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Biopaliva v Ruské federaci, Ukrajině a Bělorusku: současný stav a výhled do budoucnosti

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Čestné prohlášení: Prohlašuji, že jsem diplomovou práci na téma „Biopaliva v Ruské federaci, Ukrajině a Bělorusku: současný stav a výhled do budoucnosti“ vypracovala samostatně a veškerou použitou literaturu a další prameny jsem řádně označila a uvedla v přiloženém seznamu.

V Praze dne 13. 1. 2017 ……

Bc. Elena Stankus

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Abstrakt

Cílem diplomové práce je poskytnout přehled trhu s biopalivy v Ruské federaci, Bělorusku a na Ukrajině a odhadnout budoucí vývoj. První kapitola charakterizuje biopaliva podle surovin a jejich dalšího využití. Další část práce popisuje vývoj biopalivového průmyslu ve vybraných klíčových zemích a analyzuje aktuální trendy na globálním trhu. Další tři části se zabývají ruským, ukrajinským a běloruským odvětvím biopaliv, včetně potenciálu vstupních surovin, podpůrných politik, strategií, mezinárodní spolupráce a problémů v oblasti výroby biopaliv, jejích distribuci a spotřeby v jednotlivých zemích. Poslední část práce zkoumá potenciál vyvážených surovin, jejich přínos k dosažení stanovených cílů a pohled do budoucího vývoje.

Klíčová slova: obnovitelné energetické zdroje, biopaliva, bioetanol, biodiesel, post-sovětské země

Abstract

The purpose of diploma thesis is to provide an overview of biofuel's market in Russian Federation, Belarus and Ukraine and estimate prospects of future development. First chapter characterizes biofuels in regard of the feedstock and further utilization. Next part of the thesis describes development of biofuel industry in the key selected countries and analyses current trends on the global market. Next three sections review Russian, Ukrainian and Belarusian sectors of biofuels including feedstock potential, supportive policies, strategies, international collaboration and issues in biofuel production, distribution and consumption in each country. Last section of the thesis investigates potential from exported raw materials and its contribution to achievement of established targets with the following outlook for the future development.

Keywords: renewable energy sources, biofuels, bioethanol, biodiesel, post-soviet countries

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Introduction

Renewable energy sources have been perceived as the solution for the number of global and national concerns. The oil crises and price shock from 1970s had prompted an interest in the adoption of renewable fuels, which unlike fossil fuels could regenerate. Thus liquid biofuels would contribute to the saving of decreasing fossil fuels reserves, constantly growing energy demand and energy security. Moreover, in the context of environmental protection, biofuel's provides lower negative impact on climate change compared to traditional fuels. In view of energy security and diversification, use of biofuels would minimize energy dependence of importing countries from the major producers and exporters of fossil fuels such as The Organization of Petroleum Exporting Countries (OPEC). By the same token biofuels would be the answer to excessive production of agricultural commodities, abandon land and would bring new opportunities for the local farmers. Despite rapid expansion of biofuels worldwide, this sector is considered relatively new and being in the continuous development and renovation.

Prompted by increase in energy security and climate change many countries have decided to develop their own biofuel's industry. Thus having a comparative advantage such as arable land or feedstock availability plays significant role in the biofuel's market growth. For the purpose of the thesis were selected countries, whose potential of biofuels is considered extensive but unevolved yet. Development of biofuels in Russia, Ukraine and Belarus has only begun and until recent years their potentials were poorly utilised.

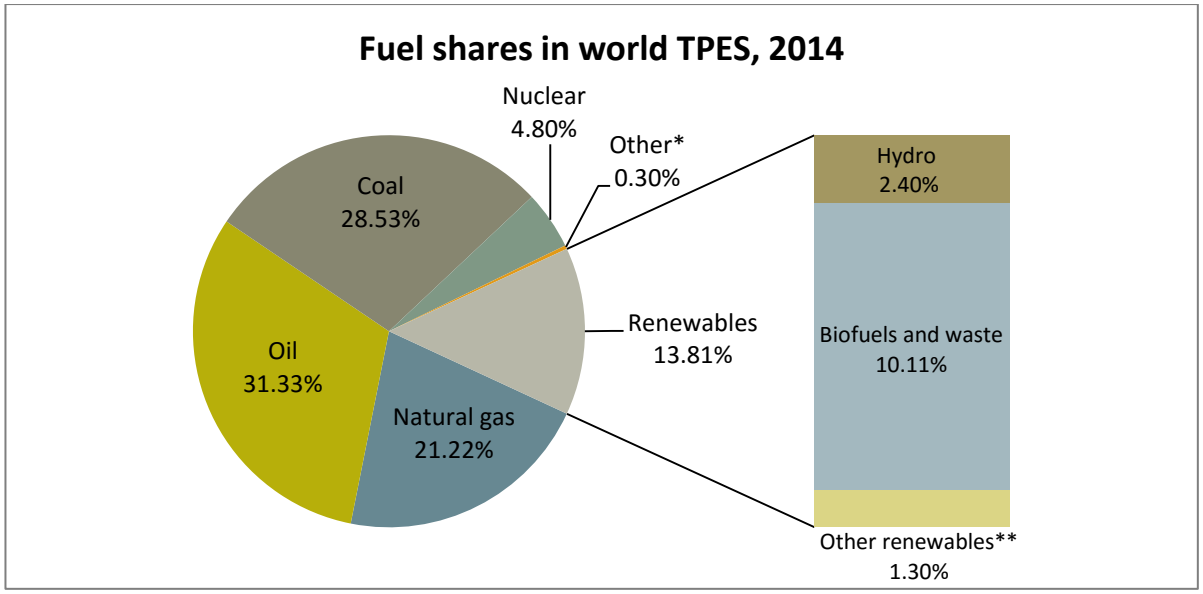
During recent decade biofuel markets has been rapidly growing and regularly thoroughly analysed. There have been written many works about biofuel development worldwide. However chosen countries lack of such literature, official data and current situation of biofuel sector remains unclear. The objective of this thesis is to provide concise but exhaustive overview of up-to-date status in biofuel's industry in Russia, Ukraine and Belarus and future prospects of their development. We would like to focus on liquid biofuels since this type of biofuels is the least analysed in the literature for investigated countries. In order to achieve the objective, we structure this thesis in the following way. In the first chapter, we define the biofuels in regard of their sources and use. Second chapter provides reader with current trends on global biofuel's market, overview of biofuel policies in the key

