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Six seas: Comparative application of investment attractiveness methodology to Arctic offshore petroleum provinces

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Summary

In the 2000s, Arctic energy sources development climbed to the top of the energy companies' and authorities' agendas. The necessity to increase production volumes and the desire to find new large oil and gas fields triggered investment flows into the Arctic.

However, in 2014 the situation changed. The sudden oil price decline left most of the Arctic resources economically unviable and upended the strategic priorities of the main market players: booming investment was replaced by austerity measures. Previously it had been expected that the Arctic states would compete over the natural resources, but with low energy prices they started to compete for investment instead as only the most economically attractive projects could now be financed. This raises the question of the comparative attractiveness of different parts of the Arctic, as oil and gas companies choose where to invest their money.

This thesis therefore develops a methodology for analyzing and comparing the investment attractiveness of Arctic offshore petroleum provinces and applies it to nine Arctic maritime areas spread across six Arctic seas. The nine areas are selected, assessed and compared on four dimensions that can affect their attractiveness for investment in oil and gas projects: climatic harshness, geography, petroleum taxation system and quality of investor protection.

Based on this multidimensional analysis the Arctic Seas are ranked according to their investment attractiveness. The most attractive areas are the Russian Barents and Kara Seas and the Alaskan Chukchi Sea. Thereafter comes the Norwegian Barents Sea, followed by the Canadian Beaufort Sea, and then Canada's Baffin Bay. The lowest ranked are the Laptev Sea, the Alaskan Beaufort Sea and Greenland's Baffin Bay.

The analysis represents quite a general and, to a certain extent, simplified approach and is intended only as a first step in the complex process of investment decision-making.

1. Introduction

Thinking about the main idea of the future thesis, I wanted to develop something new, applied and complex. After several months of long and thorough examination I decided to write a work that would allow to overcome the gap between the physical characteristics of the Arctic region and the business climate dimension. That is how the following research problem was born:

What is the investment attractiveness of different parts of the Arctic with regard to the development of oil and gas resources?

Most of the papers about the Arctic are devoted either to geography or geopolitics. This thesis addresses the research problem by developing a methodology for assessing and comparing the investment attractiveness of different parts of the Arctic. At the center of the methodology is a list of criteria or sub-indicators including not only political or geographic factors but also economic, institutional, social etc. factors. This makes it possible to create a complete picture of the Arctic regions' potential precisely for the oil and gas business and to identify the most attractive regions for the energy companies.

Despite the desire to cover the gap between two different spheres of knowledge, the particular research problem was chosen and developed based on the following ideas and considerations.

In 2008, the U.S. Geological Survey released the first publically available comprehensive petroleum resource estimate for all Arctic regions. It provided the audience with the answer to a question that enticed energy companies, authorities, the local population in the Arctic and, in simple terms, all the stakeholders and people who are interested not only in the sphere of energy policy, but geopolitics: how much oil and gas is the ice hiding? And the answer was – a lot: 90 billion barrels of oil and 1,670 trillion cubic feet of natural gas (U.S. Geological Survey, 2008). That amount of natural resources accounts for about 22 percent of technically recoverable and undiscovered resources in the world. According to the assessment, the number includes 13 percent of the undiscovered oil, 30 percent of the undiscovered natural gas and 20 percent of the undiscovered natural gas liquids in the world (U.S. Geological Survey, 2008).

At the same time, in 2008 the world faced another factor that contributed to the overall interest growth around the Arctic resources – the International Energy Agency's *World Energy Outlook 2008*. According to this report, "world oil supply is projected to rise from 84 mb/d in 2007 to 106 mb/d in 2030 in the Reference Scenario". Conventional crude oil production was expected to contribute only 5 mb/d, while the rest, to a large extent, was expected to come from non-conventional resources and technologies (IEA, 2008).

These two analyses were fated to meet, but at the same time they were only two in a long train of developments that kept Arctic petroleum resources in focus. The ensuing boom in enthusiasm over Arctic energy resources had numerous consequences of a different type: political (planting a one metre tall titanium Russian flag on the seabed of the Lomonosov ridge), economic (oil and gas companies interest in the Arctic resources development), academic (growing number of papers about the Arctic region and its resources), etc. It would not be an overstatement to say that the Arctic become a hot topic that everybody was keeping an eye on.

However, there are also important hindrances to the development of Arctic petroleum resources: lack of technology (which relates to several different challenges: from oil spill response to the solution of the remoteness problem) and high breakeven prices for the development of Arctic oil and gas fields.

And if the development of technologies is something that humanity in general can influence in the mid-term perspective and make progress on, if the breakeven price remains high it is a real stumbling-block. Of course, technological breakthroughs may decrease the costs and change the economics of field development even in the most climatically severe petroleum provinces. But the cyclical nature of oil prices has a serious effect on the oil and gas companies' interest in the Arctic. This became clear in June 2014. At that time, the WTI Crude Oil Price stood at around US$105 per barrel. However, numerous factors, both economic and political, led to a significant decrease in the oil prices. In this thesis I am not going to concentrate on the reasons of that crisis. Nevertheless, it would be negligence not to discuss its consequences in terms of the Arctic energy sources development.

The current price of WTI crude oil, as of March 2nd, 2016, is US$34.16 per barrel. And generally speaking nobody can tell us with a high degree of certainty what the price is going to be next year or even in three months. In order to understand the interconnections between the strategic picture and the current trends it is crucial to take into account several factors:

Firstly, "short-term uncertainty does little to alter the longer-term picture" (IEA, 2011). In other words, by 2035 the global population will have increased by 1.7 billion people. At the same time, the IEA predicts 3.5% annual average growth in the global economy. These trends generate ever-higher demand for energy sources and despite uncertainties concerning the details, it is safe to say that all these people will need heating/cooling, electricity, lighting, and a wide array of electrical appliances. This will create a steep rise in demand, which will be impossible to satisfy without increasing the production of fossil fuels, especially oil and gas. There is a possibility that a new energy technology will appear that will reduce the need for oil and gas, but so far this has not happened and if it does not happen in the future new fields need to be discovered and developed. According to the estimates of the Russian Ministry of Energy, the Russian Arctic contains approximately 100 billion tons of oil equivalent, which is evidently too much to ignore in a long-term perspective (REGNUM, 2016). In simple terms, Arctic oil and gas is likely to be extracted, but for now it is hard to say when exactly this will happen.

Secondly, the life cycle of an oil or gas field typically takes from 8 up to 20 years to go through all the phases and come on stream (license award, exploration seismic, site surveys, exploration drilling, appraisal drilling and development) (Cairnenergy.com, 2016). At the same time, oil prices are cyclical by nature and their fluctuations are very hard to predict. Despite the economic crisis of 2008-09, oil and gas companies “enjoyed a lengthy run of success” as there were several factors (Arab Spring spreading to Libya, for example) that entailed high prices (EY, 2015). In January 2009 Brent crude was trading around US$42 per barrel. Yet, only two years later prices surged to more than US$100 per barrel, reaching more than US$125 per barrel in early May. High oil prices in turn encouraged the shale or tight oil (LTO) production surge in the US (EY, 2015). Not surprisingly, US oil production grew by more than 1 million b/d each year. Nevertheless, the prices remained quite stable and balanced around US$100 per barrel. The situation changed by mid-2014, when some of the production outages were restored (Libya, Iraq) (EY, 2015). Economic theory tells us that when there is an abundance of something, this particular product becomes cheaper (other things being equal, of course). The same “merciless law of economics” led to the situation that we are witnessing today: the price of Brent Crude (ICE) is US$36.94.

A question inevitably comes to mind: what does this all mean? And the answer is the following: it was only 6 years since the last drop of oil prices which is a much shorter period of time compared to the oil and gas project life cycle. Thus, it is possible to state that oil and gas companies have to work and invest in new projects not only when the times are “good” for producers (high prices on energy sources), but also when the times are “bad” (low oil prices).

Thirdly, with the oil price around US$35 per barrel, one can easily imagine the situation on the market of services: even such big and recognizable oilfield services companies as Halliburton, Baker Hughes and Schlumberger cut the workforce simply in order to reduce the costs. “Used oil field equipment is a bargain these days” as more and more drilling rigs across the USA are being shut down by oil companies that face seriously declining oil prices (USA Today, 2015). What does it mean, in simple terms? Oilfield services become much cheaper. Seismic exploration, site surveys, exploration drilling, appraisal drilling: all these activities become less expensive which is evidently good for companies that are interested in the development of new oilfields.

In the end we have a paradox: falling oil prices discourage oil and gas companies from taking financial risk as every penny counts, however, the best time for that kind of activities, in terms of costs, is exactly the period of US$35 per barrel. At the same time, the development of new fields takes much more time than a high oil price cycle can provide us with and if the company wants to produce during the period of US$100 per barrel or even more it will improve its chances of doing so by investing precisely during the period of low oil prices. Adding to these factors, the previously mentioned idea that the energy sources of the Arctic region will be developed in any case sooner or later, we get closer to the overall picture as I see it: the development of the oil and gas fields above the Arctic circle is something inevitable, and the right thing to do during the period of low oil prices is all kinds of preliminary activities that include not only “on the site” part, but also managerial work.

In accordance with the previously expressed ideas the question arises: if these fields are ultimately to be developed, which of them will be at the front of the queue and which will have to wait in the wings?

The Arctic includes the northern territories of the eight Arctic states. It is an area that is home to 4 million people and a ~US$230 billion/year economy; an area that is heterogeneous in almost every aspect (economically, socially, geographically, in the sense of climate, resource richness, etc.). Thus, it is safe to say that the Arctic is also far from being homogeneous with regard to oil and gas development potential. Serious distinctions exist between onshore and offshore environments, between different regions and countries concerning existing infrastructure, population, environmental sensitivity and accessibility (World Economic Forum, 2015).

The results of the research are supposed to present a full and comparative picture of the Arctic regions' investment attractiveness based on different groups of factors that unite both, physical and business characteristics. That, in simple terms, might be a contribution to the previously mentioned preliminary managerial activities, as it will allow to understand what particular regions/fields are at the top of the agenda and have more chances to "survive" the era of low oil prices that we face today. It can also be useful for Arctic countries or regions that wish to position themselves better to attract investment during the low-oil price period.

2. Theoretical framework

The thesis relates to two literatures: geopolitics and investment attractiveness. Its theoretical part is based on the geopolitical competition concept and its Arctic dimension. While the conceptual and methodological approach to business climate and investment attractiveness will draw on the World Bank's approach and materials as well as the work of several independent scholars and research groups.

At first, it is necessary to understand that geopolitical theory and different mass media often portray the Arctic region as a territory to fight over (NewsComAu, 2015). A quote from the report called "Climate Change and International Security", that was published by the European Union in March 2008 can serve as an illustration:

"one of the most significant potential conflicts over resources arises from intensified competition over access to, and control over, energy resources. That in itself is, and will continue to be, a cause of instability. However, because much of the world's hydrocarbon reserves are in regions vulnerable to the impacts of climate change and because many oil and gas producing states already face significant social economic and demographic challenges, instability is likely to increase. This has the potential to feed back into greater energy insecurity and greater competition for resources. A possible wider use of nuclear energy for power generation might raise new concerns about proliferation, in the context of a non-proliferation regime that is already under pressure. As previously inaccessible regions open up due to the effects of climate change, the scramble for resources will intensify" (European Council, 2008).

In other words, the report says that the Arctic region represents an arena of tensions as the competition for the natural resources is supposed to intensify because of the climate change (ice melting) and, thus, for new transport routes, new oil and gas fields, new economic opportunities, after all (Howard, 2009). These energy resources "are changing the geo-strategic dynamics of the region with potential consequences for international stability and European security interests. The resulting new strategic interests are illustrated by the recent planting of the Russian flag under the North Pole" (European Council, 2008).

That final chord concerning the case of the Russian flag planting actually has become quite a popular topic as it provided Western mass media with some oil that could be easily poured on the flames of "the most significant potential conflict" (European Council, 2008) for the

European Union. That gave rise to a number of articles, the main idea of which is approximately the same and can be retold in the following logical order: the Arctic region is hiding a significant amount of natural resources, which are evidently finite and highly important for the countries' energy security and economic prosperity, thus sooner or later Arctic countries are supposed to start a severe competition for these resources and the competition can easily turn into a full-scale conflict (NewsComAu, 2015; RT International, 2014; European Council, 2008).

Newspapers try to support that point of view providing the reader with the arguments concerning the Russian activities in the Arctic and in the Sea of Okhotsk, in particular. At the same time the situation is often portrayed as something unusual and mistrustful: why would Russia apply for the Okhotsk Sea shelf? However, a lot of journalists try to speculate with the facts and present that kind of normal activity as a first step to the full-scale fight for the territory and, consequently, the resources. Many forget that the original application for the Okhotsk shelf was filed to the UN in 2001, far before the skyrocketing interest to the Arctic oil and gas (RT International, 2014).

At the same time, Russia's Arctic claims include the large seabed area of the Lomonosov Ridge and the Mendeleev Dome, which reach out into the floor of the Arctic Ocean as part of Russia's continental shelf. Other countries that have claims on the Arctic seabed include Canada, Denmark, Finland, Iceland, Norway, Sweden and the United States (RT International, 2014).

In other words, what we see is a situation when already having a prevailing point of view, journalists, politicians and scientists start to parallel facts in order to provide the idea with some trustful data. For instance, we can ask ourselves a very simple question: would these territorial applications to the UN look suspicious and arouse anxiety if there was no oil and gas hidden under the Arctic ice? In our mind, the answer is "no". That would look normal and even attract positive comments in a sense that the UN mechanisms help to peacefully and in accordance with the international law solve territorial questions. This is quite far from "the most significant potential conflict" label, isn't it?

At the same time, as soon as we involve the "natural resources card" into the previously explained and presented picture, a lot of scientists, newspapers and official representatives start perceiving the situation in the light of the geopolitical conflict the center of which is reported to be these notorious oil and gas fields.

And that is the very place we need to linger round. It would be unreasonable to deny the fact of existing competition, as it is natural and organic to compete for something that is of value for the economic development of the country. However, we believe that the existing model of international cooperation and interaction as a whole leaves a mark on the well-known geopolitical concept of the “resource wars”. At the very moment we have to admit that the world is far from being a completely safe and just place, but the whole system of supranational institutions and international law provides us with a mechanism that allows to avoid (in most cases) adverse and previously seen as “natural” consequences. In other words, we believe that in the Arctic region case “resource wars” in their initial sense gave place to something that can now be called “investment wars”.

In our mind, it is the investment arena that is going to attract the Arctic countries’ attention and focus. The existing competition is, as I have already stressed, undeniable but what is deniable is the object of it. Previously presented examples of anxiety among the mass media are based on the idea that countries are supposed to fight for the resources, which, in the end, they are to develop and produce. What we believe in is the situation when the Arctic nations are “fighting” for the investment (Øverland, 2010).

There is one more argument that makes me think that there is a very small chance to witness a real “resource war” in the Arctic and it is more practical and materially-minded: these resources are very expensive and technically challenging to extract. In simple words, those who have money may not have technologies and vise versa. Of course, it is oversimplified and wrong from the managerial and financial points of view, as there are many other reasons why companies invite different NOCs and IOCs into the projects (one of them is risk sharing, for example), but if we cast aside all the conventionalities and try to look at the problem as it is, it is safe to say that none of the existing oil and gas companies has enough experience, financial resources and technical opportunities to develop Arctic energy sources on its own. It is too risky, technologically difficult, expensive and frightening for one company to take charge of all the work.

If we take a closer look at existing (and potential) Arctic projects, we will see that in the majority of cases there are several companies included in the process of oil and gas field development in order to spread risk and draw on particular comparative advantages of different companies.

Snøhvit, for example, is the first offshore development in the Barents Sea (Statoil.com, 2007). The project is operated by Statoil, but at the same time it is done on behalf of several other oil and gas companies that own parts of the license: Petoro, Total, GDF Suez, Hess and RWE Dea.

The Goliat field is located in production license 229 (PL229), which was awarded in the "Barents Sea Round" in 1997. The licensees in the current Production Licences PL229/229B are Eni Norge AS (operator, 65%) and Statoil Petroleum AS (35%) (Eninorge.com, 2016).

The Ormen Lange field was discovered in 1997 and is about 40 kilometres long and between eight and ten kilometres wide. The project operator during the development stage was Hydro/Statoil. On 30 November 2007, Norske Shell took over as the operator (Statoil.com, 2007). At the same time, current licensees are: Petoro AS, Statoil Petroleum AS, A/S Norske Shell, DONG E&P Norge AS and ExxonMobil Exploration and Production Norway AS (Factpages.npd.no, 2016).

And finally, the Shtokman project. The Shtokman field is one of the biggest known offshore gas fields in the world – it is located more than 600 km from shore at a depth of 340 m. The Shtokman field was first discovered in 1988. Since the 1990s, a consortium of Conoco (12.5%), Fortum (12.5%), Norsk Hydro (12.5%), Total (12.5%) and headed by Gazprom (50%) has been working on assessment and solutions to technical problems (Victor, 2008). However, the situation did not develop and in 2001 Gazprom announced that it is going to work together with Rosneft. Nevertheless, the result was the same - no result at all. Finally, in 2007 Gazprom and French energy company Total signed a framework agreement, according to which the Shtokman Development Company was set up to organize the design, financing, construction and operation of the Shtokman "phase one" infrastructure. Later, a similar contract was signed between Gazprom and StatoilHydro (Gazprom owns 51% of shares in Shtokman Development Company, while Total has 25% and StatoilHydro 24% of shares) (Victor, 2008). We all know the end of the story: Statoil wrote off its investment into the project and handed shares back to Gazprom. The latter announced that the project was postponed because of low gas prices and current oversupply on the market. At the same time, there are speculations that Royal Dutch Shell is interested in the project and is considering becoming the third partner (Reuters UK, 2012).

The list of such projects can be easily extended. However, the main idea of the presented cases is that oil and gas companies need companions to develop energy sources, especially in the Arctic. Risk sharing, portfolio diversification, technological cooperation, financial resources accumulation – all these factors make the development of the Arctic fields a collective process.

In this regard, it is important to refer to the existing experience of the previously discussed Shtokman field case. It is known that one of the factors that made Norwegian Statoil write off its investment was the fact that Gazprom was a very “difficult” company in terms of negotiations over the scheme for developing the field and for marketing the gas (Financial Times, 2012). At the same time, the overall process was so slow and bureaucratically complicated that, as a result, it took several years to discuss and to solve the main problems, which in the end led to the loss of the market (as previously it was the United States that was supposed to be one of the final consumers of the gas from the Shtokman field, which, instead, due to the “shale revolution” become one of the main producers of gas).

What this story tells us is that having huge amounts of resources does not always mean that partners are going to line up and wait for the NOC to prefer them to all the competitors. Of course, it is the national company that is negotiating from a position of strength, but at the same time, partners also have the right to choose which projects to invest in and which companies to work with. Gazprom is widely recognized to be a very difficult partner to cooperate with (Henderson and Ferguson, 2014). That kind of reputation leaves a mark on the overall process of Gazprom’s cooperation with IOCs including its closest partners. It is widely known that only a few companies have necessary for the Arctic region experience in offshore developments under severe weather conditions and Gazprom’s attitude to the partners may become one of the stumbling blocks in the process of the Arctic energy sources development.

Previously discussed ideas serve as an evidence and an argument for the thesis, that widely recognized geopolitical concept of “resource wars”, to our mind, can transform into something that can be called “investment wars”, i. e. wars for the investment (Øverland, 2010). Companies are interested in new partnerships and “allies” not only because it is reasonable from the financial and managerial points of view but also because the Arctic region is a place where any otherwise is very hard to imagine due to objective reasons, partially discussed in the introductory part.

3. Methodology

The aim of the thesis is to gain an understanding of the attractiveness of different Arctic regions for investment in the development of oil and gas resources and to compare the results. This will make it possible to rank different parts of the Arctic, with those that are going to be developed with the highest probability at the top of the table. This will be done on the basis of the assessment and comparison of existing geographical knowledge about different oil and gas provinces, their technical accessibility, investment climate, existing in the "host countries", etc.

