of birth	1968.297	10.1741	1492	1961	1967	1976
Wages	623577.866	306942.3963	1492	442026	548439	767082
Log of wages	13.222	0.5216	1492	12.9991	13.2148	13.5503

Table 4.2, summary statistics of samples 2018

2018

Full sector

Male

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	45.732	10.2173	44946	37	46	54
Year of birth	1972.268	10.2173	44946	1964	1972	1981
Wages	954477.640	434364.2405	44946	679150.5	876017.5	1124415
Log of wages	13.665	0.4866	44946	13.4286	13.6831	13.9328

Female

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	44.458	9.8666	12556	36	45	52
Year of birth	1973.542	9.8666	12556	1966	1973	1982
Wages	785739.208	391853.0812	12556	543187	715290	960510
Log of wages	13.430	0.6075	12556	13.2052	13.4804	13.7752

Renewables

Male

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	48.010	10.3960	3591	40	50	57
Year of birth	1969.990	10.3960	3591	1961	1968	1978
Wages	773550.656	340595.7564	3591	585694.5	711879	899615.25
Log of wages	13.442	0.5619	3591	13.2806	13.4757	13.7097

Female

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
Age	46.900	9.8996	1152	39	49	55
Year of birth	1971.100	9.8996	1152	1963	1969	1979
Wages	641639.435	318847.8494	1152	452380	579634	800172
Log of wages	13.220	0.6337	1152	13.0223	13.2702	13.5926

4.7 Summary statistics of variables

Tables 4.3-4.6 provide summary statistics for the explanatory variables used in the regressions. The summary statistics are divided into summaries for males and females within each of the four samples investigated. These mean values will be necessary to evaluate the gender wage gap once the coefficients are estimated.

At the mean, women exceed men in years of schooling for every sample, however the gap is smallest within the renewables only samples. Work experiences show the opposite, men have more experience in the labor market than women, at the mean. Regarding children in the household, women have more children on average in two of four samples. Males in renewables have more children than women, but they have less children than the males the full energy sample. This is true for both years. The renewables sample continue to stand out when looking at the share with higher education in STEM fields. The share of females with STEM education in renewables is lower than for males, but the opposite is true for the full energy samples. Average hours worked per week is quite even between genders in all samples. However, renewables for both years have the biggest gaps, and in both renewables samples males are working more hours although the gap is still small. For the 2018 samples, males on average work more overtime than females. For the 2018 full energy sector, females have worked longer at their current company than males, while the opposite is true for the 2018 renewables sample.

Looking at the occupation variables, it is apparent that females are more prominent in administrative positions. The share of STEM positions is quite even between genders, except for in renewables. In 2014, only 16.91% of females have STEM positions, compared to 40.09% of males. In 2018, the numbers are 14.47% for females and 28.96% for males.

Table 4.3

Full energy sector without renewables, 2014

Summary statistics for regression variables

Male							Female						
Variable	**Mean**	**Std.dev**	**Observations**	**25 %**	**50 %**	**75 %**	**Variable**	**Mean**	**Std.dev**	**Observations**	**25 %**	**50 %**	**75 %**
edu	14.6112	2.1754	52124	13	13	16	edu	15.5421	2.2391	14341	13	16	18
experience	23.3418	10.8006	52124	14	23	32	experience	20.8044	10.5848	14341	12	21	29
experience^2	661.4899	519.6244	52124	196	529	1024	experience^2	544.8523	466.7051	14341	144	441	841
children	0.9141	1.0772	52124	0	0	2	children	0.9399	1.0225	14341	0	1	2
STEMedu	0.2732	0.4456	52124	0	0	1	STEMedu	0.2971	0.4570	14341	0	0	1
workhours	35.7972	3.0638	52124	33.6	37.5	37.5	workhours	35.8732	4.0272	14341	37.5	37.5	37.5
Occupations							**Occupations**						
leader	0.1120	0.3154	52124	0	0	0	leader	0.1021	0.3028	14341	0	0	0
stem_work	0.3732	0.4837	52124	0	0	1	stem_work	0.3676	0.4822	14341	0	0	1
admin	0.0468	0.2113	52124	0	0	0	admin	0.2835	0.4507	14341	0	0	1
Area							**Area**						
eastern	0.1750	0.3799	52124	0	0	0	eastern	0.1885	0.3911	14341	0	0	0
northern	0.0588	0.2353	52124	0	0	0	northern	0.0383	0.1919	14341	0	0	0
southern	0.0558	0.2296	52124	0	0	0	southern	0.0243	0.1539	14341	0	0	0
trondelag	0.0641	0.2449	52124	0	0	0	trondelag	0.0525	0.2230	14341	0	0	0
Subsector							**Subsector**						
Manufacture	0.0145	0.1197	52124	0	0	0	Manufacture	0.0183	0.1339	14341	0	0	0
Electricity	0.1175	0.3221	52124	0	0	0	Electricity	0.1311	0.3375	14341	0	0	0

Table 4.4

Renewables, 2014

Summary statistics for regression variables

Male							Female						
Variable	**Mean**	**Std.dev**	**Observations**	**25 %**	**50 %**	**75 %**	**Variable**	**Mean**	**Std.dev**	**Observations**	**25 %**	**50 %**	**75 %**
edu	14.7504	2.0456	4383	13	13	16	edu	14.9699	2.0325	1492	13	16	16
experience	26.9498	10.8511	4383	19	28	36	experience	24.7199	11.1286	1492	16	26	33
$experience^2$	844.0116	560.7318	4383	361	784	1296	$experience^2$	734.8376	546.1650	1492	256	676	1089
children	0.8952	1.0768	4383	0	0	2	children	0.8583	1.0189	1492	0	0	2
STEMedu	0.2813	0.4497	4383	0	0	1	STEMedu	0.1444	0.3516	1492	0	0	0
workhours	36.6386	3.7508	4383	37.5	37.5	37.5	workhours	34.7895	6.2148	1492	37.5	37.5	37.5
Occupations							**Occupations**						
leader	0.1332	0.3399	4383	0	0	0	leader	0.0949	0.2932	1492	0	0	0
stem_work	0.4009	0.4901	4383	0	0	1	stem_work	0.1691	0.3750	1492	0	0	0
admin	0.1154	0.3196	4383	0	0	0	admin	0.4953	0.5001	1492	0	0	1
Area							**Area**						
eastern	0.3500	0.4770	4383	0	0	1	eastern	0.4479	0.4974	1492	0	0	1
northern	0.1346	0.3413	4383	0	0	0	northern	0.1056	0.3074	1492	0	0	0
southern	0.0819	0.2743	4383	0	0	0	southern	0.0682	0.2521	1492	0	0	0
trondelag	0.0906	0.2870	4383	0	0	0	trondelag	0.0862	0.2808	1492	0	0	0

