

Changes in Oil Transportation in the Years 2020 and 2030 – The Case of the Gulf of Finland

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ABSTRACT: This paper covers the current state of maritime oil transportation in the Baltic Sea and the development of oil transportation in the 2000s, as well as estimations of transported oil volumes in 2020 and 2030 in the Gulf of Finland. The scenarios were formulated on the basis of a current state analysis, energy and transportation strategies and scenarios and expert assessments. The study showed that the volumes of oil transportation in the Gulf of Finland will increase only moderately compared to the current status: 9.5-33.8 %, depending on the scenario. Green energy policy favours renewable energy sources, which can be seen in the smaller volumes of transported oil in the 2030 scenarios compared to the 2020 scenarios. In the Slow development 2020 scenario, oil transport volumes for 2020 are expected to be 170.6 Mt (million tonnes), in the Average development 2020 187.1 Mt and in the Strong development 2020 201.5 Mt. The corresponding oil volumes for the 2030 scenarios were 165 Mt for the Stagnating development 2030 scenario, 177.5 Mt for the Towards a greener society 2030 scenario and 169.5 Mt in the Decarbonising society 2030 scenario.

1 INTRODUCTION

Maritime traffic in the Baltic Sea is very dense, especially if the traffic volumes are compared to the size of the sea area. More than 2,000 vessels continuously transport different kinds of cargoes on the Baltic Sea. Approximately 25% of the vessels are loaded with oil, oil products or chemicals. (Baltic Sea Action Group 2008; HELCOM 2009) The Baltic Sea is 392,000 square kilometres wide with an average depth of only 54 meters. As a comparison, the average depth in the Mediterranean Sea is 1,550 meters and in the Atlantic and Pacific Oceans 4,000 meters. The Baltic Sea is only connected to the North Sea and the Atlantic Ocean by the narrow straits of Denmark. (Myrberg et al. 2011)

The Gulf of Finland is the easternmost part of the Baltic Sea and it is approximately 400 km long. Width

varies between 65 km and 135 km. The Gulf of Finland is surrounded by three countries; Finland, Estonia and Russia. The narrowest point is found between Helsinki and Tallinn. The shores and the archipelago are mainly rocky, and there are hundreds of islands of various sizes. The total length of the coastline including the islands in the Gulf of Finland is up to 6,500 km. (Knuutila 2011) The Gulf of Finland is very shallow, the average depth only being 37 meters. The Gulf and the archipelago are very sensitive and vulnerable to pollution, due to for example the low volumes and slow turnover of water, low temperatures and ice cover during winter, and stratification of water into layers with different temperatures. (Knuutila et al. 2009)

The purpose of this study is to produce maritime oil transportation scenarios for the years 2020 and 2030 in the Gulf of Finland. Before the scenarios an

analysis of the current state and future development of oil transportation in the Gulf of Finland is also provided. On the basis of scenarios the group of experts estimated transported oil volumes in 2020 and 2030. The study focuses on crude oil and oil products. Crude oil and oil products are looked at separately whenever possible (in many statistics there is only one group, "oil"). The estimated oil transportation volumes include both oil and oil products.

2 MATERIALS AND METHODS

The study was carried out in two stages. First, a statistical analysis and literature review on oil transportation in the Baltic Sea and on the development of oil transportation in the Gulf of Finland was made. The current state analysis and development of oil transportation are mainly based on information from ports, operators, terminals, previous studies, governmental and EU databases. The future scenarios are based on international and national energy strategies and on other future scenarios (e.g. the Baltic Transport Outlook 2030, the Technology Outlook 2020 and the Baltic transport system – Finnish perspective). The purpose of literature review was to found out the main future trends in Russia and in EU which affect the amount of maritime oil transportation.

Second, *expert panel* gave an estimation of transported oil volumes in 2020 and 2030 in the Gulf of Finland. An expert workshop was arranged in May 2012. In addition, the experts who was not able to participate the workshop were asked to give their evaluations by e-mail.