At first, I selected six different Arctic maritime areas: the Barents Sea, the Kara Sea, the Laptev Sea, the Chukchi Sea, the Beaufort Sea and Baffin Bay. However, during the process of writing it became clear that it was necessary to divide several of them, because of the fact that oil and gas taxation and investor protection factors differ from one country to another, even though geographically it is the same region (the Beaufort Sea, for example, that is divided between the United States and Canada). At the same time, speaking about the geographical factors, they also differ from one part of the sea to another (for instance, Canadian Baffin Bay can be characterized by a narrower shelf than Greenland's Baffin Bay). Thus, at the end of the thesis the reader will be provided with the assessment and comparison of nine "assessment units": the Norwegian Barents Sea, the Russian Barents Sea, the Kara Sea, the Laptev Sea, the Alaskan Chukchi Sea, the Alaskan Beaufort Sea, the Canadian Beaufort Sea, Canadian Baffin Bay and Greenland's Baffin Bay.

The regions are going to be assesses and compared on the basis of four groups of factors: weather factors, geographical factors, oil and gas taxation characteristics and "investor protection" factors. Every set of factors includes a number of sub-factors. For example, weather factors include average ice thickness, ice coverage conditions, icebergs conditions, wind speed, average number of days with fog, etc.

After the process of data collection, firstly, I am going to rank the regions under every sub-factor of a particular set of factors. For instance, in terms of wind speed, Baffin Bay was ranked 1st (the strongest wind among the listed regions), the Kara Sea – the 2nd (less severe), etc. After that the regions will be raked in accordance with the obtained total score (sum of ranks for every sub-factor). Thus, we will have the leaders and the followers in terms of each set of factors. And finally, the investment attractiveness comparison will be based on the same pattern: the sum of ranks for every group of factors (the lower the sum – the higher the final rank). For example, the Norwegian Barents Sea is ranked 2st in terms of weather conditions, 5th in terms of geographical factors, 4th in terms of oil and gas taxation and 1st in terms of investor protection. The sum of ranks is 12 which is higher than the Russian Barents Sea (11), but lower than the Greenland's Baffin Bay (17), which makes the Norwegian Barents Sea the 2nd ranked (after the Russian Barents Sea). Obtained results will be tabulated and compared with each other in order to get an understanding of which exact oil and gas provinces are supposed to have the highest chances to be developed in the future and which ones - the lowest.

The only set of factors that was assessed and compared in a little bit different way is taxation. I decided to base the ranking on the qualitative assessment (thorough examination), not quantitative (sum of ranks for every sub-factor). The reason for that is the fact that fiscal systems are quite complex and include a serious amount of additional factors that influence the final government's take (the size of the field, the amount of resources, oil characteristics, current prices, etc.). The best decision was to conduct a research on the basis of standardized firms, oil field conditions, etc. (benchmark analysis). However, the framework of the master's thesis did not allow to follow that path both because of restrictions on the volume of the work and the time given to write the paper. At the same time, taxation is only a part of the comparison, indisputably an import, but not the only one. Thus, it was decided to concentrate on the qualitative assessment, going deeper into the details and relying on assumptions and reasoning, not only dry figures.

At the same time I also decided to avoid the weighting system in the research as it is quite hard to decide which set of factors is more important for the oil and gas development: geographical, weather, taxation or investor protection. What is truly significant in a ranking system is a position of a region in comparison with the other competitors. However, this may also be treated as an improvement that can be added in the future if the work is developed into something more solid and significant (a PhD dissertation, for example).

Having that kind of comparison and assessment is helpful both from the financial and managerial points of view as it not only allows to get a full and illustrative picture of different Arctic regions in terms of their oil and gas development potential but also to form a long-term strategy for the Arctic direction of the company on the basis of provinces' succession in the final table of the current thesis.

4. Arctic resource extraction: challenges and opportunities

Before I start the discourse about the Arctic regions investment attractiveness, it is vital to create, describe and present a more global picture of the energy sources development in the northern territories and decide, weather it provides us with more opportunities or challenges.

Nowadays the Arctic region is seen by many as an area with the highest amount of unexplored resources. According to the US Geological Survey, 30% of the world's undiscovered natural gas and 13% of the world's undiscovered oil are located in the Arctic. Keeping in mind growing energy demand, the region represents an object of high interest and is considered to be one of the most promising areas for future exploration and production of fossil fuels. However, the question is not as unequivocal as it may seem at first sight because despite numerous "driving factors", the Arctic development has several "breaking factors" that might affect the prospects of the area. First, it is reasonable, to describe and discuss existing global factors that draw attention to the Arctic oil and gas resources; second, to describe and discuss possible problems that discourage the development; third, to mention the conditions, under which the process of the Arctic oil and gas development should be carried out and forth to provide an assessment of the region's future prospects on the basis of the mentioned driving and breaking factors in a medium-term perspective (to compare pros and cons and decide which set of factors is prevailing).

Driving of the Arctic oil and gas development

It is quite hard to divide global factors that direct attention to the Arctic oil and gas resources into separate groups (geographical, political, social, or commercial) because one factor may fall into several categories simultaneously. In this regard, it is reasonable to identify and discuss these factors and characterize them in terms of group belonging.

Growing oil and gas demand (commercial, social). The world's population is growing and energy demand is expected to follow the same pattern. First, among fossil fuels it's gas that is growing the fastest (1.9% p.a.), according to the BP Energy Outlook 2035 (BP, 2015). At the same time, despite its declining share and relatively slow growth (0.8% p.a.), oil will remain one of the leading fuels in the world energy mix. Second, four out of five barrels today come from fields that were discovered before 1973 and the majority of them are declining (Friedemann, 2016).

Keeping in mind these two factors, oil companies are concentrated on new big fields exploration. In this regard, the Arctic region can be seen as a very promising and interesting area.

A resource-rich region (commercial, political). According to the estimates, made by the US Geological Survey, the Arctic region is responsible for 22% of the world's undiscovered technically recoverable oil and gas resources. They include 30% of undiscovered natural gas, 13% of undiscovered oil and 20% of undiscovered natural gas liquids.

These resources may play a vital role in the process of meeting growing energy demand, especially for the Russian Federation, keeping in mind the fact of gradually declining oil output in the central onshore regions of West Siberia as well as in the European part of Russia. Figure 1 shows different forecasts of Russian oil production. The first two are made by the Russian Government's Energy Commission and were published in the "General Scheme of Oil Industry Development to 2030" (Henderson, 2013) while the third is produced by IEA (Henderson and Loe, 2014). Both government forecasts demonstrate a clear decrease in oil production, while the IEA forecast assumes that several new fields, including those in the Arctic region, will be developed which allows to predict a certain output increase. This factor increases the pressure under which two national oil companies have to work (Gazprom and Rosneft) as they are the only to entities that are permitted to control Russian offshore licenses (Henderson and Loe, 2014). It was the President Putin himself who stressed the importance of economic activity in the Arctic saying that the Russian Federation intends to increase the influence in the Arctic region through different mechanisms one of the most important of which is the exploration of the area's hydrocarbon resources (Reuters, 2014).

At the same time it is vital to highlight the level of Russia's dependency on oil and gas production, as these commodities make significant contribution to the national economy and budget. In 2014 oil and gas industry was responsible for 17% of the GDP and for 66% of the overall export (Kommersant.ru, 2014). Thus, it is possible to assume that any decrease in the output will have a significant impact on Russian economy, which makes the question of new areas exploration a crucial one. In this regard, the Arctic region might become one of the possible options due to its high resource potential.

Development of the northern regions (commercial, social). Bringing economic activity to the Arctic countries thereby contribute to the development of the northern regions. Labor force flows lead to an increase in the region's population. A long chain of supply of inputs encourages local producers of goods and services to develop their business. New infrastructure and facilities, new jobs, growing salaries – all these are the consequences of oil and gas development. All these ripple effects are an important part of industrial activity. They make a significant contribution to the development of the local economy and increase living standards.

In the middle of the 20th century the Soviet Union artificially encouraged the development of northern and eastern regions of the country. Financial and social benefits attracted people and allowed to be more decisive and move to these areas. However, after the collapse of the USSR, the regions faced a tremendous hemorrhage of population and numerous problems including falling economic activity. The decision might be in the example.

The Arctic region is underdeveloped in all the Arctic countries (to a different extent, however) and fossil fuels development projects can be seen as a major push towards the regions' economic growth.

At the same time it is necessary to mention that oil and gas projects ripple effects overcome national borders as well. For example, economic activity on the Norwegian continental shelf has significant positive economic consequences in the EU (ECON Management Consulting, 2014).

Growing revenues (commercial, social). Among the Arctic countries there are several ones that are highly dependent on oil and gas revenues (Norway and Russia are the most evident examples). In this regard, Arctic resources may lead to an economic growth, which, keeping in mind quite harsh taxation systems in oil and gas exploration and production business (especially in Norway), result into increasing government revenues. Revenues are spent according to existing budget plans and internal economic policy, but in any case, the higher the revenues, the better for the society as a whole (ignoring existing cases of corruption, self-enriching elites etc.). In simple terms, the more profitable oil and gas companies are, the more money the country can spend on education system, local development, healthcare system etc.

The question of energy security (political). Energy security can be divided into two main categories: energy security of consuming countries and energy security of producing countries. For consuming countries energy security is seen as "the uninterrupted availability of energy sources at an affordable price" (Iea.org, 2016). However, countries that are highly dependent on revenues created by means of exporting energy resources also care about their energy security, which can be defined as an uninterrupted access to foreign markets with stable and economically profitable prices. Thus, the development of Arctic resources can be seen as a right strategic step both for consumers and for producers. European countries have been trying to decrease the dependency on Russian oil and gas resources for years, but due to Norwegian projects, including those in the Barents Sea, this is currently happening. For producing countries Arctic resources represent an opportunity to maintain the existing production level or even increase it (Norway, Russia).

Despite the fact that The United States of America are currently enjoying an increase in oil and gas production due to horizontal drilling and hydraulic fracturing technologies, according to EIA and its “Reference case”, the output might start to decrease after 2020. At the same time, the “High Resource case” assumes more active exploration and production in Alaska and forecasts an increase in crude oil production until 2040. It would allow the U. S. to satisfy a certain part of its crude oil demand and, in this regard, increase the level of the overall energy security (U.S. Energy Information Administration (EIA), 2014).

New transport routes (social, commercial). The process of sea ice melting in the Arctic Ocean gives access to new transport routes as well as to oil and gas resources. The Northeast Passage provides new opportunities in terms of cargo transportation and logistics. Of course, the question is not unequivocal and there is a lot of critic around the Northern Passage but in some cases it may be a much better alternative comparing to other transport routes (the Suez Canal and the Panama Canal) (Sputniknews.com, 2015).

At the same time, it is important to mention that the development of the Northern Passage is also crucial in terms of the northern regions development. Achieved, due to the sea ice melting, access to transport routes can provoke additional economic activity and lead to previously mentioned ripple effects (infrastructure, new jobs etc.) that help to achieve higher living standards in the North.

Geopolitical competition (political, geographical). The Arctic region is often portrayed as an object of severe competition between the states. Mostly the discussion concerns the “confrontation” between Russia and NATO countries. As it has already been mentioned in the previous parts of the thesis, the mass media and some half-scientific circles quite often overestimate existing tensions in the region. However, it would be unreasonable not to mention this factor as one of those that attract countries’ attention to the Arctic. A certain level of competition has always been an essential part of progress. In this case, it is also a question of prestige to be the first to develop necessary technologies, equipment etc. that are needed to explore and produce natural resources under severe weather conditions of the region.

President Vladimir Putin quite often stresses the geopolitical and economic importance of the Arctic for the Russian Federation and confirms the existing willingness to strengthen Russia's positions in the region. However, it doesn't mean increasing military activity but the economic one.

Obstacles to Arctic oil and gas development

This part is following the logic of the previous one in terms of the composition. However, in addition to the previously mentioned groups of factors (geographical, political, social, and commercial) new groups will be presented: environmental, geological and technological factors.

Severe climate conditions (geographical). Although Arctic climate conditions vary from region to region, mostly then can be characterized by several factors: extremely low temperatures, hardly predictable weather, low visibility, presence of ice, strong wind, big waves (not everywhere), heavy snowfall, polar lows and arctic storms. All these features represent serious limitations in terms of oil and gas exploration and production. At the same time it is important to mention one more problem related to the issue: hard schedule of project implementation. Relatively short weather windows (more or less favorable weather and ice conditions) affect the operability and any economic activities in the region.

High costs (commercial). The development of Arctic resources is almost always associated with very high production costs. This factor is one of the most crucial and seriously affects the prospects of the region. Production costs depend on a great number of different characteristics. Most of them will be discussed below. In simple terms, project costs increase with the amount of hurdles to exploration and product expansion.

Lack of infrastructure (commercial) and long distances (commercial, geographical, environmental). The first factor creates additional heavy costs. The region lacks developed logistics bases and transportation networks. Remoteness from the shore is another core problem of several Arctic projects with preliminary great potential (Stokman field, for example) as it not only increases the costs (necessity to build pipelines, arctic ships, icebreakers, terminals, emergency response equipment etc.) but also possesses high environmental risks (harsh weather conditions and floating ice can cause massive infrastructure damage leading to oil spills).

Lack of technology (commercial, technological, environmental). Previously mentioned severe weather conditions and floating ice require new, more sophisticated and more advanced seismic, drilling, storing and transportation technologies. More stringent well containment, emergency response requirements – all this leads to increasing capital expenditures and research and development investments (Wilson Center, 2014). New oil spill containment systems become an essential part of the problem, keeping in mind highly fragile ecosystem of the Arctic region.

At the same time, it is reasonable, to our mind, to mention and stress the following idea that helps to look at that problem from a different angle. Widely known that it is challenges that have been encouraging the humanity to develop throughout the history. They create opportunities and competition. In this case, numerous difficulties related to the Arctic oil and gas development make R&D departments advance existing technologies in order to succeed in the market, diminishing production costs and making new and new areas accessible for exploration, drilling, production etc.

Horizontal drilling and hydraulic fracturing technologies allowed the United States to become number one producer of petroleum and natural gas hydrocarbons in the world, according to U.S. Energy Information Administration estimates (EIA, 2014). Its success at exploiting tight oil formations and shale gas was reached due to hard work and dedication. However, one of the key factors was the question of energy policy: conventional methods of oil and gas production were not relevant any more. Economic pragmatism and the desire to become less dependent on fossil fuels import allowed to successfully meet technological challenges and reborn the industry on the territory of the United States (at least for now, as this example is quite simplified and does not include numerous factors, primarily connected with the current oil price).

The example shows that problems become opportunities if treated the right way. Thus, the same is supposed to happen in terms of the Arctic oil and gas development. New technologies, that will help to make exploration and production activities safer, more environmentally friendly and will allow to increase recovery percentage, might represent a major push to the sector as a whole.

Deficit of qualified personnel (social, commercial, environmental). Previously mentioned factors require highly trained and prepared personnel that would be able to cope with existing difficulties and immediately answer the problem in case of emergency. Lack of experience in offshore oil and gas production under similar conditions is the reason of insufficient amount of qualified labor force. Keeping in mind that the majority of accidents are the result of human factor (according to Tim Southam, 90% of accidents are attributable to some degree to human failures (Offshore Technology, 2012)), the question also has an environmental dimension: unqualified personnel may be the cause of serious environmental damage.

Social and environmental opposition (environmental, commercial, social). The Arctic Council includes the category of Permanent Participants. It was created in order to involve the Arctic indigenous representatives in the Council’s activity. Although their role is mostly consultative, they can propose cooperative projects and express their will or concerns to the decision-makers (eight member states). Thus, the question of how oil and gas development affects indigenous people in the region is of current importance. At the same time, it is very interconnected with the question of environmental impacts so it is reasonable to discuss them together.

Mostly indigenous communities as well as environmental NGOs are against the development of the Arctic hydrocarbon resources. First, it is hard to say, how it might affect fishing and whaling, which represent the main sector of indigenous peoples’ economies. Second, the effectiveness of clean-up technologies is also a matter of concern: in case of an accident (an oil spill, for example) it would be hard (if possible at all) to contain the oil, especially if it happens in the end of the drilling season (reforming ice). A leaking well could be the reason of serious environmental damage if it was left leaking until the start of the next drilling season (Wilson Center, 2014). Third, it is hard to predict the affects which oil and gas development in the region would have on the fragile Arctic ecosystem.

Although the environmental and social risks are not yet fully investigated, this factor is one of the most important and is the reason of active opposition from ENGOs and local communities. At the same time, the question has a commercial dimension as all these additional safety and environmental protection measures increase production costs and decrease investment attractiveness of the region.

Boundary disputes (geographical, political, commercial). The majority of the Arctic oil and gas resources are contained offshore. However, before staring the exploration and production it is vital to resolve questions of several disputed areas in the region (Beaufort Sea, Barents Sea, Lomonosov ridge etc.). However, the United States has not ratified the UN Convention on the Law of the Sea (UNCLOS) and thus cannot file an official claim to an extended continental shelf which also makes the issue of territorial disputes more complex and complicated.

Lease terms (commercial). Given all previously mentioned climate and commercial limitations to the Arctic resources development (short weather window, extremely high costs of drilling in remote areas, low temperatures etc.) the question of lease terms is highly important to support economic activity in the region. Current 10-year lease term in the Alaskan Arctic is apparently insufficient to encourage energy companies to take higher risks. In this regard it is longer-term leases and more favorable leasing regimes that are supposed to attract interest of the investors (Wilson Center, 2014).

Low exploration status (geological). At the moment geologists do not possess all the necessary data to make a more or less credible conclusion about the fields in the Arctic region. It is known that the amount of resources is tremendous but concrete estimates always vary. The same applies to weather, ice, wind conditions and concrete factors such as the permeability of the rocks, strength of natural drives etc. Thus, lack of information sharply increases the risks and requires additions expenditures (Zolotukhin, 2015).

Conditions under which exploration activities in the Arctic region should be allowed to proceed

As mentioned, the development of Arctic resources is associated with numerous difficulties. However, as stated before, it can also have positive aspects. Thus, when giving a green light to exploration activities it is vital to discuss several conditions under which it can be beneficial not only to oil and gas companies but to others as well.

Environmental conditions. This factor has already been widely discussed in the previous part of the thesis; thus, I will try to briefly stress the main ideas.

The current level of technological development in in the Arctic petroleum sector is insufficient in terms of safety of the environment. Despite the fact that environmental NGOs and local communities' members are highly concerned about the consequences of economic activity in the region for Arctic wildlife and marine ecosystems, one of the main issues is the question of possible oil spills clean up technologies and methods. Severe weather conditions will not allow to contain a spill if it happens in the end of the drilling season because of the reforming ice. Thus, if left leaking a well may be a cause of serious environmental damage (Wilson Center, 2014).

Relationships with local populations. Despite the fact that the Arctic region cannot be seen as a comfortable place to live (because of the reasons, widely described in the previous paragraphs) its population of about four million includes more than thirty different indigenous peoples (Arctic.ru, 2016).

Economic activity in the region provoked a lot of debates about whether it can affect the lifestyle of local communities, and if it can then to what extend. The answer is unclear because the environmental consequences are not yet fully understood (Zolotukhin, 2015). However, keeping in mind the fact that indigenous peoples are highly dependent on fishing and whaling, which are mainstays of their subsistence economies, local communities are highly concerned about how a possible oil spill might compromise these activities (Wilson Center, 2014).

In this regard, only acknowledging the interests and respecting the concerns of these peoples, oil and gas companies should be allowed to proceed the development of the Arctic resources. Moreover, representatives of these communities want to be sure that local populations are sufficiently compensated for the exploitation of their resources because it is them who will bear all the costs of any accident if happens.

Cooperation. As it has already been mentioned the Arctic is often portrayed as an object of a geopolitical race for natural resources and of confrontation (Overland, 2010). However, the situation is that the expansion of Arctic hydrocarbon development is only possible provided mutually advantageous cooperation in numerous spheres (international law, technological development, risk management, shipping, environmental protection, safety issues etc.). Despite existing tensions between Russia and Western countries the development of the Arctic should and can be successfully proceeded only under the banner of cooperation and mutual trust (Pettersen, 2015).

Qualified personnel and high HSE standards. Oil and gas exploration and production are always associated with high risks. However these risks include not only commercial and environmental ones, but also risks that personnel has to incur because of working with complex and extremely expensive machinery and explosive materials. Thus, despite the fact that accidents in oil and gas development industry can damage fragile ecosystem, it can lead so serious injuries and even lethal outcome.

In this regard, keeping in mind the fact that the development of hydrocarbon resources in the Arctic region is considered to be one of the most (if not the most) technically challenging tasks in the industry, where the cost of failure is enormously high, the personnel must include only eminently qualified and highly skilled specialists. In addition, health and safety measures must play a big role in companies' agenda. Constant dialogue, health and safety trainings and seminars will help to build a safety culture (Total.com, n.d.).