Table 4.5

Full energy sector without renewables, 2018

Summary statistics for regression variables

Male

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
edu	14.6653	2.1995	44946	13	13	16
experience	25.0625	10.4852	44946	17	26	34
experience^2	738.0650	526.1271	44946	289	676	1156
exp_intern	6.2581	7.6130	44946	1	4	9
children	0.9226	1.0773	44946	0	0	2
STEMedu	0.2843	0.4511	44946	0	0	1
workhours	35.3227	3.5148	44924	33.6	37.5	37.5
overtime	9.3687	20.0704	44924	0	0	9
Occupations						
leader	0.1129	0.3165	44946	0	0	0
stem_work	0.3665	0.4818	44946	0	0	1
admin	0.0522	0.2223	44946	0	0	0
Area						
eastern	0.1910	0.3931	44946	0	0	0
northern	0.0615	0.2402	44946	0	0	0
southern	0.0502	0.2183	44946	0	0	0
trondelag	0.0647	0.2461	44946	0	0	0
Subsector						
Manufacture	0.0152	0.1223	44946	0	0	0
Electricity	0.1558	0.3626	44946	0	0	0

Female

Variable	Mean	Std.dev	Observations	25 %	50 %	75 %
edu	15.6825	2.2545	12556	13	16	18
experience	22.7741	10.5813	12556	14	23	31
experience^2	630.6162	492.4737	12556	196	529	961
exp_intern	7.5287	8.2251	12556	2	5	10.25
children	0.9403	1.0185	12556	0	1	2
STEMedu	0.3277	0.4694	12556	0	0	1
workhours	35.8229	4.2146	12556	37.5	37.5	37.5
overtime	3.9278	10.9994	12556	0	0	0
Occupations						
leader	0.1083	0.3107	12556	0	0	0
stem_work	0.4051	0.4909	12556	0	0	1
admin	0.2549	0.4358	12556	0	0	1
Area						
eastern	0.2224	0.4158	12556	0	0	0
northern	0.0439	0.2048	12556	0	0	0
southern	0.0219	0.1463	12556	0	0	0
trondelag	0.0525	0.2230	12556	0	0	0
Subsector						
Manufacture	0.0234	0.1512	12556	0	0	0
Electricity	0.1877	0.3905	12556	0	0	0

Table 4.6

Renewables, 2018

Summary statistics for regression variables

Male							Female						
Variable	**Mean**	**Std.dev**	**Observations**	**25 %**	**50 %**	**75 %**	**Variable**	**Mean**	**Std.dev**	**Observations**	**25 %**	**50 %**	**75 %**
edu	15.0368	2.1860	3591	13	16	16	edu	15.4792	2.1641	1152	13	16	18
experience	26.9877	10.8620	3591	18	28	36	experience	25.4246	10.9325	1152	16	27	34
$experience^2$	846.2882	560.7088	3591	324	784	1296	$experience^2$	765.8267	539.5416	1152	256	729	1156
exp_intern	9.5839	10.2179	3591	2	6	12	exp_intern	8.3562	8.5833	1152	2	6	11
children	0.9139	1.0936	3591	0	0	2	children	0.8362	1.0108	1152	0	0	2
STEMedu	0.3119	0.4633	3591	0	0	1	STEMedu	0.1958	0.3970	1152	0	0	0
workhours	37.0874	3.7565	3591	37.5	37.5	37.5	workhours	36.0616	5.3138	1152	37.5	37.5	37.5
overtime	6.8520	13.0644	3591	0	0	8	overtime	1.9287	5.4525	1152	0	0	0
Occupations							**Occupations**						
leader	0.1676	0.3736	3591	0	0	0	leader	0.1256	0.3316	1152	0	0	0
stem_work	0.2896	0.4536	3591	0	0	1	stem_work	0.1447	0.3520	1152	0	0	0
admin	0.1298	0.3361	3591	0	0	0	admin	0.5251	0.4996	1152	0	1	1
Area							**Area**						
eastern	0.3815	0.4858	3591	0	0	1	eastern	0.4350	0.4960	1152	0	0	1
northern	0.1128	0.3164	3591	0	0	0	northern	0.0771	0.2669	1152	0	0	0
southern	0.0936	0.2913	3591	0	0	0	southern	0.0875	0.2827	1152	0	0	0
trondelag	0.0922	0.2893	3591	0	0	0	trondelag	0.0971	0.2962	1152	0	0	0

4.8 Results, 2014

This sub-section will present the results of the B-O decompositions for the different samples in 2014. The results for the full energy sector (excluding renewables) are first discussed, before the renewables sample is evaluated. All results that are discussed are summarized in tables 4.7 and 4.8, and the underlying regression results are presented in table 4.9. The presentation of the results is modelled after Blau and Kahn (2017), where the gap is quantified in log points and log points are in turn used to describe how much the variables affect the gender wage gap, and in which direction. The sub-section is finalized with a short summary of the results before the next chapter provides a discussion of implications of the findings.

4.8.1 Full energy sector without renewables

Without area and subsector

Looking at table 4.7, we see the results of the decomposition without area and sub-sector dummies. The results show differing effects among the variables. For the full energy sector, we find that females on average have more education than males which results in a negative impact on the gender wage gap of -21.64% (-0.046 log points). A negative impact here means that females' years of education affects the wage gap in favor of females. A positive percentage means that this variable impact the gender wage gap in favor of males. An example is the *experience* variables, which combined contributes 11.32% (0.024 log points) to the gender wage gap. This is mainly driven by the linear *experience* variable, that contributes 48.75% to the gap. Some of this figure is countered by *experience*^{2} (-37.43%). A negative value of the squared experience variable while the linear term is positive suggests that the experience effect get smaller when experience grows large.