3 OIL TRANSPORTATION DEVELOPMENT IN LAST DECADE IN THE GULF OF FINLAND

In the last decade the volumes of oil and oil products transportation has been tripled in the whole Baltic Sea area. The main reason for the increase in maritime oil transportation volumes in the Baltic Sea is Russia's new oil terminals in the eastern part of the Gulf of Finland. The Port of Primorsk started operating in 2002, and other ports have increased their capacity as well (Hänninen & Rytönen 2004; Leningrad Region 2011). Even the economic recession in 2008-2009 didn't decrease the amount of transported oil. Oil terminals in the port of Ust-Luga started operating in March 2012. This will increase the transportation of oil in the Gulf of Finland in the future. (UK & Trade Investment 2010; Ust-Luga Company 2012)

In 2010, almost 290 million tonnes of oil and oil products were transported in the Baltic Sea, of which more than 55% via the Gulf of Finland (Holma et al. 2011). The relatively small sea areas, crossing traffic between Helsinki and Tallinn and oil tankers going to the west from the eastern part of the Gulf of Finland are a combination which can cause a huge environmental disaster. Maritime oil transportation is also vulnerable to security threats, an issue that has attracted less attention in the Baltic Sea.

In the following table the development of oil and oil products transportation between the years 2000-2012 in the Gulf of Finland is presented. As it can be seen, the oil transportation has quadrupled in the past twelve years in the Gulf of Finland, compared that in the Baltic Sea oil transportation has been tripled. In the year 2000 transported volumes in the Gulf of Finland was 43 million tonnes and in 2012 almost 171 million tonnes. The increase in volumes is mainly due to the growing Russian export while the volumes in Estonia and in Finland have been quite stable during the last decade.

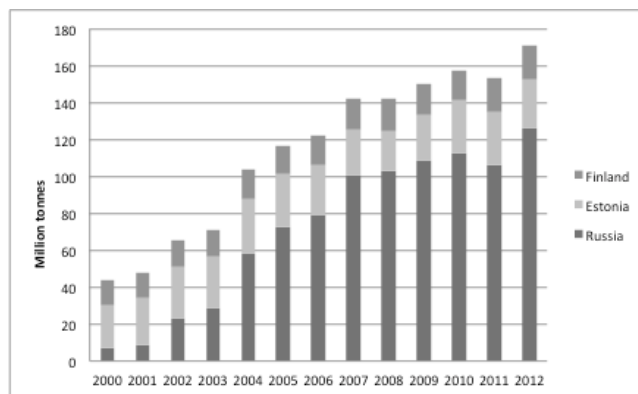


Figure 1. Oil & oil products transportation development in the Gulf of Finland 2000-2010.

In the Gulf of Finland totally 17 ports handle oil and oil products: six ports in Finland, six in Estonia and five in Russia. (Holma et al. 2011) Finland's largest oil port is Sköldvik and port handles 96 % of the Finnish volumes. In Estonia the largest port is Muuga and ports share of Estonian oil volumes is 82 %. In Estonia the majority of oil transportation is transit traffic from Russia via Estonian ports to Europe. (Port of Tallinn 2011& Holma et al.2011) Estonia has no crude oil reserves or oil production plants or refineries of its own.

In 2000 in Russia, the handled oil volume was only 7.3 million tonnes, while in 2009 the volume was almost 109 million tonnes and in the year 2012 the volume was 127 million tonnes. Russia opened the oil port of Primorsk in 2002. Since that time, the volumes in Primorsk have increased six-fold from 12.4 million tonnes to 79.2 million tonnes. The port of Vysotsk started to handle oil in 2007, and its oil volumes currently are about 14 million tonnes. In the port of St. Petersburg, the annual oil volumes have increased from 7.4 million tonnes to 16 million tonnes. (Holma et al. 2011 & Pasp Russia 2012) Besides these ports, the port of Ust-Luga started operating in 2012 (World maritime news 2012). The Baltic Pipeline System 2 was connected to the port of Ust-Luga and in future, the oil volumes in Ust-Luga are expected to increase rapidly. In the year 2013 handled oil volumes in the Port of Ust-Luga was almost 40 million tonnes. (Pasp Russia 2014)

4 PERSPECTIVES ON THE FUTURE DEVELOPMENT OF MARITIME OIL TRANSPORTATION

This section will begin by going through Russia's energy strategy and oil production plans as well as the EU's climate and energy strategies and the national energy strategies of Estonia and Finland. The scenarios concerning future transportation volumes in the Baltic Sea and in the Gulf of Finland to be presented are based on these trends.