Assessment

Nowadays the development of Arctic resources is taking place at a slow pace. Despite the fact that some areas are completely technically unavailable in terms of exploration, drilling and production there are fields where the resources are technically recoverable. However, in all sincerity it is mostly the excessively high production costs that hinder oil companies from the economic activity in the Arctic.

The process of all "breaking factors" overcoming requires enormous amount of effort and, what is more important, investment. Despite previously mentioned "driving factors" oil companies' primary goal is profit. IOCs and NOCs cannot afford the process of resources development if it is not commercially profitable. Keeping in mind the existing level of technological development it is too yearly to state that the Arctic oil and gas resources development will become a full-scale process in the immediate future. At the moment, most of the Arctic resources are not competitive in terms of production costs with other areas, especially keeping in mind current oil price. Thus, it is possible to assume that mostly oil companies are concentrated on more technically accessible fields with more favorable climate conditions and lower production costs.

However, oil price can have a significant impact on the region development as high oil price allows producing with higher costs. Taking into account certain unpredictability of oil price it is hard to forecast the mid-term future of the Arctic resources. Nevertheless, it is possible to find out, to some extend, what particular areas of the Arctic region have higher and what – lower chances to become the next oil "Bonanza".

At the same time, oil and gas exploration and production should proceed only under the circumstances/conditions mentioned and discussed above. Without environmental protection measures, acknowledgement of indigenous peoples interests, cooperation and qualified personnel's occupational safety the development of hydrocarbon resources raises serious concerns.

In a sector, where the cost of failure in extremely high in every respect (environmental, commercial, social etc.) all the decisions must be deliberate and well-weighted. In the beginning of the oil exploration and production era in the United States (the middle of the 19^{th} century), entrepreneurs did not implement any regulations at first. Quite soon they noticed that too many wells damaged oil reservoirs via excessive premature exhaustion of the gas pressure. The result was less oil recovery. According to Daniel Yergin's "The Prize: The Epic Quest for Oil, Money, and Power" there were three reasons accounted for that: lack of geological knowledge, desire to earn as much as possible in the shortest period of time and excising leasing terms (Yergin, 2009). However, soon special regulations were developed and implemented as chaotic activity did not correspond anybody's interests. Of course, today we know much more about oil and gas activity and possess comparatively serious experience. Nevertheless, this story shows us that it is always better to be prepared and make deliberate decisions, especially in the Arctic.

5. Investment attractiveness: The Arctic dimension

Without a good, in-depth knowledge about the socio-economic environment and possessing a sufficient experience in doing business in a particular country, it is almost impossible for the investors to make rational allocation decisions. Of course, it is always possible to get that experience and knowledge by traditional means (gathering concrete data on a concrete potential project), but that process is quite time-consuming and costly (Groh et al., 2015). And that is exactly what investment attractiveness indexes are for: helping to make a deliberate decision on the basis of the country's position in the rating. They allow to save a lot of time and effort on the first step of the investment decision process.

Of course, there are a lot of different ratings and indexes that are dedicated to different aspects of the economy: venture firms, the banking sector, etc. However, the majority of them are developed following the same methodological pattern: the index usually includes several sub-headings that, in their turn, include a vast body of different quantitative and qualitative data.

In order to have a more illustrative knowledge, it is reasonable to provide here an example of the research made by Alexander Groh, Heinrich Liechtenstein, Karsten Lieser and Markus Biesinger, which is called "The Venture Capital and Private Equity Country Attractiveness Index", published in 2015.

The aim was to "propose a composite measure that benchmarks the attractiveness of 120 countries to receive institutional VC and PE allocations" (Groh et al., 2015). The group of scientists decided to divide all the criteria into six sub-headings (they call them "key drivers"), which are:

1. Economic Activity,
2. Depth of Capital Market,
3. Taxation,
4. Investor Protection & Corporate Governance,
5. Human & Social Environment, and
6. Entrepreneurial Culture & Deal Opportunities.

Later on, these key drivers were used to define a subset of criteria the authors were supposed to assess for the sample countries in order to aggregate the index.

However, even though our research follows the same methodological framework, it is quite different from other indexes as the objects of the analysis are the Arctic regions, not the countries themselves. Moreover, the data, necessary for the assessment, is quite limited (due to the geographical location of the region). Plus, the assessment itself is going to be made only in terms of oil and gas development projects. And finally, the number of objects is quite small, comparing to the majority of researches of that kind (for example, previously mentioned work called “The Venture Capital and Private Equity Country Attractiveness Index” included 120 countries). All these limitations leave a mark on the research design and allow to lightly depart from the previously discussed framework.

As is has already been mentioned, the core of the thesis is the investment attractiveness of different Arctic regions in terms of oil and gas development. At first, the idea is quite simple, but upon further acquaintance the question arises: how to calculate the investment attractiveness?

On the basis of previously discussed framework of numerous works of that kind, it was decided to ground the research on the following sub-headings (or “key drivers”, if I use the terminology of Alexander Groh, Heinrich Liechtenstein, Karsten Lieser and Markus Biesinger):

1. Weather factors
2. Geographical factors
3. Taxation
4. Investor protection

Each of these drivers includes several positions (or criteria) that vary from one Arctic region to another and thus, allow to assess the object (the region itself) on the basis of the results.

Weather factors. The importance of that sub-heading is hard to overestimate as it not only has a direct impact on the final breakeven price of the produced oil, but can also be a decisive factor in terms of the investment process.

Quite often we see the Arctic climate and its weather condition as something homogeneous and severe. Nevertheless, that “severeness” differs from one region to another.

At the same time, the term “weather” is quite vast and in order to use it in terms of the research and analysis, it is crucial to single out more specific factors that are going to be used to characterize the investment attractiveness of the region.

First of all, it is the sea ice and icebergs. Different Arctic regions have different ice coverage conditions, for example, it is widely known, that due to the warm North Atlantic drift the southern half of the Barents Sea, including the ports of Murmansk (Russia) and Vardø (Norway) remain ice-free year round, while the Kara sea is completely ice covered starting from October and till May (Vokrugsveta.ru, 2016).

Ice coverage is extremely important in terms of oil and gas development and has a direct impact on the duration of the drilling season, safety measures and environmental risk management process. It represents one of the main challenges and entails new research and development projects in numerous fields including emergency response and HSE.

At the same time, even if the sea is not completely covered with ice, there is another source of possible accidents – icebergs. They can cause serious infrastructural damage and, consequently, need to be considered for structural design and operations of installations at the considered locations (DNV GL AS Oil and Gas, 2015).

Secondly, it's the wind. Despite the fact that all the regions can be characterized by the Arctic climate, still the wind speed differs from one sea to another. This sub-factor plays a significant role in the process of oil and gas fields development as strong winds do occur in storms, cause whiteout conditions and represent a threat to the infrastructure and personnel.

Thirdly, the duration of daylight is one of the important factors to the oil and gas development in the Arctic. Despite the fact that is possesses obvious difficulties in terms of daily operations, the problem has another dimension – a psychological one. Some people are "quite sensitive to the daylight and react differently to prolonged periods of darkness" (DNV GL AS Oil and Gas, 2015). Despite the fact that the average amount of daylight is not going to seriously differ from one Arctic region to another, the situation with the fog occurrence is worth to be mentioned, discussed and compared. Even though there is enough of daylight during the summer period, "visibility can be hampered by fogs" (DNV GL AS Oil and Gas, 2015).

Fourthly, it's the air and sea temperature. The temperatures in the Arctic region are evidently lower that in most of the other oil and gas production regions. At the same time, this sub-factor represents a threat to the whole process as entails marine icing, possible infrastructural damage and malfunctions.

Fifthly, it's the waves that represent one of the threats to the operational works and sea infrastructure. It is known that the development of waves depends on such factors as wind speed and direction, ice coverage conditions and the sea depth. Generally, in July and August the waves are not that big as strong winds are relatively rare at that period and the sea areas that are clear of ice are not that spread, hindering the waves development. At the same time, September and October are the months responsible for the maximum magnitude waves. In November most of the Arctic seas are almost completely ice covered, which entails either small waves or no waves at all. Waves represent a source of potential problems for the industry and need to be assessed and examined in terms of their action on fixed and floating structures (Arctic-lio.com, 2016).

Geographical factors. This set of factors includes such indicators as the overall amount of resources in the region, average depth of the sea and the main fields' remoteness from the shore. Oil and gas companies are concentrated, first of all, on big fields as they provide the "energy giants" with the economies of scale, additional technological decisions, and potentially higher profit. At the same time, the fields' remoteness from the mainland represents one of the main challenges in the whole process of the Arctic energy sources development as entails transportation problems, design challenges and additional costs, all in all.

Taxation. Taxation systems vary from one Arctic country to another. The difficulty here is that I am interested in a very specific (from the point of view of taxation) industry – energy sources development. In competition for exploration investments countries try to make their oil and gas tax regimes competitive and attractive for the investors, especially with the current oil prices. Adjustments to existing tax regimes are happening worldwide and are a matter of concern for the NOCs and IOCs.

At the same time, despite the simple analysis that includes the total tax amount, I am going to concentrate on such sub-factors as transparency and accountability of the taxation systems as a whole. Plus, keeping in mind that oil and gas industry implicates long-term investments, one of the crucial factors here is the permanence of the tax system itself, because unstable and constantly changing fiscal regimes can discourage the energy companies from serious investment initiatives.

Investor protection. The importance of investor protection has been widely discussed by numerous researchers. For example, Desai et al. (2006) show, that "fairness and property rights protection largely affect growth and the emergence of new enterprises" (Groh et al., 2015). At the same time, Knack and Keefer (1995), Mauro (1995), and Svensson (1998) demonstrate that property rights seriously impact investments and economic growth.

All these studies are devoted to the importance of the "country's legal system for the capital market" (Groh et al., 2015). Nevertheless, it is also valid for the corporate world as a whole. This is because investors need to be as much sure as possible that their claims are safe and protected. Keeping in mind the fact that oil and gas industry is mostly about the long-term investments, the business is highly exposed to different changes and legal circumstances. In this regard, the investors themselves need to be confident or, otherwise, they can refuse to allocate capital (Groh et al., 2015).

This section is going to be based on secondary data primarily taken from the World Bank's "Doing Business" project (the enforcing contracts indicator, the quality of judicial processes index, etc.).

Weather factors

That section of the thesis is going to be concentrated on the analysis of the weather conditions in different Arctic regions. In the end of the section the comparative table is to be presented.

The Barents Sea

The Barents Sea is of great importance for the cargo transportation, hydrocarbon resources development and fishing. The largest ports in the region are Murmansk (Russia) and Vardø (Norway).

Harsh climatic conditions in the northern and eastern parts of the Barents Sea determine its ice coverage. It is only the south-western part of the sea that remains ice-free year round due to the warm North Atlantic drift. The greatest spread of the ice cover is reached in April, when about 75% of the sea surface is covered with floating ice. The least amount of ice occurs at the end of August. At the same time it is important to stress that the extent of sea ice in the Barents Sea is under continuous influence of wind, waves, oceanic currents as well as air and sea temperature. The sea ice cover is dynamic, but the areal coverage has been reduced in the latest years (DNV GL AS Oil and Gas, 2015). The Barents Sea is dominated by first-year ice, which forms during late autumn, grows in the winter and melts or drifts away during spring and summer. Nevertheless, remnants of multi-year ice have also been observed (DNV GL AS Oil and Gas, 2015).

As for the icebergs, it is hard to present an illustrative and complete picture because of lack of qualitative data. There were several studies on that topic and one of the most significant was made by Abramov (1996) ("Russian iceberg observations in the Barents Sea, 1933-1990"). The major sources of icebergs are the glaciers on Franz Josefs Land, Novaya Zemlya, Spitsbergen and to some smaller extent Nordaustlandet. In general there are more icebergs in the northern and eastern parts of the Barents Sea and they rarely cross the 72nd parallel north. Usually the area includes near 500 icebergs (a year), but sometimes their number is two times bigger. The richest icebergs months are April, May and September (Koldunov, 2012:1). At the same time, it is in the Barents Sea, where the greatest number of icebergs has been recorded throughout all the years of observation (Pavlov et al., 2015). In the region there are icebergs of all shapes and sizes. About 80% of them are fragments and pieces of icebergs, 16% are tabular and 4% - pyramidal icebergs. The average length of drifting icebergs is 136 m, width - 75 m, height of the topside - 11m, the average weight - 888 ct. According to aerial photographs, icebergs can reach the maximum length of 526 m, width - 210 m and height - 35 m (Pavlov et al., 2015: 121).

As for the wind, the northern part of the sea is dominated by the arctic air masses, the southern – by the air of temperate latitudes. The border of the two main air masses often becomes the center of cyclones and anticyclones, which is actually the reason of the existing weather patterns in the Barents Sea. During the winter season the weather is unstable and can be characterized by strong winds up to 7-8 points (Beaufort scale) (13,9-17,2 m/s) and precipitation, but usually it is about 3-5 points (3,4-8 m/s) (Aari.ru, 2016).

Large areas of clean water, frequent and strong steady winds favor the waves development in the Barents Sea. At the same time it is affected by the peculiarities of the ice coverage conditions in this region. Especially big waves occur in winter, when steady (blowing for at least 16-18 hours) and strong westerly and southwesterly winds blow (up to 20-22 m/s). They occur in the central part of the sea and can reach a height of 10-11 m. The coastal zone can be characterized by smaller waves. In case of steady north-western gales wave height reaches 7-8 meters. In April the amplitude significantly decreases which leads to the situation when 5-meter (and higher) waves become quite rear. The quietest period (in terms of waves development) is the summer months, when the recurrence of waves of 5-6 m in height does not exceed 1-3%. In autumn the intensity of the waves development increases and in November it approaches its winter conditions (Proznania.ru, n.d.).

As for the length of the daylight, “due to the suns inclination to the earth, the sun does not rise above the horizon in the north during wintertime” (DNV GL AS Oil and Gas, 2015). Similarly, during summer the sun never sets at high latitudes. Although night-time operations do not represent a serious problem (as are a common thing on the Norwegian Continental Shelf), the question, as it has already been mentioned, has a psychological dimension. The report made by the DNV GL AS Oil and Gas (2015) called “Technology challenges for year-round oil and gas production at 74°N in the Barents Sea” provides us with some statistical data about the average monthly amount of daylight for SW Barents Sea location and Skarv (Figure 2). For most months of the year the differences are not that big, nevertheless during Nov – Feb the sun “barely gets above the horizon at 74°N. This does not mean it is completely dark as there will be several hours with twilight” (DNV GL AS Oil and Gas, 2015).

For the Barents Sea (especially its Northern part) fogs is a common thing. Their number and duration increase during the warm season. In some years, the number of foggy days may be over 100; average duration - 4.5-6 hours. At the same time, it is in the western part of the Barents Sea where the maximum duration of fog (among the Arctic Seas) is observed. That creates the lowest visibility during the summer period at coastal regions and around the islands, when warm currents meet cold arctic air masses (Proshutinsky, Proshutinsky and Weingartner, 1999:6).

The last weather factor in our list is the air and sea temperatures. The water temperature in the Barents Sea is determined by the water masses flows coming from the West and by the internal processes. The inflowing, relatively warm water is strongly cooled during winter and the surface gradually freezes. Incoming of warm Atlantic waters determines relatively high temperatures and salinity in the southwestern part of the sea. In February - March water temperature here is 3-5 °C at the surface, in August it rises up to 7-9 °C. In the area farther that the 74th parallel north and in the southeastern part of the sea the water temperature at the surface may be below -1 °C in winter, and during the summer period the temperature in the northern part is 2-4 °C, in the south-east – 4-7 ° C. In summer, the water temperature in the coastal zone can even warm up to 11-12 ° C (Midttun, 1990: 14).

In the ice-free southwestern part of the Barents Sea the average air temperature during the winter season is close to 0°C. At the same time, in the northern part of the sea the temperature can be as low as 20°C below zero over the ice-free areas. Summer temperature distribution depends first of all on the solar radiation. In summer, due to a stable anticyclone, the average temperature during the warmest months (July-August) in the north is of 4-6 °C, in the western and central parts of the sea - about 10 °C. During the sunny days the air temperature in the western part can be up to 20 -25 °C (UNEP, 2004:14).

To sum up, the Barents Sea weather conditions remain harsh, comparing to a well-developed Norwegian Sea. At the same time the climatic characteristic may seriously differ on the basis of the geographical location (southwestern part and northern part, for example).

The Kara Sea

The Kara Sea is a part of the Arctic Ocean and is located in the northern part of Siberia. It is separated from the Barents Sea to the west by the Kara Strait and Novaya Zemlya, and from the Laptev Sea to the east by the Severnaya Zemlya archipelago. The climate of the Kara Sea is arctic, however, it is believed to be intermediate between the Barents Sea climate, which is characterized by cyclonic weather and the climate of the Laptev Sea, formed under the influence of the East Siberian anticyclone.

The sea is covered with ice almost all year round. Ice formation begins in September and till May it is 100% frozen (ice-bound for 270-300 days a year). Ice ranges in thickness from 1.2 to 1.6 meters. However, there are large areas of multi-year ice (up to 4 meters). The northern part of the sea is always covered with ice while in the coastal zone fast ice melts during the summer period. Open areas of the sea are characterized by drifting ice, which is mainly the first-year ice of the local origin. Its maximum thickness (in May) is 1.5-2.0 m. External drift is dominating in the sea, which means that the ice is taken out to the north (Aari.ru, n.d.).

In the Kara Sea icebergs are mainly located in the areas adjacent to the groups of islands - the Franz Josef Land, Novaya Zemlya, Severnaya Zemlya, Ushakov Island. 83% of all icebergs recorded in the sea - are fragments and pieces, 10% - tabular, 5% - breaking down ones. The average size of the icebergs in the waters of the Kara Sea is: length - 63 meters, height - about 9 meters. The maximum length can exceed 150 m, height - up to 30 m. From February to May icebergs are mainly located in the northern part of the sea, close to the places of their formation. The maximum number of icebergs in the central part of the sea is observed in July-September (Pavlov et al., 2015:121).

As for the wind, during the autumn and winter seasons, the region is mainly characterized by the Siberian anticyclone. At the beginning of the cold season, wind direction depends on the geographical location. Wind speed at that time reaches 5-7 m/s. Storms often occur in the western part of the sea. The island of Novaya Zemlya constantly becomes the place of the hurricane occurrence (Novaya Zemlya bora, the speed of which can be up to 40 m/s). The duration of this hurricane can be as short as 2-3 hours, but during the winter period it can take several days. In the springtime, sea winds can blow in different directions. Their speed is typically 5-6 m/s. In summer the northern wind is beginning to dominate. Its speed is about 4-5 m/s (Aari.ru, n.d.).

Fogs are quite common in that region and the frequency of their occurrence increases during the summer period. The average number of days with fog varies from 58 in the area close to the cape Zhelaniya and up to 93 closer to the Bely Island (LLC "KARMORNEFTEGAZ", 2014:18).

As for the water temperature, during the warmer spring months the sun's heat is primarily spent on the ice melting process, therefore the water temperature at the surface does not substantially differ from the wintertime. Only in the southern part of the sea, which becomes ice-free before the other areas, sea surface temperature gradually rises. During the summer period and its warmest months (July and August) the water temperature at the surface of the ice-free areas is 3-6 °C, and under the ice coverage it's a bit higher than the freezing point (-1.8 °C) (LLC "KARMORNEFTEGAZ", 2014:20).

The air temperature below 0 ° C is a common thing for the northern parts of the sea and is dominating for 9-10 months, in the south - 7 - 8 months. The average air temperature in January is -20, -28 °C (minimum is -45, -50 °C), in July it is 1-6 °C (maximum 16 °C). In the springtime the air quickly becomes warmer. The weather is mostly quiet, cloudy, with the air temperatures -5, -10 °C. Autumn air cooling begins in late August. The temperature decreases and becomes negative. The average monthly temperature in October is -2, -6 ° C in the west and -10, -12 ° C in the east (Aari.ru, n.d.).

Frequent and strong winds cause considerable waves in the Kara Sea. However, the size of the waves depends not only on the speed and duration of the wind, but also on the ice conditions. In this regard, the most intense waves are seen during the periods of lower icing - in late summer - early autumn. The most frequent waves have height of 1.5-2.5 m, 3 m waves are seen rarely and a maximum wave height is about 8 m. Usually the biggest waves occur in the south-west and north-west of the sea, which are the areas that are usually free of ice. The sea’s central shallow areas have a weaker development of the waves. During the storms short and steep waves are formed there. In the northern part of the sea, the waves are quenched with the ice (Tapemark.narod.ru, n.d.).