selected countries and incentives applied worldwide in this sector. Next section of thesis describes Russian sphere of biofuels, analyse of its feedstock potential, policies, local projects and international collaboration within the sector. In the fourth chapter we will investigate government incentives in Ukraine and development of biofuel industry with the respect to the possible joining of EU. Fifth chapter describes current status in the Republic of Belarus in the similar way as two other countries. Key laws, strategies and incentive schemes from the past decade are reviewed. In the last section of thesis we estimate the potential of an exported feedstock from selected countries and its contribution to the development of biofuel industry and achievement of established targets. This thesis aims to contribute to the controversial debate on further development of biofuels in the post-soviet countries and provide reader with data and information that are difficult to obtain and usually available in Russian language.

1. Introduction to biofuels

In recent years renewable energy sources and especially biofuels have been one of the most discussed topics in political as well as scientific, public and economic spheres. Biofuels are renewable alternatives to fossil fuels such as gasoline, coal and diesel in the sector of transportation. Continuous issues with the supply of energy sources and environmental impacts from traditional fuels have triggered the expansion of biofuels through extensive researches and developments (R&D). Generally development of biofuels had been driven by three key global challenges: energy security, economic development and mitigation of climate change. The International Energy Agency defines energy security as the uninterrupted availability of energy sources at an affordable price (IEA, 2016). Possible risks for energy security may cause disruption of imported energy supply or high energy prices environment. Thus opportunities for development of domestically extracted sources of energy became attractive for many countries largely dependent in imported fuels. In the view of economic development, as biofuels production capacities expand, they create new "green" jobs throughout the economy and new opportunities for income for local farmers. In the context of mitigation of climate change, nowadays fossil fuels represent not only major source of energy, but also main source of carbon dioxide emissions (CO2) and greenhouse gas (GHG). Biofuels such as bioethanol and biodiesel are not CO2 neutral, however they are considered to notably reduce emissions compared to diesel or gasoline.

Global economic growth has had significant impact to the increase of energy demand. As reported by U.S. Energy Information Administration (2016), energy consumption is projected to grow by 48% by 2040. And biofuels may contribute to the meeting these needs in a sustainable way. In 2014 world Total Primary Energy Supply (TPES) had reached 13,7 Mtoe, of which 13.81% were provided by renewable energy sources. Graph bellow represents global balance of TPES in 2014, where biofuels had peaked 10.11% in 2014.



*Other includes electricity generated from energy sources not defined in the graph: non-renewable wastes, peat, chemical heat etc.
**Other Renewables consists of geothermal, wind, solar and tide energy sources.

Graph 1: Fuel shares in world Total Primary Energy Supply, 2014

Source: Key Renewables Trends Statistics, IEA, 2016

Biofuels are defined as fuels derived from the biomass and produced by contemporary biological processes. Alike traditional fuels they exist in number of forms and categories and could also be classified into several generations (from the first up to the fourth generation). The differentiation of the biofuels is primarily based on three characteristics: the type of the feedstock, the conversion technology utilized and features of the fuel molecules. Nonetheless not all types of biofuels perform equally regarding influence of climate change, energy security and ecosystems.

1.1. **The conventional biofuels**

The conventional or the first generation biofuels refers to the fuels, which have been obtained from the material like starch, sugar, vegetable oil and animal fat. The most known representatives of the 1st generation biofuels are bioethanol, biodiesel, vegetable oil and biogas. However among liquid biofuels—mainly bioethanol and biodiesel—represent the vast majority of the renewable share ("Renewables 2015.Global Status report", 2015). The main difference from the second generation biofuels is in the feedstock used and volume of GHG. The 1nd generation biofuels could notably affect the food supply in case of large

quantity production. Another big disadvantage of the conventional biofuels is that the required crops are demanding in the usage of the several inputs such as land, water, fertilisers and pesticides etc., followed by implications on the environmental side (Ziolkowska & Simon, 2011).