4.1 *Russia's Energy Strategies 2020 and 2030*

Russia has one of the world's largest energy resources and it controls one third of the global natural gas reserves, one tenth of the oil resources and one fifth of the coal reserves. (Ministry of Energy of Russian Federation 2003; Liuhto 2010 and Cohen 2007) Many countries in Europe and Central Asia are dependent on Russia's energy resources (Woehrel 2012; Cohen 2007 and BOFIT 2012). These resources are the basis of the economic growth, external trade and policy of Russia. Currently Russia exports around 70 % of its oil production (Liuhto 2010). The key elements of Russian long-term national energy policy are energy safety, energy efficiency, budget effectiveness and ecological energy security. In 2009 it was reported that Russia will invest 1.8-2.1 trillion US dollars in oil and gas projects by 2030. These projects will increase oil production for European and Asian demand and also for Russia's own demand (Kupchinsky 2009). The realization of a social and economic long-term energy state policy has been divided into two phases. The first phase includes the basis for Russia's progressive development with different scenarios of social and economic development. The key scenarios for the first phase are a normative and legislative base without barriers, energy efficiency, and exports of oil and gas in the internal and external fuel and energy markets. The second phase comprises the formation of a new fuel and energy complex. The policy aims for growth, transparency and competition in the energy markets. Existing energy modes will also be developed. (Ministry of Energy of Russian Federation 2003)

Oil production will continue in the traditional oil production regions in Russia, but also new oil and gas fields will be broached in North-eastern Russia (the Timan-Pechora region). In the future, Russia's main oil base will be in Western Siberia. In oil production, the main priority will be the rationalization and increase of productivity. Russia's Energy Strategy also contains objectives related to renewable and local energy resources, although these are not very clearly defined. (Ministry of Energy of Russian Federation 2003)

4.2 *EU and national future policies in Finland and in Estonia*

The aims of the European Union's Energy and Climate strategy are to reduce emissions of greenhouse gases by 20% (compared to the 1990 levels), to increase the share of renewable energies to 20 % of the EU's final energy consumption and to

increase energy efficiency by 20 %. The aims also include increasing the share of biofuels in the transport sector to 10%. (Finland's Ministry of the Environment 2011) The EU climate and energy package includes four directives: revision and strengthening of The Emission Trading System (ETS), An "Effort Sharing Decision", Binding national targets for renewable energy and carbon capture and storage. (European Commission 2010)

The European Union has also created the concept of Short Sea Shipping, which refers to a maritime transport space without barriers. The maritime mode of transport is highly efficient in terms of environmental performance and energy efficiency. The EU's maritime transport policy until 2018 includes the main strategic goals for the European maritime transport system until 2018 and identifies key areas for action which will strengthen the competitiveness of the sector while enhancing its environmental performance in the EU. (Commission of the European Communities 2009; European Commission 2011)

Finland's and Estonian national energy strategies follow the EU's policy. The challenged faced by Estonia is that 90% of Estonia's energy consumption is produced with oil shales. In addition, the country's connection to Russia's energy network causes carbon leakage. Estonia has already invested in cutting down on emissions from the oil shale power plants. (Hamburg 2007; Kisel 2008)

In Finland, the main goal is to decrease the consumption of energy and to cut down on emissions. Emissions that are outside Emission Trading must be reduced by 16% by 2020. In Estonia and in Finland, national energy strategies go hand in hand with the EU's climate and energy package. (Turunen et al. 2008)

5 SCENARIOS AND FORECASTS FOR MARITIME OIL TRANSPORTATION IN THE GULF OF FINLAND IN 2020 AND 2030.

5.1 *About the scenarios*

The volumes of oil and oil product transportation in the Gulf of Finland in 2020 and 2030 were formulated by using expert assessments. The workshop was attended by seven persons. In addition, an e-mail inquiry was sent to seven experts of whom two gave their estimations by e-mail. In the workshop, the basic outlines for each scenario were presented and then experts were asked to give their estimations about oil volumes in each scenario. Estimations were given as probability distributions, in other words experts gave for each scenario a most probable and minimum and maximum values of transported oil volumes.