The weather conditions in the Kara Sea are difficult and severe, comparing to the Barents Sea, discussed above. One of the main difficulties, in terms of energy sources development, is the long period of full ice-coverage and the presence of icebergs.

The Laptev Sea

The Laptev Sea is one of the most severe arctic seas. Being at a considerable distance from the Atlantic and Pacific oceans, the Laptev Sea is deprived of their warming impact. It is located between the northern coast of Siberia, the Taimyr Peninsula, Severnaya Zemlya and the New Siberian Islands. The neighboring sea on the western side is the previously discussed Kara Sea, which the Laptev Sea is connected to via Vilkitsky Strait. In the East – the East Siberian Sea, to which it is connected via Sannikov and Dmitry Laptev straits.

The sea surface is ice-covered almost all the time. Only in August and September, it is partially free of ice. The Sea’s shallowness and low salinity of its waters also contribute to the sea ice development. As a result, the Laptev Sea is the largest source of arctic sea ice. During the winter period, the shallow eastern part of the sea is characterized by very extensive fast ice, the thickness of which is up to 2. The boundary of its spread is the waters with the depth of 20-25 m, which in this area of the sea pass at a distance of several hundred kilometers from the coast. The area of the fast ice is about 30% of the entire sea (Tapemark.narod.ru, n.d.).

The sources of the icebergs in the Laptev Sea are the outlet glaciers of Severnaya Zemlya archipelago. The production of icebergs by glaciers occurs mainly along the eastern shores of Komsomolets Island and the October Revolution, as well as in the Red Army and Shokalski water passages (in August and September).

The predominant shape of icebergs is fragments and pieces - 92%, tabular icebergs are not more than 8%. The average length of icebergs in the fjords of Severnaya Zemlya is 600 m, width - 200 m, the maximum size - 2100 and 800 m respectively. The height of the iceberg reaches 20-25 m. After leaving the waters of fjords their size decreases (Pavlov et al., 2015:121).

The winter period is dominated by southerly and south-westerly winds with average speed of about 8 m / s. By the end of winter, their speed decreases and calm weather conditions become a common thing. Spring winds are very unstable in terms of direction. They are usually fitful, but not that strong. In summer, most of the northern winds are blowing at a speed of 3-4 m / s.

In the coastal area of the Laptev Sea the number of days with fog per year is more than 70, and in some areas - 80 or more. The average duration of fog here is 400-450 hours per year and summer fogs prevail. For example, in July on Preobrazheniya Island there is up to 130 hours with the fog (Anapolskaya and Kopzneva, 1979:121). The polar night and polar day in this region last about 3 months in the southern part and 5 months in the northern one.

The average air temperature in January (the coldest month) varies depending on the location between -29 °C and -34 °C (the minimum is -50 °C). In July, the temperature rises up to 0 °C (maximum 4 °C) in the north and up to 5 °C (maximum 10 °C) in the south, however, in August it can even reach 22-24 °C on the coast. The maximum (32,7 °C) was recorded in Tiksi (Tapemark.narod.ru, n.d.). The sea is also characterized by low water temperatures. In the winter period the temperature under the ice coverage is a little bit higher than -1,8 °C and can reach up to -0,8 °C (in the south-eastern part). Above the depth of 100 meters the entire layer of water has a negative temperature (up to -1,8 °C). In summer, in the ice-free areas of the sea the uppermost layer of water can be warmed up to 4-6 °C, in the bays – up to 8-10 °C, but remains close to 0 °C under the ice (Shamraev and Shishkina, 1980:110).

Predominantly weak winds, shallow waters and permanent ice cause quite calm sea conditions. On average, in summer the waves are 1 m high (July - August). Storms can occur in the western and central parts of the sea, during which the wave height reaches 4-5 m. Autumn – is the most stormy season when the sea is the most rapid and one can observe the highest possible waves (up to 6 m). However, in this season predominant wave height is still about 4 m, which is determined by the length of acceleration and depths of the sea (Tapemark.narod.ru, n.d.).

To sum up, high-latitude location, remoteness from the Atlantic and Pacific oceans, proximity of the Asian continent and polar ice make the Laptev Sea one of the most severe ones among the Russian Arctic seas. Its climate can be generally characterized as a more continental one, but with markedly distinct maritime features.

The Chukchi Sea

The Chukchi Sea is the easternmost of the Arctic seas. The Sea is slightly elongated north-west and bathes the northern coast of the Chukchi Peninsula and the north-western coast of

Alaska. The Chukchi Sea has very few islands compared to other seas of the Arctic. Wrangel Island lies at the northwestern limit of the sea, Herald Island is located near its northern limit, and a few small islands lie along the Siberian and Alaskan coasts.

The sea is covered with ice for almost the whole year. Warm Alaska stream leads to the fact that southern part of the sea becomes ice-free for 2-3 months in the warm season. Cold stream of the East Siberian Sea brings a lot of ice to the coast of Chukotka. The northern part of the Sea is covered with perennial ice, the thickness of which is more than 2 meters (Tapemark.narod.ru, n.d.). As for the icebergs, in some years they are observed in the northern areas of the Chukchi Sea and in the area of the Wrangel Island. The number of icebergs and ice islands is small and they come from the Beaufort Sea and the adjacent waters of the Arctic basin (Pavlov et al., 2015).

In autumn and winter wind direction is very unstable. The average wind speed is 6-8 m/s. In the second half of the winter it is the southerly winds that prevail. Their speed is usually about 5-6 m/s, decreasing towards the end of the winter season. During the spring period unstable winds become mostly southerly in terms of direction. Their speed is typically less than 3-4 m/s. In summer the southern part of the sea is dominated by southerly and south-easterly winds, while the northern part of the sea - by northerly and north-westerly winds. Their speed usually reaches 4-5 m/s (Tapemark.narod.ru, n.d.).

At the coastal area and on the islands of the Chukchi Sea the average duration of fogs is 650-700 hours per year. Like in all other Arctic Seas the number of days with fog is increasing in the summer period with the maximum amount in July. On the coast, the number of days with fog reaches 80-88 per year (Anapolskaya and Kopzneva, 1979:121).

Air temperature in February (the coldest month) usually reaches -28 °C (Wellen), -25 °C (Wrangel) and -28 °C (Schmidt). Such differences are associated with the warming influence of the Pacific Ocean and the cooling influence of the Asian continent. In July (the warmest month) average air temperature is + 6 °C (Wellen), + 2.5 °C (Wrangel) and + 3,5 °C (Schmidt), but in some restricted locations on the mainland it can reach + 10 °C or even + 20 °C. The summer period is usually characterized by cloudy and rainy weather (usually with snow) (Tapemark.narod.ru, n.d.).

In winter and early spring the temperature under the ice cover is distributed fairly evenly and is -1,6-1,8 °C. In spring it rises to -0,5-0,7 °C at the edge of the ice cover and up to + 2-3 °C in the Bering Strait. Summer warming and the influx of Pacific waters with average temperatures ranging from 0.2 to 4.0 °C increase the water temperature of the Chukchi Sea, but it varies from one area to another. The water temperature in August in the marginal ice zone is -0,1-0,3 °C in the western part, near the shore it can be up to 4 °C, to the east from the 168th meridian west it is 7-8 °C, and in the eastern part of the Bering Strait it can reach 14 °C. In general, the western part of the sea is colder than the eastern one, where the warm Pacific waters are mainly distributed (Tapemark.narod.ru, n.d.).

In the Chukchi Sea big waves occur relatively rarely. The biggest waves (2-4 m) are observed in autumn (the period of storm winds). However, due to the shallowness of the sea and limited ice-free water spaces the waves are small comparing to other arctic seas. Only in the large, ice-free areas in the south-eastern part of the sea strong winds can cause waves up to 4-5 meters. In rare cases, the waves can have a height of 7 m (Tapemark.narod.ru, n.d.).

The climate of the Chukchi Sea, which is entirely located in the Arctic region, is arctic. However, it differs significantly from the Laptev Sea climate, as the weather conditions during the winter season are less stable. The air temperature is also less severe due to the influence of the Aleutian Low and the warming impact of the Pacific Ocean. The Chukchi Sea receives comparatively small amount of sun heat, which results into small changes in air temperatures during the year.

The Beaufort Sea

The sea bathes the north coast of the Northwest Territories, the Yukon Territory and Alaska. The western part of the Canadian Arctic Archipelago adjoins the Beaufort Sea. North-western border of the Beaufort Sea is considered to be the line from Point Barrow (Alaska) to Cape Land's End, Prince Patrick Island, the eastern one - the island of Banks.

In terms of ice conditions the Beaufort Sea is one of the most severe in the Arctic Ocean. Almost the whole area of the Beaufort Sea is under the ice. Only in August the ice moves away from the coastal zone (at 50 - 100 km). Icing starts in the end of August - early September. During the winter season, the sea is almost fully ice-covered with fast ice and drifting ice. Fast ice is common almost everywhere along the coast and is relatively narrow. It is formed by the first-year ice, the thickness of which reaches 1.5-2 m in May. Floating ice mainly consists of multiyear ice, the thickness of which is higher than 2 m, and in some areas can even be up to 10 m and more. Ice melting begins in June in the coastal zone of the western part of the sea, and quickly spreads to the east. In the summer months, the amount of ice in the Beaufort Sea is less than in winter. However, in summer about 80% of the sea is still covered with drifting ice (Gorkyn, 2006:140).

There are no icebergs in the Beaufort Sea, but ice islands can occur. Ice islands are calved from a relic Pleistocene ice shelf (that still exists along the north coast of Ellesmere island) and can be as big as 10 km in extent. Their thickness is about 50 m. However large ice islands are very rare and there is no any justifiable need in designing offshore platforms for them. The probability of collision is also low as ice islands are easy to detect well ahead so that the “personnel could be evacuated and the oil well sealed off” (National Research Council (U.S.), 1986:250).

The Beaufort Sea is mainly characterized by north-easterly and northerly winds. The average speed is about 6-8 m/s. In the coastal zone the wind conditions are significantly affected by the orography of the coast. In this regard, the westerly winds are observed here. Autumn and winter are the stormiest seasons, due to the strengthening of the north-easterly winds. Their speed can reach 25 m/s. Calm weather at this time is rare. In the summer period the stability of the winds decreases. They are different in terms of direction, although north-easterly and south-westerly winds are prevailing. The wind speed is low - up to 5-6 m/s. Storms are quite rare (Seamap.info, 2013).

The number of days of fog in this area is almost the same as in the Chukchi Sea and can be as high as 90 (annually). At the same time the Beaufort Sea “can expect 118 days of visibility of less that 1 mile” (Alaska natural gas transportation system: final environmental impact statement, 1976:494).

In winter the center of the Arctic anticyclone is located over the Beaufort Sea. The western part of the sea is also impacted by the Aleutian depression, where the northeast cyclones originate. Such barometric situation entails predominance of cold Arctic air over the sea. The average monthly temperature in January (the coldest month) is -28-30 °C. During the summer period, the cooling effect of the adjacent part of the ocean is felt more markedly. The air over the sea warms up to a small extent. The average monthly temperature in the warmest month (July) is 6-8 °C (Seamap.info, 2013).

The sea water has a stable temperature which is separated fairly evenly, mainly due to the latitudinal stretch of the sea and its wide and free communication with the Arctic Basin. In winter, the water on the surface almost everywhere has a temperature of -1.7 °C (under the ice cover). In summer, the Beaufort Sea warms up relatively little. The water temperature at the surface in the northern and north-western parts of the sea is -1,5 °C, in the southern part it is higher (-0,5-0 °C), and at Point Barrow it is 2 °C. The eastern part of the sea is a little bit warmer that the western one (Encyclopedia Britannica, n.d.).

In the Beaufort Sea the waves are mostly low due to the predominance of small wind and limited spaces of clean water. In the summer period the waves are usually 0,1-0,3 m high. In early autumn, when the strong northeasterly winds blow the storms may occur with the waves height of 3-4 m, sometimes even up to 5 m. They usually have a greater slope (Seamap.info, 2013).

The Beaufort Sea received its name in honor of the British admiral and scientist Sir Francis Beaufort. Harsh climate conditions - cold water, small amount of light and heat from the sun, thick ice coverage were the reasons why the Beaufort Sea has been one of the most unexplored seas on the planet for a long time. For the same reasons its waters are not that reach in terms of presence of different forms of life. The fauna and flora of the region are poorer than in the neighboring seas.

Nevertheless, the Beaufort Sea proved to be a "valuable" geological object due to the fact that rich energy resources were detected on its territory. To sum up, the weather conditions in the Beaufort Sea are quite severe and represent serious challenges to oil and gas development in the region. Constant presence of ice and its thickness need to be kept in mind during the process of oil wells designing, energy sources exploration and production.

Baffin Bay

Baffin Bay is a marginal sea of the North Atlantic Ocean. It is located between Baffin Island and the southwest coast of Greenland. It is connected to the Atlantic via Davis Strait and the Labrador Sea; to the Arctic Ocean - via Nares Strait, which includes the Straits of Smith and Robson.

Ice is present in Baffin Bay throughout the whole year, but its distribution, amount, etc. differ from one season to another. Steady ice formation begins in the northern areas of the Bay in the first ten days of October. Then the icing front fairly quickly spreads to the south and southeast. In winter, 80% of the bay is covered with continuous ice, floating ice and fast ice. In some winters, the continuous ice stretches from shore to shore. The ice is most abundant in March and least in August–September. The thickness of the multi-year ice is increasing from south to north from 1,5-1,6 m to 2,0-2,2 m. The process of ice melting begins in the south-eastern parts of the Bay at the end of May - beginning of June and extends to the west and north-west. Along the western coast of Baffin Island and northern straits fast ice breaks up early - in the third decade of July. During the summer period a large part of Bay is free of ice, and by mid-August clean waters occupy nearly 3/4 of the whole sea surface. Floating ice accumulates mainly in the western and central parts of the sea, which is due to the circulation of surface waters. It is mostly the multi-year ice, much of which is brought from the Arctic basin through the northern straits (Seamap.info, 2014).

A large number of icebergs is a peculiarity of Baffin Bay. They are mainly calved from the glaciers of western Greenland. The height of icebergs usually varies from 30 to 60 m, but can reach 90 and even 100 m. Usually, the icebergs are floating, first, to the north, along the west coast of Greenland, and then to the south-west and south, along the eastern coast of the sea. The greatest number of icebergs was observed in the spring and early summer (Seamap.info, 2014).

During the winter season it is mainly northerly and north-westerly winds that blow (6-9 m/s). Winter is characterized by intensification of cyclonic activity. North Atlantic cyclones can bring with them strong winds, sometimes up to a storm. Local winds are sometimes observed in coastal areas, on the western coast of Greenland. These are very strong (sometimes their speed exceeds 55 m/s), dry and warm winds (predominantly north-easterly, easterly and southerly), which blow from the mountains to the low-lying areas of the coast.

In summer, Polar maximum shifts to the north, and its impact on Baffin Bay is felt to a lesser degree. This time of the year can be characterized by south-westerly and westerly winds blowing at an average speed of 4-6 m/s. In general the wind speed increases from the coastal areas to the open sea (Seamap.info, 2014).

The average number of days with fog in this region is not that big comparing to the previously discussed areas – 60-80 per year. However, its frequency pattern remains the same: the greatest number is observed during the summer period (maximum is in July), while in winter it is much lower (Przybylak, 2015:122).

In the coldest month (February) average temperature varies from -20 °C (in the southern part of the Bay) to -30 °C (in the northern one). Only in the most southern regions, closer to the coast of Greenland, it can increase up to -18 °C. In summer, the air temperature decreases from south to north. During the warmest month - July - its value varies from 5-6 °C in the south-eastern part (the coastal area of Greenland), to 2-3 °C in the northern sea borders. In open spaces of the sea the average temperature is 4 °C, and the maximum is 16 °C. Daily temperature fluctuations are relatively small (Seamap.info, 2014).

The water temperature on the surface increases from west to east, due to the influence of cold water entering through the northern straits and spreading along the western coast, and the flow of warm water entering from the south and moving to the north along the coast of Greenland and in the central areas of the sea. In winter, the temperature on the surface is -1,5-1,7 °C. In summer, the water is warmed up relatively weak, partially because of the ice melting process. Consequently, the water temperature on the surface is low and varies from 0 °C to 5 °C. Low water temperature is observed closer to the south-western coast and in the central part of the sea. Its higher values can be found in the coastal waters of Greenland and in the northern and north-western parts of the central area of Bay (Seamap.info, 2014).

Predominance of low speed winds and the presence of significant amounts of ice for most of the year are the reasons of relatively small waves in the sea. In the summer months the height of the waves is only about 0,1 – 0,3 m. In autumn it can sometimes increase up to 0,9-1,5 m (rarely – 2 m and more). The most frequently waves are observed in case of northerly and north-westerly winds. The average height of the waves is 0.8-1 m. Even during the violent autumn storms the wave height can be slightly over 1 m (Seamap.info, 2014).

Despite that fact that Baffin Bay was opened in the 16th century, it was hardly explored until the 20th. Climate conditions in this region are severe and one of the main features is the constant presence of ice and a great number of icebergs. The population density in this area is quite small, comparing to other regions and is a direct result of previously mentioned difficulties.

Weather factors comparison

The following table (Table 1) is supposed to be a tool that will help to illustrate the weather conditions in different arctic regions and compare them.

	Average ice thickness	Ice coverage conditions (winter/summer)	Icebergs conditions (average size: height, length, width)	Wind speed	Average number of days with fog	Water temperature (warmest month)	Air temperature (coldest month)	Waves height
The Barents Sea	Up to 2 m	75% ice covered/ fully ice free	H - 75 m; L – 136 m; W – 75m	Up to 14-17,5 m/s (usually – 6-8 m/s)	More than 100 + maximum duration among the seas of the Arctic region	7-9 °C (southwest); 2-4 (east)	-2 – 0 °C (southwest); -20 (northeast)	7-8 m
The Kara Sea	1,2 -1,6 m; up to 4 m if multiyear	100% ice covered/ partially ice free (only for 2 months)	L – 63 m; H – 9 m	5-7 m/s + bora (up to 40 m/s)	75-85	3-6 °C	-20-28 °C	1,5-2,5 m
The Laptev Sea	Up to 2 m (fast ice)	100% ice covered/ 90% ice free (only for 2 months)	L – 600 m, W – 200 m, H – 20-25 m	8 m/s	70-80 (400-450 hours)	4-6 °C	-29-34 °C	4 m
The Chukchi Sea	Up to 2 m (fast ice)	100% ice covered/ partially free (only for 3 months)	Small amount of icebergs	6-8 m/s	80-88 (650-700 hours)	7-8 °C (east)	-28 °C	2-4 m
The Beaufort Sea	More than 2 m (floating ice)	100% ice covered/ partially ice free (only for 1 month)	Small amount of icebergs, but the presence of ice islands	6-8 m/s	90	-1,5 - +2 °C	-28-30 °C	3-4 m
Baffin Bay	1,5 – 2,2 m (multiyear)	80% ice covered/ in August 75% is ice free (for 4 months)	H – 30-60 m	6-9 m/s + strong local winds (up to 55 m/s)	60-70	0-5 °C	-20 (south); -25 °C (north)	0,8 – 1 m

Table 1: Weather factors comparison

As for the average ice thickness, it is the Beaufort Sea that takes the 1^{st} place in terms of "severeness" (a lot of floating ice which can be up to 10 m thick), then goes the Kara sea with its multiyear ice (up to 4 m) (2^{nd}) and the Baffin Bay (1,5 – 2,2 multiyear ice) (3^{rd}). The Laptev and the Chukchi Sea get the 4^{th} place as are quite similar in terms of this factor. The 5^{th} place is taken by the Barents Sea with its mostly first-year ice.

Ice coverage conditions give us the following order: The Beaufort Sea (1 month ice-free and only near the coastal area), The Kara Sea (partially ice-free for 2 months), The Laptev Sea (90% of it is free in summer for 2 months), the Chukchi Sea (partially ice-free for 3 months), Baffin Bay (80% ice-covered in winter and 75% of the sea is ice-free in summer) and, finally, the Barents Sea (75% ice-covered in winter and fully ice-free in summer).

According to the presence and the average size of icebergs we have the following order: Baffin Bay (big amount of icebergs and their size is impressive), the Laptev Sea, the Barents Sea, the Kara Sea, The Beaufort Sea (no icebergs, but the presence of ice islands) and the Chukchi Sea (comparatively small amount of icebergs).