The rest of the non-occupation variables contribute very little to the overall wage gap. It is also worth noting that the coefficient for *STEMedu* is not significant at the 5% level in the male regression. The male coefficient is smaller than the female coefficient, and its use in computing the explained part of the gender gap helps to limit the overall contribution to -0.08% of the gap. However, the coefficient is significant when estimating equation (5) and its contribution to the wage gap is also then modest (-0.13%, shown in table 4.8).

The occupation variables together explain 4.82% (0.010 log points) of the wage gap. The biggest contributor is *admin* which explain 3.01%. This suggest that in terms of occupations, the higher female share in administrative positions explain most of the gender gap. However, it is a quite small contributor overall.

Summed together, we find that the included variables explain -5.73% of the gender wage gap. That is, based purely on the included variables, women should be earning *more* than their male counterparts. Inversely, the unexplained factors contribute 105.73% to the overall wage gap. Most of this unexplained gap comes from the difference in intercepts. However, some of the unexplained gap from intercepts are countered by the unexplained gap coming from the variable *workhours*. Since hours worked are drawn from the agreed upon working time, it does not include overtime, the real number of hours worked. If women take on more of the unpaid domestic work than men, it is likely that males on average will work more overtime, which in turn would explain part of the gender wage gap.

Decompositions 2014

Table 4.7

Blinder-Oaxaca decomposition 2014
Without area and subsector

	Full energy sector		**Renewables**	
Variables	Log points	Percentage of gender gap explained	Log points	Percentage of gender gap explained
Explained gap				
Edu	-0.0463	-21.64 %	-0.0163	-6.18 %
Experience	0.1042	48.75 %	0.0735	27.83 %
Experience^2	-0.0800	-37.43 %	-0.0584	-22.11 %
Children	-0.0004	-0.20 %	0.0006	0.21 %
STEMedu	-0.0002	-0.08 %	-0.0047	-1.80 %
Workhours	0.0001	0.04 %	0.0911	34.47 %
Occupations				
Leader	0.0035	1.62 %	0.0158	5.97 %
STEM_work	0.0004	0.19 %	0.0386	14.61 %
Admin	0.0064	3.01 %	-0.0588	-22.26 %
Sum Occupations	0.0103	4.82 %	-0.0044	-1.67 %
Sum Explained gap	-0.0122	-5.73 %	0.0813	30.76 %
Sum Unexplained gap	0.2260	105.73 %	0.1829	69.24 %
Total pay gap	0.2138	100.00 %	0.2642	100.00 %

*The sample includes workers in the energy sector between the ages of 25-64 years old. The log points refer to the difference between male and female endowments multiplied with the male log wage coefficients for each variable. The total unexplained gap is the mean female residual from the male log wage equation.

Table 4.8

Blinder-Oaxaca decomposition 2014
Including area and subsector

Variables	Full energy sector: Log points	Full energy sector: Percentage of gender gap explained	Renewables: Log points	Renewables: Percentage of gender gap explained
Explained gap				
Edu	-0.0411	-19.20 %	-0.0148	-5.61 %
Experience	0.1014	47.41 %	0.0741	28.08 %
Experience^2	-0.0742	-34.69 %	-0.0587	-22.26 %
Children	-0.0005	-0.22 %	0.0006	0.24 %
STEMedu	-0.0003	-0.13 %	-0.0031	-1.17 %
Workhours	-0.0002	-0.09 %	0.0908	34.43 %
Occupations				
Leader	0.0036	1.69 %	0.0156	5.92 %
STEM_work	0.0005	0.23 %	0.0381	14.43 %
Admin	-0.0075	-3.48 %	-0.0603	-22.84 %
Sum Occupations	-0.0033	-1.56 %	-0.0065	-2.48 %
Area				
Eastern	-0.0005	-0.25 %	-0.0113	-4.29 %
Northern	-0.0002	-0.11 %	-0.0002	-0.08 %
Southern	0.0009	0.44 %	0.0004	0.16 %
Trøndelag	-0.0006	-0.27 %	-0.0001	-0.03 %
Sum Area	-0.0004	-0.18 %	-0.0112	-4.25 %
Subsector				
Manufacture	0.0007	0.31 %		
Electricity	0.0054	2.52 %		
Sum subsector	0.0060	2.83 %		
Sum Explained gap	-0.0125	-5.84 %	0.0712	26.97 %
Sum Unexplained gap	0.2263	105.84 %	0.1927	73.03 %
Total pay gap	0.2138	100.00 %	0.2639	100.00 %

*The sample includes workers in the energy sector between the ages of 25-64 years old. The log points refer to the difference between male and female endowments multiplied with the male log wage coefficients for each variable. The total unexplained gap is the mean female residual from the male log wage equation.