The reason for the three different scenarios for the years 2020 and 2030 is that the future development of maritime oil transportation in the Gulf of Finland depends on many factors, and it is not realistic to give only one estimation. By giving three scenarios we can analyze how the volumes of oil transportation would differ in different situations, taking into consideration for example economic, political or energy issues. For each scenario, three different figures of oil

transportation volumes were formulated in order to take probability distributions into account.

5.2 Scenarios for 2020

5.2.1 The "Slow development" scenario

Basic assumptions:

- Stagnant economic growth in the EU
- Recession prevails
- Heavy industries move to Asia, South America and other continents
- Demand for oil decreases
- Oil production in Russia fails to increase
- No investments in oil production technology

The "Slow development" scenario is based on the assumption that the European countries and Russia will suffer from a long-term economic slowdown. It is expected that the economic crisis prevails especially in Southern Europe. The demand for consumer goods will decrease or remain at the current level. Also it is assumed that heavy industries, such as the metal and forest industry, will continue to move to Asia, South America or other continents in order to cut production costs and because of the growing demand in developing countries.

The demand for oil and oil products will decrease because of high oil prices and that is why the logistics costs will become more expensive. Russia has no interest in investing in new technology in oil production as the demand for oil is decreasing. Despite the low economic situation, in this scenario the Baltic Pipeline System 2 is connected to port of Ust-Luga, in other words 15-20 million tonnes of oil will be transported via Ust-Luga, starting in late 2012 or 2013. The oil transportation will increase in Russia, but it will cut the transit transportation from Russia via Estonian port.

5.2.2 The "Average development" scenario

- Economic growth continues in the EU and Russia
- Heavy industries develop new products and production capacity is maintained in Europe
- Demand for oil increases despite of the increase in the price of oil and oil products
- Russia produces oil at full capacity with Soviet era equipment
- Some investments in oil production/technology are made

This scenario depicts a "business as usual" situation. The population, economy, technology and society continue to develop in a similar manner to the past decades in Europe. It is believed that economic growth will be more rapid in Russia than in the rest of Europe. New oil and gas pipelines connect Russian ports and gas lines to Europe. In Russia oil ports, Ust-Luga and Primorsk will operate at full power and full capacity. In Europe, fossil fuels and oil will remain the main energy sources for transport. Present investments plans for efficient energy technologies will be realised by 2020. Also growing demand for oil will lead to investments in new and more efficient oil products technologies. In this scenario, heavy industries will continue their operations in Europe

and new green products and innovations will be made.

In Finland and Estonia, the demand for oil products will only increase a little, because the share of bio fuels and other alternative energy sources will increase. Oil transportation in Estonia will decrease, because Russia will concentrate its oil transportation to its own ports and only small amounts of Russian oil will be transported via Estonian ports.

5.2.3 The "strong development" scenario

- Fast economic development in Europe and Russia
- Despite new innovations in transportation, oil remains the main energy resource despite its high price
- Russia speeds up its investments in production and refinement technology to increase its oil producing capacity
- Russia starts to explore new oil deposits in Arctic areas and seas
- The EU invests more and more in green technology and renewable energy resources
- Large investments in ports, vessels and tankers

The "Strong development" scenario is the most optimistic vision of economic development and transport in Europe and Russia. The overall economic situation and trends are very positive at the global level.

The demand for oil will remain high all over the world, regardless of its high price. Russia will invest in oil production and refinement technologies for the current oil production areas and expand oil drilling in the Arctic areas, but the production will not start. Oil production in the Arctic areas is more expensive, but the high price of oil products will make drilling economically viable.

The EU will invest more and more in green technologies and renewable energy resources. The targets of the climate and energy package for 2020 will be achieved as planned in the strategies. This scenario assumes that the physical size of ports will not grow much, meaning that there will be no new pier areas for larger tankers.

5.3 Oil transportation volumes in 2020

In the Slow development 2020 scenario, the expected volume of oil transported by ships in the Gulf of Finland will be 170 million tonnes. The minimum volume was estimated to be 151 million tonnes and the maximum volume 182 million tonnes. The minimum figure almost equals the volume of oil transported in 2009. In the project the year 2009 was chosen as basic year where to compare the results.

In the *Average development 2020* scenario, the expected volume of oil transported is 187 million tonnes, the minimum volume 169 million tonnes and the maximum volume 207 million tonnes. In the *Strong development 2020* scenario, the expected volume of oil transported in the Gulf of Finland is 201 million tonnes, the minimum volume 177 million tonnes and the maximum volume 218 million tonnes. In the following table the expected volumes of oil transportation in each scenario for 2020 are presented.