As for the average wind speed, it is Baffin Bay that is taking the 1^{st} place (average speed is not that high, but local coastal winds can be up to 55 m/s), then go the Kara Sea (with its 40 m/s bora), the Barents Sea, the Laptev Sea, and finally, the 5^{th} place is occupied by the Chukchi and the Beaufort Sea (the same average wind speed).

According to the average number of days with fog (annually), presented in the table, the situation is the following: The Barents Sea (> than 100 days of fog), the Beaufort Sea (90), the Chukchi Sea, the Kara Sea, the Laptev Sea and Baffin Bay (60-70 days, the 6^{th} place).

It has been chosen to compare the water temperature during the warmest period as during the coldest months it would be approximately the same (close to -1,8 °C). Thus, the 1^{st} place is taken by the Beaufort Sea (-1,5 - +2 °C), than go Baffin Bay (0-5 °C), the Kara Sea (3-6 °C), the Laptev Sea, the Chukchi Sea (the water temperature on the surface is 7-8 °C in its eastern part) and, not surprisingly, the Barents Sea (7-9 °C in the southwestern part and 2-4 °C in the eastern one).

As for the air temperature during the coldest months it is the Laptev Sea that takes the 1^{st} place (-29-34 °C), the 2^{nd} is the Beaufort Sea (-28-30 °C), then go the Chukchi Sea, the Kara Sea, Baffin Bay (varies from -20 °C in the southern part to -25 °C in the northern one) and the Barents Sea (-2 – 0 °C in the southwestern part, -20 °C in the northern one).

According to the average wave height it is the Barents Sea, that goes 1st (7-8 m, but can be as high as 10-11m). Then go the Laptev Sea, the Beaufort Sea, the Chukchi Sea, the Kara Sea (1,5-2,5 m) and Baffin Bay (0,8-1 m).

To make the final picture more illustrative it is reasonable to include this data into the table of ranks (Table 2). Total score is a simple sum of ranks, achieved for every sub-factor. The higher the total score, the easier and less severe the weather conditions of the region are. At the same time, the final rank (weather conditions rank) is calculated by comparing the sum of ranks of each sea. However, in order to make the ranking more conventional, it is reasonable to write them vice versa: the higher the number the more severe and unfriendly the weather conditions are (in terms of oil and gas development).

According to the Table 2, it is the Chukchi Sea that is the most favorable in terms of weather conditions for the energy sources development among the chosen Arctic regions. It is important to stress, that the preliminary suggested “winner” was thought to be the Barents Sea. However, it took the 2nd place and mainly because of its big number of days with for, serious winds, numerous icebergs and comparatively big waves. Nevertheless, its arrearage from the leader is quite small and in some sub-factors was even nominal. The Chukchi Sea, in its turn, was not the leader in any of the sub-factors (except for the icebergs conditions: their number is low, if compared with the other arctic regions from the list), but showed “good” results in almost every component. At the same time, it is necessary to understand that its 1st position does not mean it is a friendly and “easy to do business” place. What it means is that all other regions were even more severe: the Beaufort Sea, for example, got only 20 points in the total score, which explained its 6th position in the final rank. The reason for that was the region’s thick floating ice, almost constant ice-coverage, big number of days with fog, -30 °C in winter and low water temperature even during the warmest months.

To sum up, if compared on the basis of the sum of the sub-factors ranks, the results lie quite close to each other (except for the Beaufort Sea, which got much less points than most of the other regions). At the same time, the final rank represents only the first “key factor” among the briefly discussed four. The next is the geographical one.

	Average ice thickness (place)	Ice coverage conditions (winter/ summer) (place)	Icebergs conditions (average size: height, length, width) (place)	Wind speed (place)	Average number of days with fog (place)	Water temperature (warmest month) (place)	Air temperature (coldest month) (place)	Waves height (place)	Total score (sum of ranks)	Weather conditions rank
The Barents Sea	5	6	3	3	1	6	6	1	31	2
The Kara Sea	2	2	4	2	4	3	4	5	26	4
The Laptev Sea	4	3	2	4	5	4	1	2	25	5
The Chukchi Sea	4	4	6	5	3	5	3	4	34	1
The Beaufort Sea	1	1	5	6	2	1	2	3	20	6
Baffin Bay	3	5	1	1	6	2	5	6	29	3

Table 2: Weather factors table of ranks

Geographical factors

This part of the thesis is supposed to concentrate on the geographical factors of the previously mentioned six arctic regions.

The Barents Sea

The Barents Sea is located off the northern coasts of Norway and Russia. In terms of weather factors comparison the sea was assessed as a single entity as the differences were not that evident and necessary to stress (fog, winds, icebergs and other conditions are approximately the same, no matter which part of the sea is being discussed). However, in terms of the geographical factors (and all the other following key-factors) it is reasonable to divide the Barents Sea into two separate regions: the Norwegian Barents Sea and the Russian Barents Sea, as there are significant distinctions in the amount of resources and main fields' remoteness from the shore.

The Barents Sea is a rather shallow shelf sea. However, it has a very uneven distribution of the depths. With its average depth of 222 m, difference in depths in the open areas of the sea can reach 400 m. The Maximum depth is 600 m. The Southern part of the sea is mostly less than 200 m deep and has a quite leveled bottom. (Tapemark.narod.ru, n.d.). At the same time it is the shelf that the oil and gas companies are mostly interested in. As for the White Sea, a considerable part of its shelf consists of shallow bays with an average depth of only 67 m and a maximum of 350 m (Barentsinfo.org, n.d.). However, the depth of the shelf in the whole Barents Sea is 100-350 m (Arctic-info.ru, n.d.).

The Norwegian part of the Barents Sea has several big fields (mostly the gas fields, actually): Snøhvit, Goliat, Johan Castberg. Their remoteness from the shore is 160 kilometres, 85 kilometres and 185 kilometers correspondingly (Statoil.com, 2016). At the same time, there are several projects that are located even closer to the North Pole. For example, the Skrugard oil field is 200 kilometers offshore in the western Barents. Of course, it is quite costly to develop the energy sources that far from the mainland, but Norway's oil production is declining year by year, thus the government itself is interested in big fields and in the very process of moving the oil and gas frontier farther to the north.

As for the amount of energy resources, then it is reasonable to use the statistics, provided by the US Geological Survey. In their report, called "Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle" scientists put Norway's potential oil and gas resources in its section of the Barents Sea at 6,704 million barrels of oil equivalent. As for the Russian part of the Barents Sea, it is said that the amount of undiscovered conventional oil and gas resources in this region is 61,755.10 million barrels of oil equivalent, which is almost 10 times more that in the western (Norwegian) part (USGS, 2008:4).

Among the oil and gas fields on the Russian side of the Barents Sea the most promising are the Shtokman field (600 kilometers north of Kola Peninsula), the Prirazlomnoye oil field (60 kilometers off the shore (Varandey settlement)) (Gazprom.com, n.d.), the Murmanskoye field (about 220 km off the coast of the Kola Peninsula) and the Ledovoye field (700 km off the shore). Thus, it is possible to suggest that despite the fact that the fields in the Russian Barents Sea are much bigger (in terms of resources) than in the Norwegian one, their remoteness is also quite challenging and requires additional technological decisions.

To sum up, the Barents Sea is probably the most explored one in terms of oil and gas business, partially, because it is ice-free almost year-round. At the same time, it is the Norwegians who also contribute to its further development, as Norway is the acknowledged leader in the sphere of offshore technologies, which is being proved year by year. Nevertheless, the Eastern (Russian) part of the Barents Sea is responsible for much bigger deposits. However, main fields' remoteness and water depth in these areas hinder the process and bring serious additional costs.

The Kara Sea

The Kara Sea is mainly located on the shelf. It can be characterized by a big amount of islands. Dominating depth is about 50-100 meters; the maximum depth is 620 meters. The average depth of the shelf is about 100 m (Arctic-info.ru, n.d.). However, depths may seriously vary on the basis of the area of the sea: from more than 500 m in the St. Anna Trough (the northern part) and 433 m in the Novaya Zemlya Trough (in the southwest) to an average depth of 50 m and even less in the central and Sothern parts (Ruediger, 2003).

As for the amount of resources, it is reasonable to address to the previously mentioned USGS reports. In 2008 they published a separate assessment (that still is a part of the USGS Circum-Arctic Resource Appraisal program) of the West Siberian Basin Province. The report divided the province into two separate regions: the Northern West Siberian Onshore Gas AU and the South Kara Sea Offshore AU. The framework of the research allows us to take into account only the second one, as we are interested only in the offshore resource potential of the Kara

Sea. According to the report, the South Kara Sea Offshore AU accounts for 2,507 million barrels of oil, 622,222 billion cubic feet of gas, and 19,479 million barrels of natural gas liquids (USGS, 2008:2).

In order to make the final comparison more simple and comfortable I need to convert all these numbers into million barrels of oil equivalent. Thus, 622,222 billion cubic feet of gas equal 117,270 million barrels of oil equivalent (1 billion cubic feet NG = .18 million barrels of oil equivalent (Extension.iastate.edu, n.d.)) while 19,479 million barrels of natural gas liquids (NGL) equal 1873 million metric tons of NGL (10.4 barrels per metric tone (Eia.gov, n.d.)), which, in its turn equal 22,238 million barrels of oil equivalent (1 barrel of oil equivalent equals 0.0837 tonnes of NGLs (Statoil.com, n.d.)). Consequently, the total amount of undiscovered resources in the southern part of the Kara Sea, according to the USGS, is approximately 142,015 MMBOE.

However, I also need to add the amount of resources that is located in the northern part of the sea. That information is taken from the previously mentioned “Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle” report. American specialists believe that North Kara basins and platforms are responsible for 4,693.07 MMBOE (USGS, 2008:4). Thus, the overall amount of undiscovered technically recoverable resources is 146,708.07 MMBOE.

As for the main oil and gas fields in the region, they are mainly located on the Yamal Peninsula (Bovanenkovskoye, Kharasaveyskoye, Kruzenshternovskoe, etc.). However, the research is mainly oriented on the offshore energy sources development. Thus, the attention is going to be concentrated on the two promising fields: Leningradskoye (125 kilometers off the shore) and Rusanovskoye (235 kilometers off the shore). At the same time in 2014 Rosneft announced that it made a major oil and gas discovery in the Arctic Kara Sea following the drilling of the northernmost well in the world in the “East-Prinovozemelsky 1” block, which it explored together with ExxonMobil. The field was called “Pobeda” and it is approximately 250 km off the continental part of the Russian Federation (Rosneft.ru, 2014).

To sum up, the Kara Sea is a very interesting area in terms of resource potential. Its big deposits (probably the biggest among the Arctic regions) make it an attractive area for doing business. Nevertheless, severe weather conditions make the development of the shelf quite challenging and create additional difficulties. Plus, the remoteness of the most promising fields is also significant (but not extraordinary).

The Laptev Sea

The Laptev Sea occupies the entire shelf, continental slope and captures a small part of the ocean floor, so its bottom can be described as a plain that is gradually going down, at first, and then recedes steeply. The overwhelming part of the sea is shallow. Half of its area can be characterized by the sea depth of 50 m, and to the south of the 76 ° north latitude it does not exceed 25 m. The northern part of the sea is much deeper. In this area, the depth is gradually increasing from 50 to 100 m, and then sharply goes up to 2000 m and more. Even though the average depth of the Laptev Sea is 540 m (because the maximum depth is 3385 m), it is reasonable to keep in mind that most of the sea area can be characterized by the depth of only 50 m, while the shelf itself - 10-40 m (Arctic-info.ru, n.d.).

As for the amount of resources that is hidden under the ice, it is going to be assessed by referring to the same “Circum-Arctic Resource Appraisal” report by the USGS. The report divides the area of the Laptev Sea into two separate regions: the Northwest Laptev Sea Shelf and the Laptev Sea Shelf which are responsible for 1,039.90 and 9,409.87 million barrels of oil equivalent respectively. Consequently, the total amount of undiscovered technically recoverable resources in the Laptev Sea region is 10,449.77 MMBOE (USGS, 2008:4). This number is hardly competitive with the previous assessment (the Kara Sea region), but is still significant, which is proven by the Russian energy companies’ interest in the local oil and gas fields (Rosneft’s and Lukoil’s dispute over the oil resources of the Laptev Sea) (The Independent Barents Observer, 2015).

Speaking about the main oil and gas fields, it is important to mention that this region is quite unexplored. At the same time Rosneft is already the owner of the following license blocks in the Laptev Sea: Ust' Oleneksky, Ust' Lensky and Anisinsko-Novosibirsky.

Ust-Lensky license block “is located 130 km from Ust-Olenyok, 260 km from Bykovsky and 305 km from Tiksi. Distance to Yuryung-Khay is about 150 km, to Syskalah - about 250 km. The nearest settlements to Ust-Oleneksky license block are Ust-Olenyok (145 km), Bykovsky (290 km) and Tiksi (335 km)” (Mackenzie, n.d.).

As for Anisinsko-Novosibirsky license block it is Bykovsky (440 km), Tiksi (490 km) and Nizhneyansk (500 km) (Mackenzie, n.d.). It was chosen to calculate the remoteness of the license blocks using the distance of the closest settlements, as the blocks are quite big and wide. At the same time, the before mentioned settlements are located right on the shore, thus represent a fair reference mark.

It is also important to mention the final “getting” of Rosneft: the Khatangskoye field. However, it is located in the Khatanga Bay and, thus, not going to be included in the Laptev Sea main oil and gas fields remoteness assessment as it is a part of a well-known East Taymyrsky block, owned by Lukoil, and despite the fact, that it is technically located on the shelf, it can hardly be taken into account keeping in mind its geographical location.

To sum up, the region of the Laptev Sea is potentially quite rich in terms of oil and gas resources. At the same time, its sea depth is comparatively small, which is a plus for the industry. Nevertheless, the Sea is one of the least explored areas of the Russian Arctic and there is quite little information about the exact location, amount of resources, etc. of particular oil and gas fields. Thus, the region can be characterized as potentially promising, but practically underdeveloped and unexplored.

The Chukchi Sea

In the previous parts the region of the Chukchi Sea was described and assessed as a single entity. At the same time, keeping in mind the framework of the research, the main idea of which is to calculate and compare the investment attractiveness of different Arctic regions, hereinafter it is reasonable to take into account only the eastern part of the sea. The number of cases is seven (for now) (keeping in mind Norwegian and Russian Barents Sea), and three of them are located on the territory of Russia, thus, in order to make the thesis more valuable, it was decided to concentrate on the American part of the Chukchi sea, so that it would be more illustrative in terms of global assessment and comparison (as taxation, investor protection, etc. are different in the US and Russian Federation). Nevertheless, characteristics of the relief are supposed to be presented for the whole territory of the sea.

The bottom of the Chukchi Sea is quite smooth. Two major canyons cut into the shelf: Herald Canyon (up to 90 meters deep) to the west and Barrow Canyon (with a maximum depth of 160 meters) to the east. They are separated by Herald and Hanna Shoals in the middle. In between the two shoals there is a topographic depression called Central Channel (Pickart and Gong, n.d.). The depth is increasing in the central part of the sea, which reminds a bowl. The Chukchi Sea is located on the continental shelf the depth of which is 20-60 meters (Arctic-info.ru, n.d.). There are shallow areas with depths up to 13 meters. 56% of the area has a water depth less than 50 m, maximum depth is 1256 meters. The average water depth is 71 m. The number of islands in the Chukchi Sea is comparatively low.

As for the amount of undiscovered technically recoverable oil and gas resources, in this case I am going to use the estimates, provided by the BOEM (Bureau of Ocean Energy Management) in their report called “Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation’s Outer Continental Shelf”, published in 2011. According to the American scientists, the Chukchi Sea is responsible for 15.38 billion barrels of oil and 76.77 trillion cubic feet of gas, which result into 29.04 billion barrels of oil equivalent or 29,040 MMBOE (BOEM, 2011:3).

There were five exploratory wells on the territory of the Chukchi Sea shelf: Klondike, Burger, Popcorn, Crackerjack and Diamond (the last one was drilled in 1991). These early wells allowed to suggest that the area was reach in terms of natural resources and entailed further development of the region (Offshore Technology, n.d.). However, at that time there was no trace of commercial quantities of oil or gas, thus the leases expired and exploration was discontinued in 1992. In 2008 Shell purchased a portion of the lease area 193 for US$2.1bn. They were going to develop four fields over the leased area. Burger, by the way, was estimated as 5 TCF and was supposed to be the biggest domestic oil field in the country (Energypolicygeek.wordpress.com, 2011). Nevertheless, in 2015 Shell abandoned its Arctic search for oil after failing to find enough crude (Karolin Schaps, 2015), which has a negative effect on further oil and gas development of the region.

Thus, there is no any available data about the oil and gas fields in the region, as nothing concrete has been found. However, the most promising area is the so-called “Burger field” (which is actually a prospect), that lies 90 km from the Alaska shoreline (Offshore Technology, n.d.).

To sum up, the picture can be characterized by the following ideas: the amount of undiscovered technically recoverable resources is comparatively big; the geographical conditions also encourage the development of the region, however, despite the efforts, the latest of which were made by the Shell company, there has not been found any sufficient amount of oil or/and gas to start economically viable production. Seismic activities and preliminary assessments allow to suggest that the oil is right there, but the exploratory wells provide us and the companies with the opposite information, which led to the fact that Shell lost its bet in the Arctic.

The Beaufort Sea

The situation with the Beaufort Sea is approximately the same as with the Barents Sea. The territory of the Beaufort Sea is divided between the United States of America and Canada. Thus, it is reasonable to assess the region not as a single entity but as two separate cases: the US Beaufort Sea and the Canadian Beaufort Sea, increasing the number of assessment units up to eight.

The Canadian shelf and the Yukon/Alaskan shelf form the southern boundary of the Beaufort Sea. At the same time, their physical characteristics are quite different: the Canadian shelf is approximately 110 km wide and runs northeast on a bearing of 52º, whereas the Alaskan shelf is about 50 km wide and runs east-southeast at 105º (the narrowest part of the Arctic basin shelf). The water depth on the shelf is approximately 80 m (near the coast – 60 m) but then it rapidly increases up to 3500 and even close to 4000 (Williams, Dunbar and Carmack, 2001). The continental slope begins at a depth of 200 m. The average depth of the sea is 1,004 m, maximum depth - 4,683 m.

As for the resource potential, the American part of the Beaufort Sea is believed to hide approximately 13.14 billion barrels of oil equivalent (8.22 billion barrels of oil and 27.64 trillion cubic feet of gas) (BOEM, 2011:3). At the same time, the Canadian part of the Beaufort Sea is responsible for 11.6 billion barrels of oil equivalent (6.0 billion barrels of oil and 33.6 trillion cubic feet of gas) (Drummond, 2008:21). Thus, the US Beaufort Sea is supposed to be richer in terms of undiscovered resources, than the Canadian Beaufort Sea. However, the numbers are quite comparable and the difference is not that big (especially keeping in mind the probability of the findings, which is always the case when deal with undiscovered resources assessments).

The Beaufort Sea is comparatively well explored in terms of the oil and gas development. What first comes to mind is Prudhoe Bay and Kuparuk-River, two supergiant oil fields that are responsible for the major part of the resources in the area. However, as it has already been mentioned, the framework of the research takes into account only offshore energy sources development. Thus, in the western part of the Beaufort Sea I am going to concentrate on the Endicott oil field (it is being produced from two artificial gravel islands, 6 km offshore), Liberty (9 km offshore), Niakuk (2 km offshore), Northstar Unit (9.7 km north of the Alaska coast) and Nikaitchuq Oilfield (both offshore and onshore; offshore development is done from an 11-acre artificial floating gravel island at Spy Island, located about 4.5km from the coast in Harrison Bay) (Offshore Technology, n.d.).

The Canadian part of the Beaufort Sea is characterized by the following offshore fields: Amauligak (located about 50 kilometers from the last landfall in the Northwest Territories, and lies at water depths of 30 meters), Paktoa (approximately 40 km offshore), Koakoak (74 km off the coast), Issungnak (approximately 50 km offshore) (Drummond, 2008:10).

Thus, we can see that the remoteness of the main oil and gas fields both in the US and in the Canadian parts of the Beaufort Sea is comparatively low (in general, the distance is bigger in the eastern part (Canada)). Despite the fact that it is quite comfortable to extract oil today (shallow waters and low remoteness from the shore), narrow shelf can limit further activities, if companies want to go farther to the north.