Underlying regressions 2014

Table 4.9

Regression results 2014

	Full energy sector excl. Renewables				Renewables			
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Edu	0.0497***	0.0647***	0.0441***	0.0604***	0.0744***	0.0955***	0.0675***	0.0932***
	(0.00132)	(0.00199)	(0.00125)	(0.00192)	(0.00361)	(0.00621)	(0.00362)	(0.00618)
Experience	0.0411***	0.0533***	0.04***	0.0521***	0.033***	0.0497***	0.0332***	0.0502***
	(0.00077)	(0.00138)	(0.00073)	(0.00132)	(0.00232)	(0.004)	(0.00229)	(0.00396)
$Experience^2$	-0.0007***	-0.0009***	-0.0006***	-0.0009***	-0.0005***	-0.0008***	-0.0005***	-0.0008***
	(0.00002)	(0.00003)	(0.00002)	(0.00003)	(0.00005)	(0.00008)	(0.00005)	(0.00008)
Children	0.0164***	-0.0288***	0.0183***	-0.0242***	0.015***	0.0036	0.0171***	0.0062
	(0.00177)	(0.00355)	(0.00168)	(0.00339)	(0.00532)	(0.01092)	(0.00525)	(0.01082)
STEMedu	0.0068	0.0716***	0.0119**	0.0732***	-0.0346**	0.0084	-0.0226	0.0207
	(0.00611)	(0.00936)	(0.00578)	(0.00895)	(0.01537)	(0.03242)	(0.0152)	(0.03213)
Workhours	-0.0011**	0.0287***	0.0026***	0.0283***	0.0493***	0.0414***	0.0491***	0.041***
	(0.00048)	(0.00079)	(0.00045)	(0.00076)	(0.00119)	(0.00158)	(0.00117)	(0.00157)
Occupations								
Leader	0.3493***	0.2744***	0.3627***	0.2716***	0.4118***	0.4996***	0.4079***	0.4931***
	(0.00616)	(0.0126)	(0.00583)	(0.01204)	(0.01759)	(0.03892)	(0.01735)	(0.03865)
STEM_work	0.0734***	0.0034	0.0901***	-0.0205**	0.1666***	0.2351***	0.1644***	0.2183***
	(0.00432)	(0.00932)	(0.0041)	(0.00894)	(0.01222)	(0.03375)	(0.01205)	(0.0337)
Admin	-0.0272***	-0.167***	0.0315***	-0.1519***	0.1548***	0.1007***	0.1587***	0.1048***
	(0.00864)	(0.00896)	(0.00822)	(0.00858)	(0.01794)	(0.02412)	(0.01772)	(0.02403)
Area								
Eastern			0.0391***	0.0528***			0.1157***	0.1102***
			(0.00454)	(0.00831)			(0.01193)	(0.02236)
Northern			-0.0113	-0.0193			-0.0076	-0.0413
			(0.00706)	(0.01626)			(0.01566)	(0.03354)
Southern			0.03***	0.0056			0.0307	0.0554
			(0.00714)	(0.01991)			(0.01895)	(0.03954)
Trøndelag			-0.0491***	-0.0385***			-0.02	0.0176
			(0.00672)	(0.01376)			(0.01814)	(0.03633)
Subsector								
Manufacture			-0.1752***	-0.1227***				
			(0.01352)	(0.02268)				
Electricity			-0.3986***	-0.3479***				
			(0.00535)	(0.00984)				
Intercept	12.4463***	10.8852***	12.4208***	11.0117***	9.9967***	9.5803***	10.0548***	9.5668***
	(0.02499)	(0.04165)	(0.02372)	(0.04005)	(0.07104)	(0.11695)	(0.07036)	(0.11711)
Observations	51966	14324	51966	14324	4370	1493	4370	1493
R^2	0.2299	0.3668	0.3115	0.4234	0.5209	0.5899	0.5347	0.5999
Adjusted R^2	0.2298	0.3664	0.3113	0.4228	0.5199	0.5874	0.5333	0.5964

*The sample includes workers in the energy sector between the ages of 25-64 years old. Regressions (1) through (4) is performed on the full energy sector, while (5) through (8) is for renewables. Standard errors are showed in parentheses, and significance levels are shown like this: ***p<0.01, **p<0.05, *p<0.1

Full specification

Table 4.8 presents the results based on the estimations of regression equation (5) for the full energy sector without renewables. This specification includes area dummies and subsector dummies. Comparing table 4.7 to table 4.8 for the full energy sample, there are only small differences. Coefficients for the experience variables in total explain a little more of the gender gap in, explaining 12.72% in the full specification compared to 11.32% in table 4.7. Breaking down experience variables, they still show the same pattern of lower returns to experience when experience grows large. Females does still have more education than males, which now explains -19.2% compared to -21.64% in table 4.7, also a small difference.

As before, the rest of the non-occupation variables contribute little to the overall gap. The coefficient for *STEMedu* in the male regression was not significant in the previous estimation, but the coefficient in the full specification is now significant. The contribution to the overall is small and similar to the results in table 4.7.

The findings among occupation variables have now changed its contribution from 4.82% to -1.56%. The reason for this is because the contribution from *admin* has changed from 3.01% to -3.48%. This change is in turn driven by a positive coefficient for *admin* in the male regression for the full specification. The overall contribution from occupations is still small.

The newly implemented area and subsector dummy variables are also explaining only a small part of the gender wage gap themselves. The combined effect of *area* is -0.18%, and for *subsector* it is 2.83%.

The sum of the total explained gap is -5.84% for the full specification, compared to -5.73% without area and sub-sector. This corresponds to a total unexplained gap of 105.84%, very similar to the findings from table 4.7. The unexplained gap in table 4.8 does also show a lot of the same properties as the unexplained gap in table 4.7, with most of the difference coming from the difference in intercepts. Overtime is still not controlled for, which could affect the results as mentioned.

4.8.2 Renewables

Without area

While the B-O decomposition of the full energy sector showed a large unexplained gap, the findings from the renewables sub-sector are somewhat different. Table 4.7 summarizes the findings from the estimation of regression (4) in the renewables sample. As for the full energy sector, females have more education than males on average. The part of the explained gender wage gap attributable to years of schooling as more modest for renewables than we observe for the full energy sector. *edu* explains -6.18% (-0.0163 log points) of the total wage gap, whereas this correspondent percentage for the full sector was -21.64%. Furthermore, the total effect of experience variables is 5.73%, coming from the linear form (27.83%) and experience squared (-22.11%), reflecting more experience among males. The findings determine similar properties for experience as for the full sector, with diminishing marginal returns to experience.

The number of children and whether an individual has STEM education does not explain much of the gender wage gap. However, since females in renewables work less hours than males on average, this explains 34.47% of the gender wage gap. This effect is far larger than the negligible effect of 0.04% in the full energy sector. Where experience was the biggest driver (in favor of males) of the explained gender wage gap for the full energy sector, in renewables the agreed upon working hours are the biggest contributor.

Occupation dummies are also included in this estimation. In the decomposition, these dummies together contribute -1.67% to the total gap. Variables *leader* and *stem_work* explain quite much of the wage gap (5.97% and 14.61%, respectively), but the effects are more than offset by *admin* which contributes -22.26% to the wage gap. This effect is driven by a positive coefficient in the male regression, and that almost half of females in renewables are in administrative positions.

The explained gender wage gap sums up to 30.76% of the total gap. Thus, the unexplained portion of the wage gap amounts to 69.24%. Again, is the difference in constant terms the biggest driver of the unexplained gap.

Full specification

The decomposition based on regression results from estimating equation (6). Recall here that sub-sector dummies are omitted, since there is no sub-sector level under renewables (that are included in the analysis). The results of the decomposition are found in table 4.10. First, notice that the full specification results are similar to the results without controlling for area. Education and experience variables account for almost identical percentages of the total wage gap, with -5.61% (-6.18% in the full sector) for *edu*, 28.08% (27.83%) for *experience*, -22.26% (-22.11%) for *experience*^{2} and 5.82% (5.73%) for experience combined.