The table also shows the change in percentage points in comparison with the 2009 volumes.

Table 1. Estimated oil and oil products transportation in the Gulf of Finland in 2020

	Million tonnes	Change (%)
Year 2009	150.6	
Slow development 2020	170.6	13.3
Average development 2020	187.6	24.2
Strong development 2020	201.5	33.8

5.4 Scenarios for 2030

5.4.1 The "Stagnating development" scenario

- Targets of the EU's climate and energy strategy will not be achieved
- Lack of investments in green technologies
- Transportation costs are high
- Heavy industries relocate production to Asia, South America or to other continents
- No new oil or gas production areas have been taken into use in Russia because of a lack of investments
- No new investments in tankers or new maritime technology
- The Arctic sea route has been opened

The forecast for 2030 is more negative than that for 2020 because of the longer time span. More radical changes may take place, for example in the economy, politics and the climate. The *Stagnating development* scenario assumes that the implementation of the EU's climate and energy package has failed and there is no interest in greener technology. It is believed that despite of the recession, some development must have happened over the next two decades. In this scenario the main energy resource for transportation will still be oil. The demand for oil will increase the price of oil and transportation costs. Because of the poor economic situation all over the world, there are no investments in new energy saving transportation technology.

Heavy industries have relocated their production from Europe to Asia, South America or other continents because of lower labour and production costs. Russia has not been able to increase its oil or gas supply. Oil production in the Arctic area is so expensive that only test drillings have been made, but production has not started. No new investments are being made in ports or vessels, except for the compulsory investments to replace outdated tanker fleet. The opening of the Arctic Route will change transportation routes to some extent by 2030.

5.4.2 The "Towards a greener society" scenario

- The EU's climate and energy package will have been implemented as planned
- The EU will become a more and more carbon neutral society following the visions of the energy strategy 2050
- Demand for oil products has decreased
- In the industrial sector, new, successful openings will be made in Europe

- New innovations in transportation are made, which helps to handle increasing volumes more efficiently
- Russia will have expanded its oil production activities to Arctic areas
- The Arctic sea route will be opened

In the *Towards a greener society* scenario, growth continues in a similar way as in the *Average development* scenario for 2020. The economic situation will be mainly positive. In 2030, the EU's climate and energy package objectives will be achieved and new, more ambitious strategies will be formulated for the following decades. The EU is becoming more and more carbon neutral society. Renewable energy is increasingly replacing fossil fuel energy recourses.

Despite of economic growth; it is believed that the demand for oil will decrease. The reason for the decreasing oil demand is the increasing amount of renewable energy sources and bio fuels. In the transportation sector, there will also be a shift towards railways and multimodal transportation modes. Heavy industries have relocated their production to countries in what are now called developing countries, but the green wave will have brought new innovative industries to Europe.

Russia will have been building up its oil production capacity especially in the Arctic. The growing demand for oil will be in Asia, so the majority of the oil from new oil production areas will go to China and India, where private and public transportation will increase strongly.

5.4.3 The "Decarbonised society" scenario

- The EU will implement new stricter environmental policy
- Many vehicles use electricity
- Demand for oil products is decreasing in EU
- Russia will build new gas lines to Europe and oil pipelines to the Arctic Sea and Asia
- Oil volumes in Russia will increase, but most of the new oil production will be consumed in Asia
- The Arctic sea route will be opened

In this scenario, the EU will implement very strict environmental policies, which all EU member states follow. This trend will also be apparent in other western countries. Green technology will be one of the major export products in Europe, and less wealthy countries in particular are attempting to solve their energy problems with green technology. Still it is believed that oil and fossil fuels will remain the main energy recourse in poorer countries and also in Russia. Russia will still use oil and fossil fuels because of its national production capacity. New battery technologies will enable the use of electricity as a power supply in cars. The remainder of the world will still be mainly using combustion engines in cars.