To sum up, the Beaufort Sea is potentially rich in terms of undiscovered oil and gas resources. Its shelf is only 50-100 m wide, which makes the development of farther lying areas quite challenging. However, this fact has also a positive dimension: shallow waters at the coastal area and small distances from the main fields to the shore make the exploration and production activities more comfortable and economically viable.

Baffin Bay

The territory of Baffin Bay is divided by the border between Greenland (Denmark) and Canada; thus, I am going to do the same thing in terms if the research design. Baffin Bay, which was previously assessed as a single entity is also going to be divided into two separate units (like the Barents Sea and the Beaufort Sea): the western part of Baffin Bay (Canadian) and the eastern part (Danish). Thus, the final number of assessment units becomes nine.

The main topographic features of Baffin Bay are the following: the width of the continental shelf on the Greenland side (40-250 km out into the sea) is bigger that on the Canadian side (only 30-50 km); there are deep canyons that run across both shelves (Ewa Dunlap & Charles C.L. Tang, 2006). The average depth of Baffin Bay is approximately 725 m, while the maximum one is over 2700 m in the Baffin Bassin (Nuttall, 2005:190). The continental shelf consists of a series of shallow banks, separated by troughs up to 800 m in depth. Most of the fjords and inlets are 200 m deep and often exceed 500 m. On average, water depth on the shelf is between 140 and 240 m (Park Establishement Branch, n.d.).

As for the amount of resources, the situation is a little bit more complicated compared to all the previously discussed cases. In 2008 the USGS published a report called: "Assessment of Undiscovered Oil and Gas Resources of the West Greenland–East Canada Province". This report defines five assessment units (AU): the Eurekan Structures AU, the Northwest Greenland Rifted Margin AU, the Northeast Canada Rifted Margin AU, the Baffin Bay Basin AU and the Greater Ungava Fault Zone AU (Figure 3).

At the same time, these AUs are defined on the basis of the tectonic evolution of the West Greenland–East Canada Province, which led to "the formation of several major structural domains", not on the basis of maritime boundary between Canada and Denmark. Thus, it was decided to split the AUs in the following way: the Northwest Greenland Rifted Margin AU and the Greater Ungava Fault Zone AU are going to be fully assessed as a part of Danish Baffin Bay, the Northeast Canada Rifted Margin AU – as a part of Canadian Baffin Bay, while the Eurekan Structures AU and the Baffin Bay Basin AU (which lie right on the boundary line) will be simply divided by two and taken into account both for Danish and Canadian resource bases (USGS, 2008:1).

Of course, previously discussed idea does not provide us with the exact and highly justifiable data about the amount of undiscovered technically recoverable resources of each part of Baffin Bay. However, keeping in mind the overall probability of the USGS research and its quite approximate numbers, and the fact that any concrete information about the resource base of each part was not found, the decision is taken and considered to be the least harmful (among the other options, one of which is to take the whole Baffin Bay without dividing it on the basis of countries' territory) for the thesis.

I am going to start with the Danish part of Baffin day: the Northwest Greenland Rifted Margin AU is responsible for 2,746 million barrels of oil, 17,798 billion cubic feet of gas and 396 million barrels of NGL (which equals 6.4 billion barrels of oil equivalent, based on the conversion numbers, discussed previously), the Greater Ungava Fault Zone AU - 991 MMBO, 7,995 billion cubic feet of gas and 162 million barrels of NGL (which equals 2.6 billion barrels of oil equivalent) (USGS, 2008:2).

At the Canadian coast the Northeast Canada Rifted Margin AU is responsible for 850 MMBO, 5,161 BCFG and 115 MMBNGL (that equal 1.9 billion barrels of oil equivalent) (USGS, 2008:2).

As for the two assessment units that lie both on the territory of Canada and Denmark, the Eurekan Structures AU is supposed to hide 1,133 MMBO, 8,590 BCFG and 229 MMBNGL (which equals 2.9 billion barrels of oil equivalent) while the Baffin Bay Basin AU – 1,555 MMBO, 12,272 BCFG and 250 MMBNGL (that equal 4,1 billion barrels of oil equivalent). Together they are responsible for 7 billion barrels of oil equivalent, which means that during the assessment both the Canadian and the Danish part will get 3.5 billion barrels (USGS, 2008:2).

Consequently, the Canadian part of Baffin Bay is estimated to hide approximately 5.4 billion barrels of oil equivalent, while the Danish part – 12.5 billion barrels, which is not that big, comparing to the well-known oil and gas provinces, discussed above, but is still a significant number.

Speaking about the main oil and gas fields, the situation in this region is also a little bit different from the previously assessed cases. Cairn Energy was the first company to drill for oil offshore in Greenland and in 2010 they said they had "early indications of a working hydrocarbon system" in Baffin Bay. Cairn's T8-1 well found small quantities of gas in thin sands. This prospect is actually a part of the Sigguk Block, which is located 175 kilometers west of Disko Island, Greenland (BBC News, 2010). However, since that small discovery, nothing changed. Greenland is interested in oil and gas business, but despite having seen 19 wells drilled, "Greenland's 40-year fling with oil ultimately proved fruitless" (for now, at least). However, despite the fact that no one is actively drilling at the moment, companies are actively analyzing seismic data in preparation for future opportunities (The Arctic Journal, 2015).

As for the Canadian shelf of Baffin Bay, the situation is approximately the same: five wells were drilled in the Davis Strait and allowed to discovered a giant natural gas field, Hekja, 68 km east of Frobisher Bay. Hekja remains the only discovery along Baffin Shelf, and the best estimation of Hekja's discovered resources is 4 trillion cubic feet of natural gas and condensates (Nrcan.gc.ca, 2016). However, the Davis Straight does not belong to the sphere of the research interest (geographically) and this field is not going to be taken into account.

Thus, during the process of comparison it will be important to decide, what is better: to find oil and gas fields that are quite remote from the mainland or to know, that presumably the fields are supposed to be close to the shore, but for now nothing is found? I believe that actual findings and concrete information is more important than simple conjectures and assumptions (even promising and heart-warming).

To sum up, the West Greenland–East Canada Province is quite attractive in terms of oil and gas resources development, however, the shelf in the region is quite narrow, and, what is more important, nothing significant has been found for now. These factors discourage energy companies from active actions and hinder further exploration.

Geographical factors comparison

The following table (Table 3) is supposed to help and make the picture of geographical factors comparison more illustrative and easy to understand.

	Water depth and shelf characteristics	**Estimated amount of resources (in billion barrels of oil equivalent)**	**Main fields remoteness (simple average)**
The Norwegian Barents Sea	Average water depth (AWD) – 222 m; depth of the shelf (DS) – 100-350 m	6.7	Approximately 150 km
The Russian Barents Sea	AWD – 222 m; DS–100-350 m	61.8	Approximately 400 km
The Kara Sea	DS – 100 m; dominating depths – 50-100 m	146.7	Ap. 200 km
The Laptev Sea	DS – 10-40 m; AWD – 540 m; 50% of the sea – 50 m and less	10.4	Presumably 240 km, but nothing concrete has been found
The Alaskan Chukchi Sea	DS – 20-60 m; AWD – 71 m; 56% of the sea – less than 50 m	29.0	Presumably 90 km (Burger), but nothing concrete has been found
The Alaskan Beaufort Sea	AWD – 1004 m; DS – 60-80 m; width of the shelf – 50 km	13.1	Ap. 6 km
The Canadian Beaufort Sea	AWD – 1004 m; DS – 60-80 m; width of the shelf – 110 km	11.6	Ap. 50 km
Canadian Baffin Bay	AWD – 725 m; DS – 140-240 m; width of the shelf – 30-50 km	5.4	Nothing concrete has been found
Greenland's Baffin Bay	AWD – 725 m; DS – 140-240 m; width of the shelf – 40-250 km	12.5	Presumably 175 km (Sigguk), but nothing concrete has been found

Table 3: Geographical factors comparison

As for the water depth and shelf characteristics comparison, the most comfortable for the oil and gas business is the Alaskan Chukchi Sea (shallow waters, small depths on the shelf). Then go the Laptev Sea (shallow shelf, but a little bit higher average depth) and the Kara Sea. The 4th place is taken by both the Norwegian Barents Sea and the Russian Barents Sea (deeper shelf and comparatively small AWD). The 5th is the Canadian Beaufort Sea (despite the fact that the DS is lower than in the Barents Sea, it is comparatively narrow). Then go the Alaskan Beaufort Sea (even narrower shelf), Greenland’s Baffin Bay (higher DS) and Canadian Baffin Bay (narrow shelf, comparatively big AWD and DS).

Speaking about the estimated amount of undiscovered technically recoverable oil and gas resources, the ranking is quite simple to do: the first place is undoubtedly taken by the Kara Sea (146.7 billion barrels of oil equivalent). Then go the Russian Barents Sea (61.8), the Alaskan Chukchi Sea, the Alaskan Beaufort Sea, Greenland’s Baffin Bay (12.5), the Canadian Beaufort Sea, the Laptev Sea, the Norwegian Barents Sea and, finally, Canadian Baffin Bay (with its 5.4 billion barrels of oil equivalent).

As for the main fields remoteness, we have the following order: the least remote fields are in the Alaskan Beaufort Sea (6 km), then go the Canadian Beaufort Sea (50 km), the Norwegian Barents Sea (150 km), the Kara sea (200 km) and the Russian Barents Sea (5th) (more than 400 km).

As for the other regions from the list, there is no any concrete information about the found oil and gas fields. However, from the point of view of the research, they are also supposed to be evaluated and ranked.

It was decided to do that in the following way: the Alaskan Chukchi Sea is the 6th (there are some insignificant findings; Burger, for example is lying 90 km offshore), Greenland’s Baffin Bay is the 7th (Cairn's T8-1 well in Baffin Bay found small quantities of gas in thin sands in the Sigguk Block, which is 175 km offshore), Canadian Baffin Bay is the 8th (nothing concrete found) and, finally the Laptev Sea is the 9th (nothing concrete found, but is ranked lower, than Canadian Baffin Bay as the license blocks themselves are located approximately 240 km offshore).

The following table (Table 4) illustrates previously discussed results. It is designed the same way as the previous one (weather factors comparison). Total score is a simple sum of ranks, achieved for every sub-factor. The higher the total score, the worse the geographical conditions of the region are.

At the same time, the final rank (geographical factors rank) is calculated by comparing the sum of ranks of each region: the higher the sum is, the worse the results for every sub-factor are, consequently, the lower the region's position in the final rank is.

According to the Table 4, it is the Kara Sea that is the most interesting region for the oil and gas companies (only in terms of geographical factors), as it is responsible for an impressive amount of undiscovered resources, its waters are not very deep and despite the fact that its main fields are comparatively remote from the shore, we have concrete knowledge about their particular size and location. The Alaskan Chukchi Sea is also quite attractive despite the absence of concrete information about the exact fields. The lowest geographical factors rank was given to Canadian Baffin Bay as the depth of its shelf is comparatively high (plus it is narrow), estimated amount of resources is the lowest (among the given regions) and there is no any information about the location, size, etc. of any oil and gas field. The Laptev Sea is also quite low in the final table but it was "saved" from being the last one in the list by the fact that its waters are shallow, which is good for NOCs and IOCs.

To sum up, the results of this section are based, to a large extend, on the USGS reports. However, this information should not be treated as the truth of last resort as its probability is also a matter of concern (which is inevitable, if we speak about the assessment of undiscovered technically recoverable resources). Thus, the results of the section also need to be taken in terms of preliminary and more general assessment of investment attractiveness of the region.

	Water depth and shelf characteristics (place)	Estimated amount of resources (in billion barrels of oil equivalent) (place)	Main fields remoteness (simple average) (place)	Total Score (sum of ranks)	Geographical factors rank
The Norwegian Barents Sea	4	8	3	15	5
The Russian Barents Sea	4	2	5	11	3
The Kara Sea	3	1	4	8	1
The Laptev Sea	2	7	9	18	6
The Alaskan Chukchi Sea	1	3	6	10	2
The Alaskan Beaufort Sea	6	4	1	11	3
The Canadian Beaufort Sea	5	6	2	13	4
Canadian Baffin Bay	8	9	8	25	8
Greenland's Baffin Bay	7	5	7	19	7

Table 4: Geographical factors table of ranks

Oil and gas taxation systems

This section is devoted to the assessment and comparison of the countries' fiscal regimes in terms of oil and gas industry (Arctic dimension). We understand, that detailed examination of the tax systems does not fit in the design of our research, thus we will try to reflect the main points.

Norway

I am going to start with one of the most severe (in terms of government's take) fiscal regimes, especially if we speak about the oil and gas business. At the same time, it is mitigated by different capital allowances and investment incentives.

To start with, the company, which is "involved in upstream activities on the NCS or the area within Norwegian territorial borders, is subject to a marginal tax rage of 78% (27% ordinary corporate income tax and 51% resource rent tax) on the net operating profits" (EY, 2015:421).

Norway's petroleum tax system is based on the taxation of the entity, not specific assets or licenses, thus, there is no ring fencing between different licenses. At the same time, "income derived from offshore activities, in principle, may not be offset against losses incurred from onshore activities, or vice versa. However, 50% of a company's onshore losses may be offset against income from offshore activities that are subject to the ordinary tax rate of 27%. Similarly, losses from offshore activities may be offset against income from onshore activities that are subject to the ordinary tax rate of 27%" (EY, 2015:422).

For taxable income "that is subject to a marginal tax rate of 78%, investments in offshore production facilities (including pipelines and installations) that are used in extraction activities are depreciated over a six-year period beginning with the year of investment" (EY, 2015:422).

Additional allowances are also permitted (at a rate of 22%) when calculating the special tax basis for the 51% tax rate. Thus, 89.2% of the investments in offshore activities are "nominally borne by the Government" (EY, 2015:422). Losses may also be carried forward indefinitely for offshore activity. The Ministry of Finance sets interest on such losses annually.

There is also an environmental tax (the CO2 tax for upstream companies is NOK1 per standard cubic meter (Sm^3), and a fee of NOK19.19 per kilogram per date "is levied on NOx emissions”), but these numbers are not that significant in terms of the overall comparison and assessment (EY, 2015:423).

Withholding tax is 0% if the recipient owns at least 25% of the distributing entity (EY, 2015:423).

Thus, if simplified, the situation is the following: the Government’s take is quite big in Norway (78%), however, it is mitigated by the fact, that offshore investments are depreciated over six years; an additional 22% uplift “applies against the special tax for upstream activities”; losses from offshore activities may be “carried forward indefinitely with interest” (EY, 2015:423). All these factors encourage oil and gas companies to explore new areas and look for new possibilities (which becomes less risky, due to the cash refund), but when (if) the production finally starts, the Government “gets its own back”.

Russia

The fiscal regime of the Russian Federation consists of the following components: royalties (called mineral extraction tax (MET)), corporate profits tax and export duty. However, I am going to concentrate the attention on a particular sector of oil and gas business – offshore projects in the Arctic regions. From 2014, a new tax and customs regime for shelf projects applies. “New offshore hydrocarbon deposits” (NOHD) are divided into four categories, but we are mainly interested in the fourth one: deposits lying at least 50% within the Kara Sea, the northern part of the Barents Sea (at or north of 72 degrees north latitude) and the eastern Arctic. The MET rate, in this case, is 5% and applies for 180 months (15 years) after production begins, but not later than 31 March 2042 (after the expiration – general MET rules). MET rate can be even zero (if depletion is less than 0.1%) or reduced (if lie north of the Arctic Circle and subject to special conditions, such as low level of depletion) (this rate applies for no more than 5 years) (EY, 2015:518).

As for the export duties, NOHDs that fall into the forth category are exempt from them (without time limits). The profits tax rate is established as 20%. It cannot be “reduced by regional governments and all profit tax is payable to the federal budget”. Offshore platforms (fixed and floating), mobile drilling rigs and vessel are also exempt from the transport tax, property tax and assets tax (EY, 2015:518).

Speaking about the depreciation, fixed assets of license holders/operators that are used "during the process of hydrocarbon extraction at the NOHD" can be depreciated at up to three times the usual rates.

All companies are also VAT taxpayers (18%); the rate is 0% if oil, oil products, gas and gas condensate are exported. Input VAT incurred at the development stage may generally be offset immediately (EY, 2015:525).

There are also import duties (varying from 0% to 25%) for many goods, materials and equipment that come to Russia from abroad. At the same time, it is important to mention excise duties. The current rates that apply to gasoline are in the range of RUB5,530 to RUB9,500 per tonne. In 2015 "Gazprom-neft" paid RUB68.3 billion as excise duties.

Withholding tax rate on dividends is 15%; on interest, royalties and leases – 20%. The rates can be changed on the basis of a double tax treaty (down to 5% and 0% correspondingly) (EY, 2015:524).

To sum up, the Government has decided to encourage the development of the regions that are explored to a less extend, then all the well-known onshore oil and gas provinces. Thus, different tax exemptions allow to make the Russian sector of the Arctic more competitive and attractive (from the point of view of fiscal regime) for NOCs and foreign investors. At the same time, it is important to stress that Russia's tax legislation, as a whole, is comparatively difficult to understand and complex, has a lot of loopholes and clarifications and is an object of constant corrections and amendments. This has a negative effect on the investment attractiveness of different projects on the Russian territory, as investors cannot be sure that the current tax system is going to remain the same in several years. "Manual guidance" is prevailing in Russia's petroleum taxation regime, as tax rates are different from one license block (or even field) to another, which make the whole picture quite complicated and provokes additional difficulties and misguidance.

The United States of America

As for the fiscal regime of the United States of America, it consists of 3 different components: corporate tax, severance tax (production tax) and royalty payments (EY, 2015:645).

Corporate tax rate is 35%, however, it is a federal rate, while state tax regimes can be different. Keeping in mind, that we are mainly interested in Alaska, their corporate income tax rate varies from 0% (taxable income of $25,000 and below) to 9.4% (taxable income of

$222,000 and more). During the process of comparison and assessment, I am going to include the 9.4% rate, as oil and gas industry is quite capital-intensive.

The situation with royalty payments is also a little bit complicated: it is paid on the gross wellhead value of production. Wellhead value is calculated the following way: market price – marine shipping - TAPS tariffs. If the market value is US$100, for example, then I simply deduct the cost of shipping (US$2, for instance) and TAPS tariffs (US$4). Thus, the gross value at point of production equals US$94. For offshore projects royalty payments are 18.75% (for 19 March 2008 auction), 16.667% (in certain previous lease auctions) and 12.50% for older leases (EY, 2015:645).

At the same time, the State of Alaska also has an oil and gas production tax (MAPA), which was changed in 2013 and became the object of different debates and discussions. Current tax rate in 35% and it replaced a quite complicated progressive scale. It is paid on the production tax (net) value: PTV = Gross Value at Point of Production - Lease Expenditures (operating and capital costs).

The reader's special attention should be paid to various credit programs, connected with the oil and gas production tax. The framework of the thesis does not allow us to describe all of them, thus, I will concentrate on the main features. MAPA distinguishes three "new oil" categories ("oil produced from a new unit, from a new participating area in an existing unit, or from an extension of an existing accumulation" (Goldsmith, 2014:3)), which are called GVR: Gross Value Reduction oil. MAPA treats differently the GVR oil, firstly, by excluding 20% of the wellhead value from the tax base (production tax value) and, secondly, by providing a flat US$5 per barrel credit (Goldsmith, 2014:5).

As for the non-GVR oil, the most important tax credit is the production credit, which is based on the wellhead price (of a barrel of oil). It can be characterized as a sliding scale with US$8 per barrel if the wellhead price is below US$80 and down to US$0 if the wellhead price is above US$150.

Withholding tax rate is 30% and is paid on interest, royalties and dividends. The rate can be modified on the basis of a concrete tax treaty. The branch remittance tax is also 30% (EY, 2015:655).

As for the property tax, its rate is 2%. Property tax is paid on the basis of the assessed value of the petroleum property. The assessment is done by the Department of Revenue (Alaska Department of Revenue, n.d.).