The same pattern applies to the rest of non-occupation and non-area findings, with small percentages for number of children and STEM education. Number of hours worked continues to have a big impact, with a corresponding percentage of 34.43% (34.47% in the full sector). The occupation dummies explain an almost identical share of the gap in the full specification, together accounting for -2.48%.

The area dummy variables explain -4.25% of the gender gap, with close to everything attributable to the eastern category (-4.29%). This finding comes from a positive male coefficient for this area together with a higher share of women in the area. All the explained factors amount to an explained portion of the wage gap at 26.97%. This is slightly lower than the findings excluding the area dummies. The total unexplained gap is then 73.03%.

4.9 Results, 2018

To investigate the implications on including data on overtime and tenure in the regressions, we also estimate and decompose the gender wage gap within the energy sector in 2018. Here, only the full specification including overtime and tenure is included. The results for the whole energy sector excluding renewables are presented first, followed by the results from the renewables sub-sector. The 2018-results are summarized in table 4.10.

4.9.1 Full energy sector

Similar to the 2014 findings, the female superiority in years of schooling result in a negative overall effect on the gender wage gap of -15.25% (-0.036 log points). Recall that negative explanation in percent means that females' years of education affects the wage gap in favor of females. The experience variables on the other hand show an aggregate explanation of the gender wage gap of 18.81%. Experience shows the same pattern as in 2014, with diminishing marginal returns. Females have on average spent longer time at their company than males, which explains -1.2% of the gap through the variable *exp_intern*. Remembering that experience variables in the full specification estimation explained 12.72% in 2014, experience does explain more of the gender gap in 2018.

In this estimation, overtime is added to the non-occupation, non-sector, and non-area variables. Of these variables, overtime does explain the largest part of the gender wage gap with 3.65% (0.0087 log points). This percentage is bigger than those seen for number of children, STEM education, and hours worked (without overtime) in the 2014 full specification, which were negligible. This is due to the fact that, males on average are working over 9 hours overtime each year, compared to just under 4 hours per year for females.

Regarding the occupation dummy variables, they explain relatively little of the total pay gap. Summed together, they explain -0.34% of the gap. The reason this is negative is because more females than males have STEM jobs (explain -1.53%). The explanation attributable to leaders and administrative work are smaller, but positive and in favor of men (more men are leaders, more women have administrative jobs while the male *admin* coefficient is negative).

The area dummy variable explains very little of the gap, with a total of -0.31%. The subsector dummy variable on the other hand explains 5.96% of the gap. Most of this comes from the electricity sub-sector (excluding renewables). The coefficient in the male regression is negative (relative to the base, oil, and gas), and therefore the higher share of women in electricity explains 5.18% of the wage gap in favor of men.

Summed together, the included variables explain 13.71% of the gender wage gap in the full energy sector in 2018. Conversely, the unexplained part of the gap is 86.29%. As in the previous decompositions, the biggest part of the unexplained gap comes from the difference in intercepts. Compared to the findings from 2014, the variables explain around 20 percentage points more in 2018. Parts of these differing findings are probably attributable to the inclusion of the *overtime* and *exp_intern* variables, in addition to differences in the unobserved characteristics.

4.9.2 Renewables sector

In the B-O decomposition for the renewables sub-sector in 2018, years of schooling explain a similar proportion of the gender wage gap as in the full energy sector, with -14.09% (-15.25% in the full sector). Compared to renewables in 2014, however, years of schooling have a bigger negative impact on the overall gap (5.61% in 2014). Experience variables combined explain a somewhat smaller proportion of the 2018 gap within renewables, with 14.99% compared to the full sector's 18.81%. Experience variables show a similar trait as all other decompositions, with diminishing marginal returns to experience in the male regression. Experience within the current employer firm does here exhibit a positive portion of the explained gap (3.24%), whereas this was negative (-1.20%) for the full energy sector. This difference comes from higher tenure on average for males in the renewables sub-sector, whereas the opposite is the case for the full energy sector.

As in the 2014 decompositions, is the *subsector* variable omitted because most of sub-sectors within renewables are very small. Looking at the non-occupational and non-area variables, the agreed upon number of hours during a week (*hours*) exhibit the starkest difference from the full energy sector decomposition. Within renewables, 16.40% of the gap can be explained by hours worked, compared to only 1.11% in the full energy sector. This difference comes from males working around one hour more than females on average in renewables. In the full energy sector, females actually work around half an hour more than males on average, while the negative male coefficient causes the decomposition percentage to be slightly positive (but small). Hours of overtime explain 5.17% of the gap, where males on average work almost five hours more overtime than females throughout the year.

The occupation variables combined explain -7.20% of the wage gap. The main driver here is *admin*. In the male regression, there is a positive return to working in an administrative position. Then, because the share of administrative positions among females are far higher than for males (52.5% versus 13%), *admin* explains -22.75% of the gender wage gap. This differs a lot from the full energy sector, where the aggregate explanation from occupation variables is negligible. Lastly, area dummy variables explain a small portion of the wage gap in favor of women (-2.23%).

Adding up these findings, the observable characteristics of employees explain just over 10% of the gender wage gap, whereas 89.84% of the gap is unexplained. The unexplained gap is higher than in the full energy sector in 2018, and also higher than the unexplained gap found within renewables in 2014. The latter finding show an opposite trend than the development found within the full energy sector.

Decomposition 2018

Table 4.10

Blinder-Oaxaca decomposition 2018
Including area and subsector

	Full energy sector		Renewables	
Variables	Log points	Percentage of gender gap explained	Log points	Percentage of gender gap explained
Explained gap				
Edu	-0.0364	-15.25 %	-0.0308	-14.09 %
Experience	0.1878	78.63 %	0.1502	68.69 %
Experience^2	-0.1400	-58.63 %	-0.1246	-56.94 %
Exp-intern	-0.0029	-1.20 %	0.0071	3.24 %
Children	-0.0004	-0.15 %	0.0022	1.00 %
STEMedu	0.0006	0.24 %	-0.0085	-3.87 %
Workhours	0.0026	1.11 %	0.0359	16.40 %
Overtime	0.0087	3.65 %	0.0113	5.17 %
Occupations				
Leader	0.0017	0.73 %	0.0143	6.53 %
STEM_work	-0.0037	-1.53 %	0.0197	9.01 %
Admin	0.0011	0.47 %	-0.0498	-22.75 %
Sum Occupations	-0.0008	-0.34 %	-0.0158	-7.20 %
Area				
Eastern	0.0001	0.03 %	-0.0068	-3.11 %
Northern	-0.0003	-0.14 %	0.0015	0.66 %
Southern	0.0002	0.06 %	0.0003	0.14 %
Trøndelag	-0.0006	-0.26 %	0.0002	0.08 %
Sum Area	-0.0007	-0.31 %	-0.0049	-2.23 %
Subsector				
Manufacture	0.0018	0.77 %		
Electricity	0.0124	5.18 %		
Sum subsector	0.0142	5.96 %		
Sum Explained gap	0.0327	13.71 %	0.0222	10.16 %
Sum Unexplained g	0.2061	86.29 %	0.1965	89.84 %
Total pay gap	0.2388	100.00 %	0.2187	100.00 %