Russia's oil production will expand to the Arctic areas, and the country will produce increasing amounts of oil. As in the *Towards a greener society* scenario, in this scenario, too, almost all Arctic oil will travel through pipelines to Asia. Russia's domestic demand for oil will decrease and Russia will begin to use greener technologies in transportation and energy production. New gas pipelines will be built to Europe

via the Baltic Sea. Europe will prefer using gas because the carbon capture is one of the EU's key tools in the fight against global warming and climate change.

5.5 Volumes in 2030

In the *Stagnating development 2030* scenario, the expected volume of oil transportation is 165 million tonnes, and the minimum and maximum volumes are 148 and 177 million tonnes respectively. Compared to the oil volumes transported in 2009, oil transportation will increase by 9.5%.

In the *Towards a greener society 2030* scenario, oil transportation in the Gulf of Finland will increase by almost 18% compared to 2009. The expected volume is 177.5 million tonnes. The minimum volume is 156 million tonnes and the maximum volume 192 million tonnes. The demand for oil in Europe will probably decrease or remain stable, while Russia will continue transporting oil and oil products overseas via the Gulf of Finland.

In the *Decarbonised society 2030* scenario, the transportation of oil and oil products will be almost at the same level as in the *Stagnating development* scenario. It is expected that oil transportation volumes will increase by 12.5 % from the 2009 level. The expected volume is 165.5 million tonnes and the minimum and maximum volumes 153 and 190 million tonnes respectively.

In the following table the expected volumes of oil transportation in each scenario for 2030 are presented. The table also shows the change in percentage in comparison with the 2009 volumes.

Table 2. Expected volumes in oil transportation scenarios for the year 2030 and change in percentage.

	Million tonnes	Change %
Year 2009	150.6	
Stagnating development 2030	165	9.5
Towards greener society 2030	177.5	17.8
Decarbonised society 2030	169.5	12.5

6 SUMMARY AND CONCLUSIONS

Oil transportation in the Gulf of Finland has almost quadrupled in the past ten years. In Figure 2 the oil transportation development from the year 2000 to 2012 is presented in black dots. As it can be seen from the figure, the development has been relatively linear from the year 2000-2012.

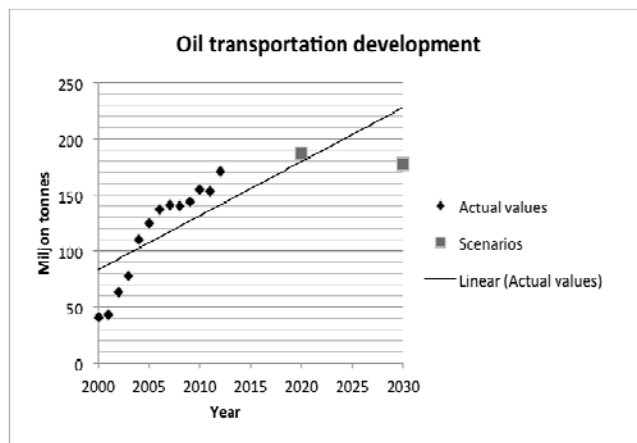


Figure 2. Development of oil transportation in the Gulf of Finland.

The volumes of transported oil in the GoF cannot increase in a linear manner because of production capacity. Grey dots are scenarios, which have been created in the MIMIC project. The scenarios for the years 2020 and 2030, are the average growth scenarios estimated that the oil transportation volumes are 187 million tonnes in the year 2020 and 178 million tonnes in 2030 (towards a greener society scenario). The estimates presented in the aforementioned scenarios were based on expert interviews.

According to the experts, there will only be a moderate increase in the oil transportation volumes compared to the statistics for 2009. Variations in the scenarios are not major, but the minimum and maximum volumes of oil and oil products transported in each scenario have quite a wide range. This variation between the minimum and maximum scenarios varies around 30 to 40 million tonnes. Transported oil volumes in the *Slow development* scenario in 2020 and the *Stagnating development* scenario for 2030 are almost the same. We can see that the estimated volumes of Ust-Luga increase the transportation volumes, but depending on the scenario, the volumes for Estonia and Finland might decrease a little. In the *average and strong* development scenarios for 2020, the transported oil volumes will increase. The reason for the increasing oil volumes is that new technologies and the share of renewable fuels will not develop rapidly in the next seven years. If new technologies, for example electric vehicles, are in a wide use, the demand for oil products will decrease. However, especially in transportation of passengers and goods, fossil fuels will remain the main energy source.

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