To sum up, the fiscal regime of the United States of America was assessed on the basis of the fact that the thesis is focused on the Alaskan Beaufort Sea and Chukchi Sea. In 2013 the fiscal regime in the Sate of Alaska was changed, which provoked a wave of discussions and debates. Progressive scale of the oil and gas production tax was replaced by a flat one (35%). It was supposed to be a tool to ease the process of investment analysis for the oil and gas companies, as there would be no need in complex and complicated assessments of the future tax liabilities, because the rate became stable and easy to predict. At the same time, several specialists believe that these incentives do not correspond the interests of the State and allow the companies to avoid additional payments in the State's budget (Kevin Banks, former director of the DNR's Division of Oil and Gas; Victor Fischer; Bella Hammond, etc.). Despite the growing opposition, even the referendum, held in 2014, did not lead to the return to the previous tax regime. The current fiscal system is aimed at increasing the investment attractiveness of the State of Alaska for NOCs and IOCs and, according to the words of Gov. Sean Parnell, "the tax break would entice oil companies to come to Alaska and boost production" (Ballotpedia.org, 2014).

Canada

Canada's fiscal regime consists of the following components: royalties and corporate income tax (which includes federal rage and provinces' or territories' rates).

As for the corporate income tax, the federal Government's rate is 15% (in 2015, as the basic rate is 25%, but it was reduced to 15%). Provincial and territorial tax rates are added to the federal one and usually vary between 10% and 16% of taxable income (EY, 2015:93). For Yukon and Northwest Territories (Canadian Beaufort Sea) the higher tax rates are 15% and 11.5% respectively. For Nunavut (Baffin Bay) it is 12% (Taxtips.ca, 2015).

Oil and gas companies are also required to make royalty payments to the holder of the mineral rights. The majority of the mineral rights is owned either by a particular province, territorial or federal governments or by First Nation. Royalties are deductible while determining income tax (EY, 2015:94).

If the owner of the mineral rights is the Government, NOCs and IOCs must pay the so-called "Crown royalties". The process of calculation of Crown royalty payments is quite complex and varies from one province (territory) to another. In general, it depends on such factors as the well's productivity, wellhead price, etc. Thus, the payments themselves can seriously differ even among the neighboring fields. Usually the Crown royalty rate is between 10% and 45%, but if the resources are hard to extract and develop (oil sands) or weather conditions cause additional costs (Arctic and Atlantic offshore), special tax and royalty regimes can be applied (EY, 2015:94).

If the owner of the mineral rights is First Nation, resources are governed in accordance with the Indian Oil & Gas Act. Indian royalty payments are discussed individually between the lessee and the owner on the well-by-well basis.

Mineral rights can also be privately owned. In this case the rate is typically based on production. The Crown "does not receive royalties on freehold lease"; thus, a special "freehold mineral tax" was introduced, which is also production based (EY, 2015:94).

Canada's fiscal regime is also providing oil and gas companies with special capital allowances. Several pools exist (Canadian Oil and Gas Property Expense, Canadian Exploration Expense, Canadian Development Expense, Foreign Resource Expense, Class 41) that allow to accumulate costs incurred in acquiring properties, seismic and exploratory activities, production, foreign oil and gas resources exploration and development, well acquisition, etc. These expenditures are deductible at different rates: COGPE – up to 10%, CEE – up to 100%, CDE – up to 30%, FRE – minimum 10%, Class 41 – up to 25%. The deduction is optional and can be carried forward in order to be used in the future. At the same time, pools do not include "any tangible or depreciable property" (expect for the Class 41). These allowances are supposed to encourage oil and gas companies to explore new areas, develop new fields and, generally speaking, invest in the future activities (EY, 2015:95).

It is also important to mention the Atlantic investment tax credits: federal income tax payable can be reduced by the amount of investment tax credits (ITCs) that equal to 10% of the expenditures borne in the Canadian Atlantic (including the offshore areas). For 2015 ITC is being reduced to 5% and then to 0% after 2015. However, unused investment tax credits can be carried forward for up to 20 years and back for 3 years in order to decrease the taxable income for particular period of time (EY, 2015:97).

What is more, scientific research and experimental development (SR&ED) expenditures can also be deducted on the analogy of previously discussed pools (up to 100%). At the same time current SR&ED expenditures are an object to federal ITC at a rate of 15%. In addition to the federal credit, most provinces and territories offer similar incentives (rates varying from 10% to 20%) (EY, 2015:97).

As for the indirect taxes, goods and services tax (GST) applies at each point of the supply made in Canada (a value-added tax). The rate varies from one province/territory to another, but as I am interested in Yukon, Northwest Territories and Nunavut, the rate there is 5%. At the same time, these territories do not have provincial sales tax (EY, 2015:100).

Withholding tax rate is 25% and paid on dividends, royalties, interest and certain other payments. The rate, however, can be changed on the basis of a tax treaty (EY, 2015:97).

To sum up, keeping in mind the fact that the corporate income tax is comparatively low in Canada, the main burden for the oil and gas companies are the royalty payments. They seriously vary from one province to another and are calculated on the well-by-well basis, depending on the production, weather conditions, oil physical characteristics etc. Thus, Canadians have created a system which makes the development of difficult to extract oil competitive (to a certain extend, of course) with other kinds of production. Moreover, different capital allowances and investment tax credits also encourage NOCs and IOCs to look for new business opportunities.

Greenland

Greenland is developing its oil and gas taxation system on the basis of the existing world experience. For now, there are no any special tax laws that govern the oil and gas sector, thus, NOCs and IOCs are simply subject to Corporate Income Tax Act and "additional regulations under licenses" (EY, 2015:229).

Greenland's corporate income tax rate is 30%. "Prospecting and exploration activities can be carried out either by the branch or by the company", while a license to exploit can only be given to the public limited companies domiciled in Greenland (EY, 2015:230).

In accordance with the Mineral Resources Act, NUNAOIL A/S, a publicly owned company, must be a participant of a license. If a company wants to take part in oil and gas activities in Greenland, it has to sigh a carry contract with NUNAOIL A/S, according to which it is "taking all the risks and provides financing during the exploration phase". NUNAOIL's share it determined on a license-to-license basis, thus, can differ from one project to another. Nevertheless, after the commencement of the field development NUNAOIL A/S "will assume its own costs" (EY, 2015:230).

As for the royalty payments, a special surplus royalty regime exists, according to which the rate can be 7.5%, 17.5%, and 30% on the basis of the project's internal rate of return (IRR) (if IRR exceeds 21.75%, 29.25%, and 36.75%, respectively). However, a new royalty regime has been developed, which is formed on the basis of turnover. The basic rate is 2.5%, plus a surplus royalty (7.5%, 17.5%, and 30% rate is paid when the accumulated turnover exceeds 35%, 45%, and 55%, respectively). At the same time, licenses in Baffin Bay can be characterized by the surplus royalty levels of 7.5%, 10%, and 12.5% at 35%, 45%, and 55% IRR, respectively. Thus, royalty payments are going to seriously differ from one license block to another (Taxsummaries.pwc.com, 2016).

A special regime exists concerning a shutdown provision. When a company is granted a license, it is supposed to prepare a detailed plan of all installations removal. Preparing a statement of taxable income, the company, thus, can deduct any sum that is "set aside" in order to ensure that previously approved shutdown plan can be implemented (EY, 2015:231).

As for the depreciation terms, license right "is amortized on a straight-line basis over a 10-year period of time". Fixed assets may be depreciated by up to 30% a year in accordance with the reducing-balance method (EY, 2015:231).

At the same time, all the costs related to exploration activities on the territory of Greenland are deductible from the taxable income statement. Tax losses may be carried forward, in case there are no significant changes in the ownership of the company. Greenland authorities can also exempt companies that hold an exploitation license from taxes.

Withholding tax rate is 36% on dividends and 30% on royalties. In general, there are no any indirect taxes (except for some specific products).

To sum up, Greenland is trying to develop a comfortable fiscal system that would benefit both, the society and the oil and gas companies. Tax rates are not that high, which, together with the possibility to write-off exploration costs, encourages NOCs and IOCs to invest in Greenland's energy sources development.

Oil and gas taxation systems comparison

To make the process of taxation systems comparison more illustrative and vivid, it was decided to tabulate the data. However, the table is not going to divide the taxation components into different columns (e.g. corporate tax, special tax, etc.), as the overall picture of the country's taxation system can be quite complicated and complex (Canada's royalty payments system, for example), which makes it hard to calculate total government's take, as it seriously varies from one field/license/well to another. Thus, the process of comparison is going to be based both on quantitative data (tax rates, royalty payments, etc.) and qualitative analysis (e.g. the mechanisms that encourage new fields development, seismic activities, etc.).

The following table (Table 5) includes some complex information on the countries' oil and gas taxation regimes and a ranking column.

	Oil and gas taxation system main characteristics	**Taxation rank**
Norway	27% CIT and 51% resource rent tax; 89.2% of offshore investments are depreciated over 6 years; no VAT and WHT	4
Russia (Arctic offshore; 4th category)	20% profits tax rate; 5% MET (and lower); 18% VAT (0% if oil/gas is exported); excise duties on gasoline vary from RUB5,530 to RUB9,500 per tonne; WHT on dividends is 15%; on interest, royalties and leases – 20%	1
USA (Alaska)	35% federal CIT + 9.4% Alaska's CIT; 18.75% royalty from GVPP; 35% oil and gas production tax (paid on PTV), WHT and branch remittance tax are 35%; property tax – 2%; credits: 20% deduction from PTV tax base and US$5 per barrel credit for GVR; US$8 per barrel credit (if PTV less that US$80) for non-GVR	5
Canada (NW Territories, Nunavut, Yukon)	15% federal CIT + territories' CIT (15% in Yukon, 11.5% in NWT and 12% in Nunavut); royalty payments (seriously vary, depending on the characteristics of the field/license; usually between 10% and 45%); GST – 5%; WHT – 25%; expenditures deductions system: COGPE – up to 10%, CEE – up to 100%, CDE – up to 30%, FRE – minimum 10%, Class 41 – up to 25%, Canadian Atlantic – 5% for 2015, SR&ED – up to 100%	2
Greenland	30% CIT; royalty payments: basic rate is 2.5%, plus a surplus royalty (7.5%, 17.5%, and 30% depending on the turnover); in Baffin Bay royalties are 7.5%, 10%, and 12.5% depending on the IRR; deductions: shutdown, exploration activities (100%); tax losses can be carried forward; WHT rate is 36% on dividends and 30% on royalties	3

Table 5: Petroleum taxation regimes comparison (the Arctic dimension)

According to our estimates and detailed assessment of the presented fiscal regimes in terms of oil and gas business (in particular regions), it was decided to make Russia the leader of the list. In 2014 a new tax and customs regime for shelf projects was applied. The general idea of the initiative is to encourage energy companies to invest in new, technologically challenging projects, especially in the Arctic region. 5% MET rate (or even lower) and exemptions from export duties, property tax, assets tax and transport tax allowed to create a system which can be characterized by comparatively little government's take. If the thesis was written several years earlier, Russia would hardly be ranked 1st because of its unstable and highly complicated fiscal regime. However, Russian authorities' incentive was supposed to increase the investment attractiveness of the Arctic region, which, from the nominal point of view, was done. Of course, current oil prices distract NOCs from the northern areas, however the efforts made today may be seen in several years, if/when prices increase and Western countries' sanctions on Russia are lifted (here I mean oil and gas industry oriented sanctions, that were imposed against the Russian Federation over its actions during the crisis in Ukraine that started in 2014).

Canada was decided to become the 2rd ranked due to its flexible system of royalties and territories' CIT, that allow the development of the fields to be profitable both for the owner of the land and the energy company. Moreover, numerous capital allowances provide the NOCs and IOCs with additional opportunities and encourage them to invest in SR&ED and exploration activities.

The third place is taken by Greenland with its comparatively low corporate income tax (30%) and royalty payments that increase with the years of production (turnover). This system encourages oil and gas companies to invest in the region, however, nothing significant has been found so far. This does not mean that the interest has been lost, because most of the players still proceed further with seismic activities (The Arctic Journal, 2015). Nevertheless, Greenland is actively promoting the development of its natural resources, partially via its fiscal regime.

As for the 4th place, it is Norway that takes it. Despite its comparatively big oil and gas tax (51%) and CIT (27%) the Norwegian fiscal system provides energy companies with capital allowances that encourage the development of the northern region. What is also important is that the tax regime is stable and predictable, which increases its attractiveness in the eyes of the investors.

And finally, the United States of America is taking the 5^{th} place. The state of Alaska was ranked the fifth because of the following factors: high overall CIT, royalties and production tax; additional taxes that include WHT, property tax and branch remittance tax. Despite the fact that several measures have been taken (new credit system) it was decided that the Alaskan Chukchi and Beaufort Seas are less attractive for the investors in terms of the host country's taxation system. At the same time, it is quite complicated and complex, which makes the process of accounting quite a challenge.

Investor protection

Sub-factors description

This section of the thesis is going to be devoted to the "investor protection" factor. While presenting the methodological part of the work, the importance of this "key driver" for investment attractiveness assessment has already been discussed. Regions' observation and comparison is incomplete and insufficient if "investor protection" is not included and described.

At the same time, this section is gong to be based on the analysis of secondary data, as different corresponding researches have already been done. I have decided to assess the investor protection factor on the basis of the following data:

1. Efficacy of corporate boards
2. Strength of legal rights
3. Business extend of disclosure
4. Legal enforcement of contracts
5. Property rights
6. Rule of Law

Of course this list of sub-factors does not allow to provide the reader with the whole and detailed picture of the legal system of the country in terms of investor protection. However, it creates an illustrative and complex picture of it, enabling the researchers to use acquired data while assessing the investment attractiveness of different Arctic Seas with regard to oil and gas development.

Efficacy of corporate boards was addressed in "The Global Competitiveness Report 2014–2015" published by the World Economic Forum. Corporate governance by investors and boards of directors has been analyzed and compared in terms of management accountability to them “(1 = management has little accountability, 7 = investors and boards exert strong supervision of management decisions)” (World Economic Forum, 2014:424).

Strength of legal rights is the object of the analysis made by the World Bank as a part of its Doing Business project. The index assesses how the collateral and bankruptcy laws work in terms of “borrowers and lenders protection” and lending facilitation as a whole (0 = weak protection to 12 = strong protection) (The World Bank, 2015). With the fact that oil and gas business is capital intensive, this sub-factor plays a significant role in the process of investments attractiveness calculations and regions ranking.

Business extend of disclosure index was prepared by the same World Bank and is aimed at the assessment of the extend up to which the investor is protected through disclosure of the information about ownership and of financial data. The scale ranges from 0 and up to 10 (from less to more disclosure) (The World Bank, 2015). In sight of the situation with the Moscow Domodedovo Airport’s beneficial owner, who the authorities could not identify for quite a long period of time because of the company’s complicated and confusing ownership chain, this sub-factor is becoming even more significant in investment attractiveness assessments of any kind.

Legal enforcement of contracts is assessed on the basis of the procedures, time and cost of the commercial dispute resolution between two firms. The methodology does not take into account the quality of the judiciary directly but via these indicators. The research has been done as a part of the World Bank’s Doing Business project. Efficiency of the commercial court systems characterizes the legal system itself and is an important sub-factor in the investor protection comparison process.

International property rights index (IPRI) was developed by the Property Rights Alliance. IPRI is believed to be one of the most inclusive and far-reaching studies on the correlation between the institution of property rights and economic development of the region/country. The index is based on three main components: Legal and Political Environment (LP), Physical Property Rights (PPR), and Intellectual Property Rights (IPR). The higher the cumulative score - the more secure the property rights are (Internationalpropertyrightsindex.org, 2015).

The Rule of Law index is the result of the World Justice Project (WJP) work and is acknowledged to be one of the most solid and reliable research papers due to the fact that it is the only one (of its kind) that fully relies on the primary data, thus, increasing its objectiveness and credibility (Worldjusticeproject.org, 2015). The scale is from 0 and up to 1.0 with the highest values characterizing the better results in terms of the "rule of law" concept. The ranking is based on the data on 9 main factors and 47 sub-factors, such as judicial independence, inadequate witness protection, incompetent investigators, prosecutorial independence, corrupt investigators and prosecutors, etc. All these indicators play a significant role in the process of investment decision-making as additional risks associated with inadequate judicial system decrease the attractiveness of the country/region from the financial point of view. At the same time, oil and gas business itself can be quite interconnected with the world of policy (the examples of Gazprom, Rosneft, Mikhail Khodorkovsky's Yukos oil company, etc.), thus, well-developed, stable and secure judicial system becomes a hypothetic "safeguard" against possible challenges of legal and political nature.

"Investor protection" factor comparison

The following table (Table 6) is the result of work of the author, however, the values on the sub-factors are taken from the previously mentioned sources. There is no any particular information on Greenland in the listed indexes, thus, in order to have any comparative data the case of Denmark has been taken. As for the numbers, the first one is the country's score in a particular index (for example, Norway got 5, Russia - 6 in the World Bank's strength of legal rights index); the second one is the country's rank in terms of that particular sub-factor among the countries in our list. The higher the score, the higher the rank, except for the case of "legal enforcement of contracts" sub-factor (as it is not an index but an indicator with its own ranking system).

The last two lines are the total score (where I simply summarize all the ranks the country got on each sub-factor) and the "investor protection" factor rank (the final rank where I set the country's position on this factor)

	Norway's score / rank on the sub-factor	**Russia's score / rank on the sub-factor**	**USA's score / rank on the sub-factor**	**Canada's score / rank on the sub-factor**	**Greenland's (Denmark's) score / rank on the sub-factor**
Efficacy of corporate boards	6.0 / 1	4.6 / 5	5.4 / 3	5.6 / 2	5.2 / 4
Strength of legal rights	5 / 5	6 / 4	11 / 1	9 / 2	8 / 3

Business extend of disclosure	7 / 2	6 / 3	7 / 2	8 / 1	7 / 2
Legal enforcement of contracts	8th / 2	5th / 1	21st / 3	49th / 5	37th / 4
Property rights	8.2 / 1	4.5 / 4	7.6 / 3	7.9 / 2	7.9 / 2
Rule of Law	0.87 / 1	0.47 / 4	0.73 / 3	0.78 / 2	0.87 / 1
Total score (the sum of ranks)	12	21	15	14	16
"Investor protection" factor rank	1	5	3	2	4

Table 6: "Investor protection" factor comparison

As for the results, the 1st place is taken by Norway, that is the leader in 3 out of 6 sub-factors and is the second one in two of them. The only sub-factor where Norway didn't show high results is the World Bank's strength of legal rights index. The next three are Canada (2nd), United States (3rd) and Greenland (4th), the results of which lie quite close to each other. The 5th place was taken by the Russian Federation with a significant gap in the total score.

The framework of the master's thesis does not allow to conduct a deep research on this factor and explain from a scientific point of view the difference in the obtained results. The use of secondary data imposes several limitations, one of which is the fact that it is quite hard to justify the numbers not being a part of the research team from the very beginning (e. g. working in the World Bank). It was anticipated that Russia would hardly be the leader in this component and Norway would be somewhere on the top of the list but as for the other countries, the results lie quite close to each other, making the difference explanation quite a challenge. In simple terms, Canada, USA and Greenland are where they are (in terms of this factor ranking) partially because of slight and sometimes even nominal difference on several sub-factors, which, nonetheless, need to be taken into account both now and during the process of final comparison of the investment attractiveness of the regions.

Investment attractiveness: comparison of the Arctic regions

After a long and thorough process of data collection, analysis and comparison we got closer to the final step: the comparison of the Arctic regions on the basis of the obtained results on each of the sub-factors (weather, geographical, taxation and investor protection). In order to make the final picture more illustrative I am going to tabulate the data and then proceed with short analysis of the results.

During the process of geographical factors evaluation and comparison it was decided to divide several regions on the basis of the fact that the waters of these seas lie on the border of two different countries: the Barents Sea, the Beaufort Sea and Baffin Bay. At the same time only the eastern part of the Chukchi Sea (the Alaskan one) has been taken into account, as a number of Russian Seas are already included. Thus, for now we have 9 assessment units: the Norwegian Barents Sea, the Russian Barents Sea, the Kara Sea, the Laptev Sea, the Alaskan Chukchi Sea, the Alaskan Beaufort Sea, the Canadian Beaufort Sea, Canadian Baffin Bay and Greenland's Baffin Bay.

As for the dimensions of the comparison, there are four groups: weather factors, geographical factors, taxation in the oil and gas sphere (the Arctic dimension) and investor protection. At the same time, during the process of factors assessment and comparison, there was no division on the previously mentioned basis (except for the geographical factor), thus, the results obtained for such factors are going to be included in both regions. For example, if the Barents Sea takes the second place in terms of the weather factors comparison, that means that this number is going to be included in the final comparison both for the Norwegian Barents Sea and for the Russian Barents Sea. The same is done with the taxation systems and investor protection comparison, which is based on the country-by-country principle (not sea-by-sea).