*The sample includes workers in the energy sector between the ages of 25-64 years old. The log points refer to the difference between male and female endowments multiplied with the male log wage coefficients for each variable. The total unexplained gap is the mean female residual from the male log wage equation.

Underlying regressions 2018

Table 4.11

Regression results 2018

	Full energy sector		Renewables	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Edu	0.0358***	0.0524***	0.0697***	0.087***
	(0.00164)	(0.00285)	(0.0061)	(0.00949)
Experience	0.0821***	0.1151***	0.0961***	0.1048***
	(0.00101)	(0.00205)	(0.004)	(0.0065)
Experience^2	-0.0013***	-0.002***	-0.0015***	-0.0016***
	(0.00002)	(0.00005)	(0.00008)	(0.00014)
Exp_intern	0.0023***	0.0014**	0.0058***	0.0054***
	(0.00028)	(0.00061)	(0.00092)	(0.00184)
Children	0.02***	-0.0072	0.0282***	0.0664***
	(0.00218)	(0.00509)	(0.00898)	(0.01677)
STEMedu	-0.0132*	0.022*	-0.073***	0.0547
	(0.0074)	(0.0128)	(0.02474)	(0.04541)
Workhours	-0.0053***	0.0102***	0.035***	0.0339***
	(0.00054)	(0.00101)	(0.00188)	(0.00273)
Overtime	0.0016***	0.0016***	0.0023***	0.0029
	(0.00009)	(0.00034)	(0.00059)	(0.0024)
Occupations				
Leader	0.3746***	0.2503***	0.3403***	0.4566***
	(0.00753)	(0.01781)	(0.02751)	(0.05596)
STEM_work	0.0947***	-0.0111	0.136***	0.0945*
	(0.00542)	(0.01336)	(0.02262)	(0.05485)
Admin	-0.0055	-0.1405***	0.1259***	0.1221***
	(0.01015)	(0.01331)	(0.02985)	(0.03936)
Area				
Eastern	-0.0024	0.0058	0.127***	0.1522***
	(0.00572)	(0.01177)	(0.02011)	(0.03425)
Northern	-0.0196**	-0.0697***	0.0407	0.0017
	(0.00891)	(0.02262)	(0.02856)	(0.05818)
Southern	0.0054	-0.0376	0.0499	0.0569
	(0.00963)	(0.03102)	(0.03097)	(0.05583)
Trøndelag	-0.051***	-0.0234	-0.034	0.0604
	(0.00859)	(0.02031)	(0.03108)	(0.05378)
Subsector				
Manufacture	-0.2246***	-0.1573***		
	(0.01706)	(0.0297)		
Electricity	-0.3875***	-0.4281***		
	(0.00624)	(0.01306)		
Intercept	12.1753***	10.9298***	9.5626***	8.9028***
	(0.02949)	(0.05645)	(0.11885)	(0.18563)
Observations	44265	12375	3526	1137
R^2	0.3636	0.4333	0.3902	0.4834
Adjusted R^2	0.3633	0.4325	0.3876	0.4764

*The sample includes workers in the energy sector between the ages of 25-64 years old. Regressions (1) and (2) is performed on the full energy sector, while (3) and (4) is for renewables. Standard errors are showed in parentheses, and significance levels are shown like this: ***p<0.01, **p<0.05, *p<0.1

4.10 Summary of the results

The similarity between all the decompositions is that the unexplained part of the gender wage gap is high, and observable characteristics explain only a small part of the wage gap. Reasons for this will be further discussed in chapter 5, but some of it could be explained by the limited opportunity to use industry dummies, meaning that we cannot capture differences in industry selection among genders. Although some of the findings differ along decompositions, some findings have similar traits. Females have more years of schooling on average across decompositions, which imply that women should earn more than men when looking at it in isolation. Males on the other hand have more experience on average than females, which consistently explain a positive part of the gender wage gap.

The occupation dummy variables do generally explain a small part of the wage gap, compared to education and experience variables. Although still small compared to education and experience, we find the biggest explanations in percent in the decompositions for renewables in 2018 (-7.20%) and in the full sector in 2014 without area and sub-sector dummies (4.82%). Area and sub-sector dummy variables do rarely explain much of the gender gap themselves.

Lastly, a note on the significance of estimated coefficients is useful. There are some cases of non-significant estimates in the regressions, that are included in the decompositions. The decomposition results using these coefficients does however yield small parts of the explained gap. Also, possibly the most interesting coefficients like education, experience, and time worked are always statistically significant.

5. Discussion

As presented in chapters 3 and 4 the findings do not paint a picture of a gender equal sector along many dimensions. This chapter features a discussion of the presented results and findings, in light of existing knowledge and research. The chapter is divided into sections where the findings of the descriptive summary (Chapter 3) and the decomposition of the gender wage gap (Chapter 4) is discussed separately, before some general comments are made towards the end. The chapter is closed with a discussion of the methodology and potential limitations of the thesis.

5.1 Descriptive summary

5.1.1 Sector sizes

Regarding the findings of the descriptive summary, there seems to have been an evolution in some key characteristics of gender equality. However, there are also findings that does not align with the general world trend. First, IRENA (2018b) have estimated an almost threefold increase in the number of workers in renewable energy towards 2050. Contrary to this, the results actually show a decline of workers in renewable energy from 2010 to 2019 (where the data allows to divide workers into renewables) by almost 2 000 workers. In the same period, the energy sector in total has grown by around 7 000 workers. There has admittedly been a reduction in overall workers from 2015 to 2019, but this is arguably marginal. The electricity, gas and water supply sub-sectors are also experiencing growth in number of workers, adding to the expectation of growth in renewables.