In Table 7 total score represents a simple sum of ranks that are obtained for each of the factors. Investment attractiveness rank is based on the total score: the lower the total score, the higher the investment rank is.

	Weather conditions rank	Geographical factors rank	Taxation rank	“Investor protection” factor rank	Total score (sum of ranks)	Investment attractiveness rank
The Norwegian Barents Sea	2	5	4	1	12	2
The Russian Barents Sea	2	3	1	5	11	1
The Kara Sea	4	1	1	5	11	1
The Laptev Sea	5	6	1	5	17	5
The Alaskan Chukchi Sea	1	2	5	3	11	1
The Alaskan Beaufort Sea	6	3	5	3	17	5
The Canadian Beaufort Sea	6	4	2	2	14	3
Canadian Baffin Bay	3	8	2	2	15	4
Greenland’s Baffin Bay	3	7	3	4	17	5

Table 7: Investment attractiveness comparative table of ranks

According to the Table 7, it is the Russian Barents Sea, the Kara Sea and the Alaskan Chukchi Sea that got the lowest total score and, thus, became the 1st ranked.

As for the Russian Barents Sea, its weather conditions are comparatively comfortable (2nd ranked): low sea ice extent and warm air/water temperatures allow to conduct exploration and production activities and encourage the development of the region. At the same time, it is the 3rd ranked in terms of geographical factors assessment and comparison due to significant remoteness of the main fields from the shore and significant water depths. Taxation also contributed to the fact that the region has become one of the leaders of the list as a new tax and customs regime for shelf projects has made Russian Arctic seas more attractive in regard to the fiscal system. The analysis and comparison of the "investor protection" factor has become the "Achilles' heel" of the Russian Federation and did not allow the region to become a single leader of the final list. Nevertheless, the Russian Barents Sea has established itself as one of the most promising choices in terms of investment in the Arctic region.

The Kara Sea is also taking the 1st place, however, due to predominance in different from the Russian Barents Sea factors. The region's weather condition did not allow it to be on the top of the list (4th ranked): 100% ice-coverage in winter and only partial ice-melting in summer, strong winds and low air/water temperatures make the Kara Sea one of the most severe one among the Arctic seas. However, the US Geological Survey assessed the region's undiscovered resources to be 146.7 billion barrels of oil equivalent, which is a highly significant number and makes the Kara Sea (together with the fact that its waters are quite shallow) the 1st ranked in terms of geographical factors assessment. The factors of Russian taxation system (1st ranked) and investor protection (5th ranked) has already been discussed, thus, I will not focus on them here.

The Alaskan Chukchi Sea closes the group of the 1st ranked regions. Its weather conditions (absence of icebergs, small waves and comparatively high water/air temperatures) favor the development of energy sources (1st ranked). The Chukchi Sea is also quite shallow and is hiding a significant amount of resources, which makes the region the 2nd ranked in terms of geographical factors. Alaskan oil and gas taxation system prevented the province from becoming a single leader, as the tax burden is one of the biggest ones from the list. And even the recently implemented credit system did not change the fact that the companies working in the State of Alaska are supposed to give a significant share of their income to the government.

As for the "investor protection" factor comparison, the United States is the 3rd ranked (after Norway and Canada).

After the group of leaders goes the Norwegian Barents Sea (2nd). The weather conditions of the Barents Sea have already been discussed, thus, I will skip that part just mentioning that they are one of the most favorable ones among the Arctic seas (2nd ranked). As for the geographical factors (5th ranked), the situation is a little bit different from the Russian sector of the Sea as the amount of undiscovered resources here is 6.7 billion barrels of oil equivalent (in the Eastern part – 61.8 BBOE). However, the main fields' remoteness is not that big, compared to the Russian Barents Sea. Norway's oil and gas taxation system also implies significant tax burden on the energy companies, nevertheless it is mitigated by several capital allowances, which led to the fact that it is the 4th ranked. At the same time, Norway is the leader in terms of investor protection in most of the sub-factors, which allowed the country to be ranked 1st and get the second place in the final comparison for the Norwegian Barents Sea.

The 3rd ranked is the Canadian Beaufort Sea. Its weather conditions were assessed to be the worst among the taken regions (the 6th ranked) because of thick floating ice, 100% ice coverage in winter and short summer period, on average 90 days with fog per year and highly negative water and air temperatures. As for the geographical factors, it is the 4th ranked because of comparatively small amount of undiscovered resources (11.6 BBOE) and the fact that its shelf is quite narrow. However, Canadian oil and gas taxation system, which is the 2nd ranked and can be characterized as flexible and encouraging, and "investor protection" factor comparison (also 2nd ranked) allowed the Canadian Beaufort Sea to take the 3rd place in the final comparison.

Canadian Baffin Bay is the 4th. However, the weather conditions there are more favorable for the energy companies then in the Canadian Beaufort Sea as Baffin Bay is only 80% ice-covered in winter. Despite strong coastal winds, icebergs and low water temperatures it was the 3rd raked due to comparatively small average number of days with fog and small waves. At the same time its geographical factors assessment and comparison made the region the last one in the table (ranked 8th) because of the fact that the shelf is narrow and deep, nothing particular has been found (no concrete information on the oil/gas fields location and size) and the amount of undiscovered resources is 5.4 BBOE. However, once again taxation and investor protection factors (2nd ranked in both) allowed the region to get a higher position and resulted in the 4th final place.

The last, 5th position is also shared between the Laptev Sea, the Alaskan Beaufort Sea and Greenland's Baffin Bay.

The Laptev Sea can be characterized by severe weather conditions (5th ranked) (100% ice-covered in winter, short summer, difficult iceberg situation, low air temperatures). At the same time, in terms of geographical factors, the region is also in the lower part of the table (6th ranked) because of comparatively small amount of undiscovered resources and the fact that it is quite unexplored (no concrete data about the location of the oil/gas fields). Russian fiscal system allowed to strengthen its position a little bit (1st ranked) but investor protection once again increased the gap (5th ranked).

The Alaskan Beaufort Sea is on the 5th place partially because of the difficult weather conditions (which have already been discussed above). At the same time, geographical factors comparison (3rd ranked) increased the region's chances to climb up in the final table (despite the fact that the shelf of the sea is quite narrow and the amount of resources is not that big, the average remoteness of the main fields is approximately 6 kilometers, which seriously increases the attractiveness of the region). As for taxation, it has already been mentioned that the burden is quite heavy in the State of Alaska (5th ranked). Nevertheless, being the 3rd ranked in the field of "investor protection" factor comparison allowed to grade up to two other regions and avoid even greater gap from the leaders.

And finally, Greenland's Baffin Bay – the region that presumably was supposed to be among the leaders. However, its comparatively comfortable weather conditions (3rd ranked) did not help it to rise on the top of the list. As for the geographical factors, Greenland's Baffin Bay took the 7th place because of comparatively small amount of undiscovered resources (12.5 BBOE), deep shelf waters and quite unclear situation with the location of the main fields (for now, there has been drilled 19 wells and all of them proved to be fruitless). Greenland's taxation system took the 3rd place, because of the fact that the tax burden is comparatively small and several capital allowances exist. However, "investor protection" factor comparison (ranked 4th) did not allow the region to get a higher final place.

The following table (Table 8) illustrates the obtained results and summarizes them:

Investment attractiveness rank	Region
1st	The Russian Barents Sea The Kara Sea The Alaskan Chukchi Sea
2nd	The Norwegian Barents Sea
3rd	The Canadian Beaufort Sea
4th	Canadian Baffin Bay
5th	The Laptev Sea The Alaskan Beaufort Sea Greenland's Baffin Bay

Table 8: Investment attraciveness ranking of nine Arctic offshore petroleum provinces

6. Conclusions

The 2014-2015 oil price collapse made the idea of Arctic expansion less attractive for energy companies. Austerity measures started to dictate their terms and influenced the Arctic strategies of both IOCs and NOCs. However, the majority of specialists believe that it is just a delay, not an end to the Arctic fling and that higher oil prices will restore the companies' interest in the region. Thus, the oil price decline represents a good opportunity to conduct all kinds of preparatory activities (seismic works, exploratory drilling, etc.) as prices on them have followed the general pattern and seriously decreased.

However, at first, it is necessary to define the object of the investment. And that is where the difficulties start to occur, as most of the literature on Arctic oil and gas belong either to the sphere of geography, or the sphere of geopolitics. At the same time, the process of investment decision-making in the oil and gas industry must take into account numerous sets of factors that include not only geographical conditions, but also rely on the existing knowledge in the spheres of economics, law, etc.

At the same time, due to declining interest in the northern seas, the host countries start to understand that they have to compete for the investment by increasing the investment attractiveness of the projects. This can be achieved via changing oil and gas taxation regimes towards the decrease of the total government take, developing the quality of investor protection, etc.

Thus, it was decided to fill the existing gap and address the Arctic regions' investment attractiveness problem from different points of view and create a complex and sufficient picture.

The aim of the thesis was to answer the following question: what is the investment attractiveness of different parts of the Arctic with regard to the development of oil and gas resources?

I tried to answer it by characterizing nine Arctic regions on the basis of four sets of factors: weather, geographical ones, taxation and investor protection. That allowed to create a unique ranking system for each factor group and compare the regions in accordance with the obtained data.

The results singled out several most attractive areas for investment (the Russian Barents Sea, the Kara Sea and the Alaskan Chukchi Sea) and also several followers (the Norwegian Barents Sea, the Canadian Beaufort Sea). At the same time the thesis allowed to find out which regions have less chances to become object of investment and lower probability to be developed in the future. In other words, those on the top are more likely to “survive” the period of low prices and become the primary option when the “right times” come (high prices on energy sources, that will make the development of the Arctic oil and gas economically viable).

I did not know what the results of the research would be until the very last minute of comparison as I fully relied on the developed methodology and ranking system. However, it is important to understand that the results of the research should not be treated as the truth of last resort, because they have several evident limitations.

Firstly, the number of factor groups is quite small, comparing to other works in the sphere of investment attractiveness methodology application. For example, such factors as presence of infrastructure in the region, remoteness from possible consumers, approximate breakeven price of the main fields could be added. Secondly, it was decided not to use the weighting system. However, it could add credibility to the work and make it more complex. Thirdly, the comparison of taxation regimes was done on the basis of qualitative assessments, which could be enhanced by providing a benchmark analysis (standardized firm, size of the field, amount o resources, etc.).

All these limitations were partially caused by the framework of the master’s thesis (its volume and time, provided for the analysis). Thus, they can serve a solid basis for future research (a PhD dissertation, for example) and would only contribute to the credibility and sufficiency of the paper. At the same time the number of provinces can be increased in order to cover the whole Arctic region.

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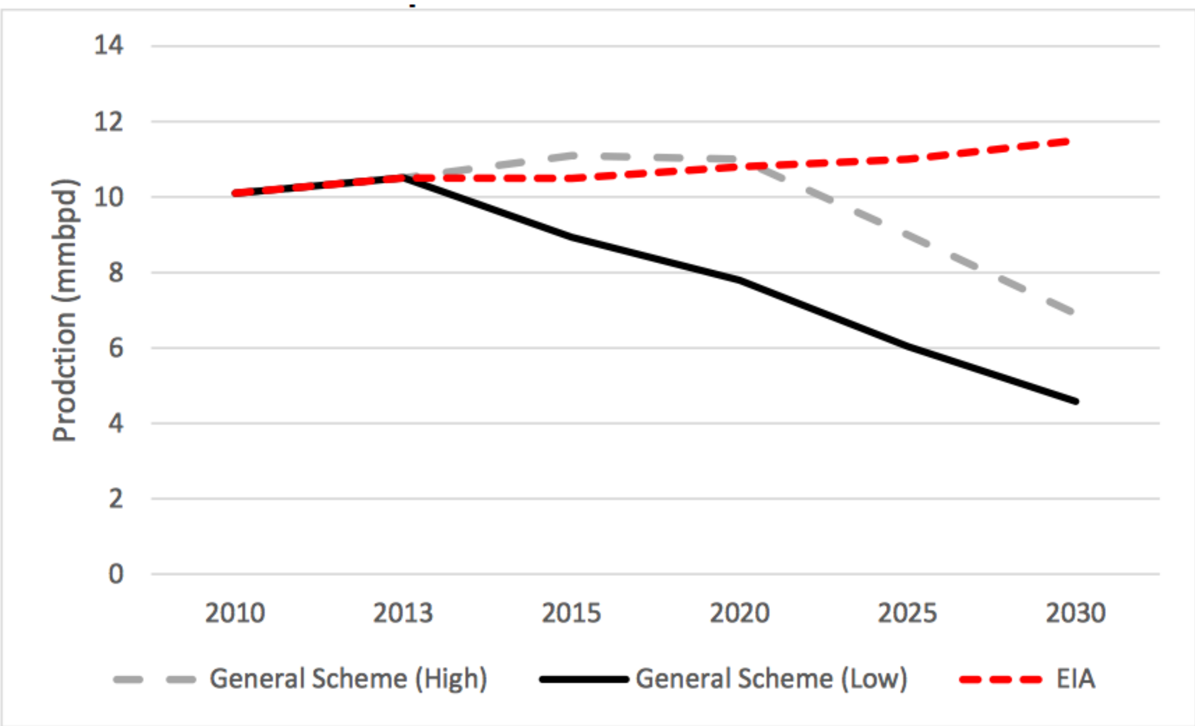
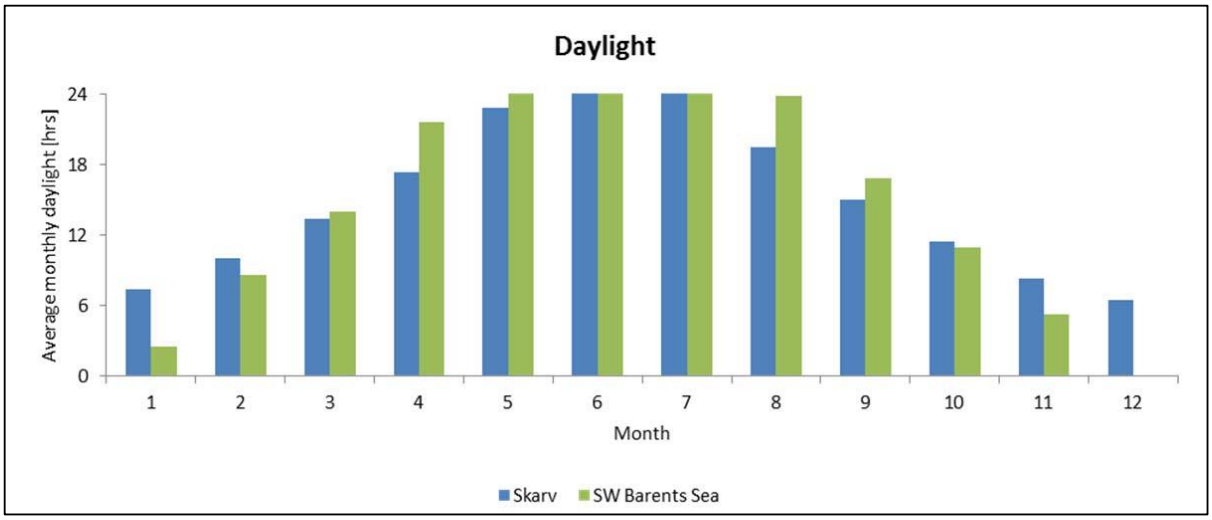
8. Appendix

Figure 1: Forecasts of Russian oil production



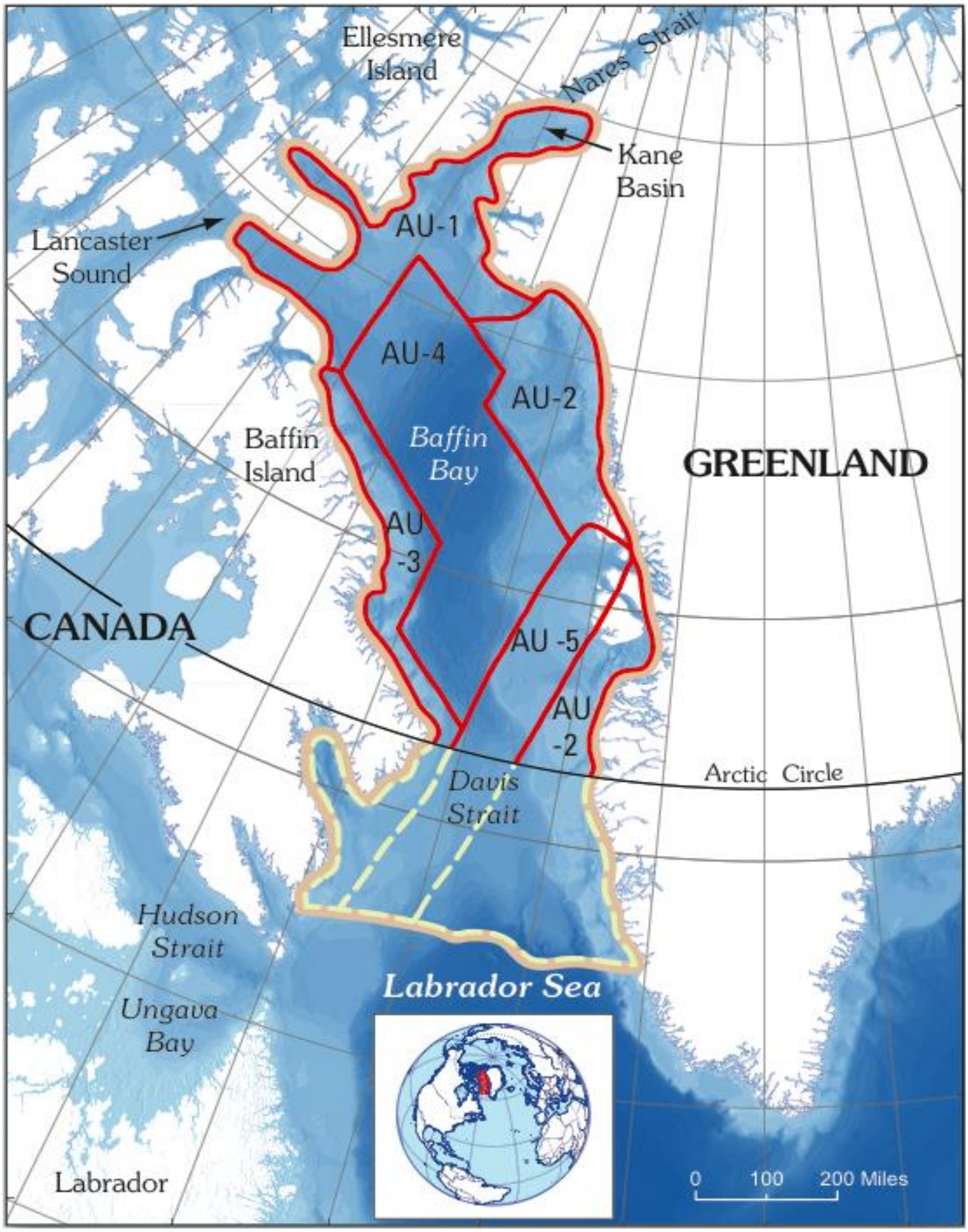
Source: Henderson, J., Loe, J. (2014) The Prospects and Challenges for Arctic Oil Development, The Oxford Institute for Energy Studies, p. 25: http://www.oxfordenergy.org/wpcms/wp-content/uploads/2014/11/WPM-56.pdf

Figure 2: Average monthly amount of daylight for SW Barents Sea location and Skarv



Source: DNV GL AS Oil and Gas, (2015). Technology challenges for year-round oil and gas production at 74°N in the Barents Sea.

Figure 3: The West Greenland–East Canada Province



The West Greenland–East Canada Province (tan line) contains Baffin Bay, Davis Strait, Lancaster Sound, and Nares Strait west of and including Kane Basin. Five assessment units (red lines) were defined in this study: AU-1, Eurekan Structures AU; AU-2, Northwest Greenland Rifted Margin AU; AU-3, Northeast Canada Rifted Margin AU; AU-4, Baffin Bay

Basin AU; AU-5, Greater Ungava Fault Zone AU. Dashed yellow lines represent portions of those AUs that extend south of the Arctic Circle.

Source: USGS, (2008). Assessment of Undiscovered Oil and Gas Resources of the West Greenland–East Canada Province. Fact Sheet 2008–3014. [online] p. 2. Available at: http://pubs.usgs.gov/fs/2008/3014/pdf/FS08-3014_508.pdf [Accessed 19 Apr. 2016].