The findings of Lucas et al. (2018) that the workforce is not easily transferable from traditional energy to renewables is a potential explanation for this. If the Norwegian renewable energy sector is now experiencing a lack of competent workers with the right skill set, this could explain the unexpected decline in workers. It would be desirable to have data for a longer period than ten years in order to examine whether this is just a temporary decrease. However, in the Norwegian setting, this reasoning likely only applies to new technologies such as biofuel and wind power. With waterpower being a more traditional source of energy in Norway compared to other countries, this transition has probably occurred at an earlier time. Looking at the renewable sources themselves, waterpower exhibits a sharp decline, while wind power is showing a doubling of workers, more in line with expectations. A potential explanation of this could be streamlining of the long-lived waterpower sub-sector.

5.1.2 Female participation

Figure 3.1 displays the share of women in the energy sector over time. IRENA's (2019) survey, found that there is a bigger share of women in renewables compared to traditional energy. In 2010, this is also true in our data, but it is only marginally bigger than other sub-sectors. However, where the other sub-sectors are somewhat stable or have a positive development in this aspect towards 2019, the renewable sector exhibits a decline. From ranking first in 2010, female participation ranks third out of four sub-sectors in 2019. Nevertheless, female participation is still marginally better in renewables compared to extraction of oil and gas. The decline in female participation is somewhat surprising but is likely to have an explanation in the overall decline in workers where it appears more women than men have left the sector. Retainment of female workers is an interesting path for new research in this regard. On a more positive note, the share of women at the top of the wage distribution has tripled from 2000 to 2019 in the energy sector overall, but it is not apparent whether this effect is the same in the renewables sector alone.

Considering the presented literature on women's positive effects on firm performance when included in managerial positions, one could argue that a higher share of women could be beneficial for the financial performance of the energy companies. Recall that Christiansen et al. (2016) listed two channels where female participation correlated with firm performance, namely in sectors with large share of women and in knowledge-intensive sectors. The Norwegian energy sector overall and renewables specifically does arguably do not fit in the first group but possibly in the second. It is therefore unclear what theoretical conclusions can be drawn based on the findings (low female participation) and this research. If IRENA's (2019) reasoning is correct, can a higher share of women itself influence more women to enter a sector? Our findings do not show much evidence for this, and this is also an area for novel research.

5.1.3 Key characteristics

When investigating the mean key characteristics, the findings are more coherent with the literature, former surveys, and expectations. For example, women normally work more part-time than men, one of the normal drivers behind the gender wage gap. Women are normally younger and have more children in the household than men. Looking at the summary statistics of the variables included in the regressions in chapter 4, there is a familiar pattern. A higher proportion of males have STEM jobs, and females have higher proportions in administrative positions. Also, the majority of leaders are males, around four out of five leaders are male. Regarding leaders, it does not seem to be a big difference between renewables and traditional energy.

These findings about jobs are similar to the findings of the 2019 IRENA report. Women are overly represented in the most likely lower paying non-STEM jobs, mostly finding themselves in administrative roles. Clancy and Feenstra (2019) argues that a potential source of the gender gap is that females do not have the right skill set due to differences in education choice. Towards 2019 women are catching up and surpassing men in terms of education in general, and even have a higher share of STEM education than males. Theoretically should this decrease the gender wage gap, but this could also depend on the age of the ones having higher education, and the education effect could manifest later, narrowing the wage gap. Also, it is possible that women with STEM education are still not employed in STEM jobs, due to indirect or direct discrimination and/or difference in job search behavior between genders.

5.2 Gender wage gap decomposition

The results in chapter 4 are possibly more in line with the expectations, both considering the IRENA survey and general literature showing that there is a persistent gender wage gap. As mentioned in the summary of chapter 4, the findings across years and sectors are quite similar for some variables. Females have more education than males across decompositions, whereas males have more labor experience (naturally, since experience is created using years of schooling). However, the linear experience variable is consistently explaining more of the gender wage gap than the education variable.

Another similarity is the high portion of unexplained gender wage gap. The highest share of explained gap is found in the 2014 decomposition of renewables excluding area variables, with 30.76% (69.24% unexplained). Comparing to Blau and Kahn’s (2017) study, these decompositions explain a small part of the gender wage gap. Recall, however that a substantial part of the explained gap was explained by the inclusion of industry and occupation dummies. We have controlled for occupations and included sub-sector variables, but these are not explaining as much as they do in Blau and Kahn's study. One potential reason for this is that these sub-sectors are similar in terms of reputation, necessary skill set, education, tradition and older norms, and salary expectations. It is plausible that the selection effects shown in Blau and Kahn's study are not captured here when most industries are omitted.

The unexplained part of the gender wage gap is, as mentioned often attributed to discrimination. Building on the thought that these decompositions do not capture all industry-related explanations, it is unlikely that all the unexplained gaps shown are due to discrimination in the energy sector. It is still possible that a lot of the gap stems from discrimination and gender norms, however it is likely that some of this discrimination occurs before workers are entering the sector. Examples can be discrimination and low share of women in relevant education, again causing a lower share of women obtaining degrees in STEM fields, for instance. Nonetheless, it is very likely that a substantial part of the unexplained gap can indeed be attributed to some form of discrimination also inside the energy sector.

Another interesting feature that is not directly controlled for, is the number of job changes by males and females. Looking at the summary of regression variables in table 4.5 and 4.6, females in the full energy sector has a longer tenure (experience at that firm) than their male counterparts. The reverse is true in the 2018 renewables sector. Findings from Faberman and Justiniano (2015) suggest that switching jobs could lead to higher wages. Although longer tenure not necessarily means less job switches, it is a potential source of the unexplained part of the wage gap. In the reverse situation, it could still be the case that men in renewable energy have switched jobs more often even if their tenure is higher than for women. This also needs further investigation to reach a definitive conclusion.

In 2018, we had available statistics on overtime and not only number of hours agreed upon (limited to around 40 hours a week). Directly, the number of overtime hours registered accounted for some of the gender wage gap (3.65% in the full energy sector and 5.17% in renewables). However, unpaid overtime hours are generally not reported, so considering women are working more part-time and doing more domestic unpaid work, it is possible that the gap in overtime hours actually worked are even bigger in favor of men. This itself does not have an impact on the wage gap as these are unpaid, but there is evidence that suggest that a substantial part of promotion gaps between men and women could be explained by differences in overtime hours, contract hours (part-time) and occasional late work (Deschacht, 2017). If this is true also in the Norwegian energy sector, only the direct monetary effect of overtime hours has been accounted for, and the indirect consequences of overtime (paid and unpaid) can be found in the unexplained part of the gender wage gap.

5.3 General comments

Comparing to the findings of IRENA's survey, the Norwegian energy sector seem to face some similar challenges related to achieving gender equality. Blau and Kahn (2017) found that although the gender wage gap in USA narrowed from 1980 to 2010, most of the progress occurred in the 1980s. In some aspect, this does appear to be the case for the Norwegian energy sector as well, exemplified with a quite stable share of women in the workforce over the last twenty years. There is also a persistent gender wage gap still present in both traditional and renewable energy, as expected.

In contrast to the IRENA survey it does seem like there is a more similar trend in Norwegian traditional energy sector and renewable sector. Whereas IRENA found a female participation to be at 32% in renewables and 22% in traditional energy, the gap is much smaller in our findings. The share of women in traditional is comparable to IRENA at just over 20%, but female participation in renewables ranges from 23% to 25%, actually showing a negative trend from 2010 to 2019. Earlier, we argued that waterpower (the dominant energy source within renewables) could be seen as a more traditional energy source in the Norwegian context. In that respect, it is possibly expected that the Norwegian renewables sector exhibit some of the same properties as the traditional energy sector in IRENA's survey, thus being a possible explanation to why our findings differ somewhat from IRENA's findings.

5.4 Methodology and limitations

Having used Norwegian registry data through microdata.no, we have sorted employees into different sectors using information reported by employers. Employees are sorted into sectors based on the employer firms' industrial codes. The workers are sorted only on their main employment, normally the employment with the highest number of agreed hours. Because only main employment is included, there are some individuals that are not included. This could potentially have a small impact on the descriptive statistics generally and sector sizes and part-time share among genders specifically. We acknowledge this limitation in the study, but believe the effects are rather small. However, additional studies where this is accounted for in a better way could be desirable.

Already mentioned, some of the unexplained part of the gender wage gap is often explained when including industry dummy variables, which is not done here since we only investigate the energy sector. By only looking at the energy sector, the sample sizes would preferably be larger than the ones included in this thesis. Although most estimated effects of variables were statistically significant at (at least) the 95% confidence level, a larger sample would likely yield a more precise estimate.

The sample sizes available and the fairly high homogeneity among top earners made it hard to test for the Arulampalam et al. (2007) findings that the gender wage gap widens at the top and bottom of the wage distribution. Obtaining similar data on the energy sector in bigger regions such as Scandinavia or Europe could be an interesting way to investigate the properties of the gender wage gap in the energy sector. A bigger dataset would also increase sample sizes in general, as per the discussion in the former paragraph, potentially giving better estimates of coefficients and a better decomposition.

Lastly, it is worth mentioning again that a lot of the variables' definitions and classification have changed slightly over the observed years. We have tried to acknowledge this and made necessary changes to the data, but there is a chance that some observations are coded in a different way from year to year. We do however believe that these possible mistakes are negligible. Also, it would be interesting to investigate the evolution of the energy sector even further back in time, to at least 1990. The data unfortunately do not comply with this. In addition, it would be very desirable to have data at the detail level that A-ordningen supplies, but data at this level of detail were not reported by firms until 2015. A more thorough investigation of these variables and their evolution is an interesting opportunity at a later point.

6. Conclusions

This thesis has sought to investigate the gender inequality of the Norwegian energy sector, and the renewable sector in particular. The thesis has taken inspiration from an IRENA survey published in 2019 that pointed towards a more gender equal workforce in the renewable sector than in traditional energy. Through a descriptive depiction of the energy sector in five-year increments from 2000 to 2019 and a decomposition of the gender wage gap in the sector and sub-sectors in 2014 and 2018, we have attempted to check the conclusions in the Norwegian environment.

In the descriptive part, we found a lower share of women in renewables than IRENA found. This was somewhat surprising considering Norway's position and standing in the fight for gender equality. We argue that parts of this surprising finding can be explained with the waterpower sector dominating renewable energy in terms of number of employees, and simultaneously exhibiting some "traditional" traits. With regard to key characteristics such as education, STEM education, and part-time work, women are showing some positive development. The sector sizes itself exhibit a surprising development, as the renewable sector shrinks from 2010 to 2019 whereas IRENA's estimates is that the number of workers in renewable energy should be increasing towards 2050.

Chapter 4 presented a Blinder-Oaxaca decomposition of the gender wage gap in both the traditional energy sector and renewable sector for 2014 and 2018. This chapter sought to answer the three research questions presented in the introduction. The first research question asked whether there is a gender wage gap in the Norwegian energy sector. To this question, our findings exhibit a clear yes.

The second research question asked how much of the gender wage gap that could be attributed to observed and unobserved characteristics, and discrimination. Generally, the observable characteristics explained only a small part of the gender wage gap, compared to findings from for example Blau and Kahn (2017). We argue that whereas some of the unobserved gap probably should be attributed to discrimination within the energy sector, some of the unexplained gap can also be attributed to discrimination not necessarily in the energy sector but more in education or gender norms in the society.

The third and last research question asks if there are any differences in the decompositions of the workforces in traditional and renewable energy. In the 2014 findings, the findings indicate that there is less discrimination (higher portion of the wage gap is explained by observed variables) in the renewable energy sector compared to traditional. In the 2018 findings on the other side, the findings are very similar after controlling for some extra variables. Since it was not possible to control for the additional variables in 2014 it is unclear if the more similar results are due to these variables or if the properties of the wage gap have changed from 2014 to 2018. Summing up, it is not clear that the renewable sector is more gender equal than the traditional sector in terms of wage gaps, which matches the findings of the descriptive part.

To conclude, the findings from the Norwegian energy sector exhibit less difference between the traditional and renewable sector than the IRENA survey imply. If the goal is to increase gender equality, the Norwegian energy sector has a long way to go. A female participation rate of around 25% and a persistent gender wage gap is not a positive finding in this respect. There is not much evidence of a positive development either along many dimensions, although there are some changes in key characteristics of workers that can manifest in a higher share of women and a narrowing gender wage gap in the future.

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