In the beginning of 21st century the interest in biofuels production had globally significantly escalated, mainly in the food crops containing source of the biomass related to the first generation. Therefore nowadays the production of the conventional biofuels is represented by well-established and already developed technologies.

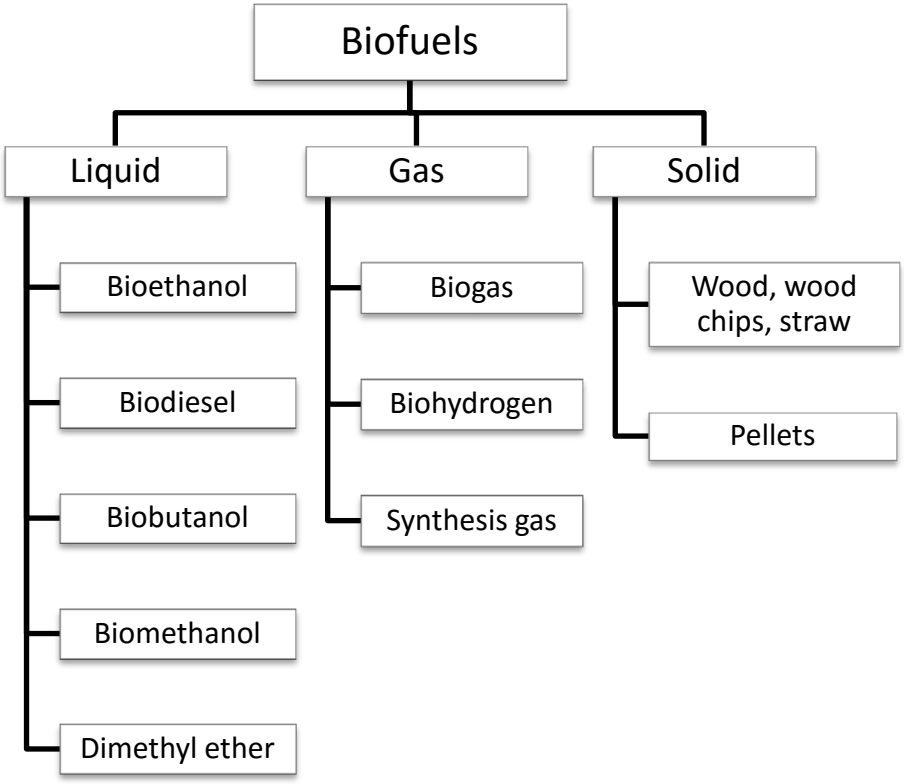
1.2. The advanced biofuels

Since the boom in the 1st generation biofuels, the focus shifted to the advanced biofuels which include the second and further generations. The main aspect of advanced biofuels definition is reduction of GHG emissions by minimum 50% compared to fossil fuels. Interesting to note, that the U.S. Environmental Protection Agency (EPA) considers Brazilian sugarcane ethanol as an advanced biofuel since it decrease greenhouse gases by 61% in comparison with traditional gasoline. As was mentioned earlier the 2nd generation biofuels are extracted from a different non-food feedstock, the food crops could only be used in production of advanced biofuels, if they were already used for food purposes, for the instance - the vegetable oil waste. Therefore the main source for the 2nd generation biofuels is wastes, energy crops, agricultural and forestry remains and algae. This generation of biofuels is considered to be “greener”, based on the sustainability of the feedstock, the greater reduction of GHG (greenhouse gas) emissions, its influence on the biodiversity and the land usage. Moreover advanced types contribute to the cost reduction in biofuels production in the long term than its predecessors. Nowadays modern industries pay attention to the organic waste as a new resource due to its re-use. European countries especially have been lately devoted to the waste management. Utilisation of lignocellulosic biomass provides high value usage of low value wastes, what lifts revenues for companies, processing residues flows.

The 3rd generation biofuels are extracted from algae and have gained a lot of attention only recently. It became quite popular because of the major advantage it is capable of – diversity. From algae not only biodiesel and some components of gasoline can be obtained, but also it could be genetically transformed for production of other numerous fuels

directly, such as bioethanol and butanol. The fourth generation of biofuels are facing experimental stage so far and aimed to provide not only sustainable fuel but also to absorb and store CO2 (Schmetz & Ackiewicz, 2009).

Table 1: Classification of biofuels based on state of aggregation



1.3. Liquid biofuels: closure look to bioethanol and biodiesel

Bioethanol

First generation bioethanol is made by distillation from the agricultural products containing starch or sugar, such as corn, grain or sugar cane. Production of conventional bioethanol can generate significant amount of by-products such as food gluten, enzymes, starch, bioplastic and fodder. In this regard bio-refinery plants are focused not only on the production of the bioethanol but big range of the additional products.

Cellulosic bioethanol is a 2nd generation biofuel and offer wider range of feedstocks to be obtained from. All different types of the lingo-cellulosic materials could be used for its extraction, which provide full usage of the biomass in the production of the bioethanol.

Lingo-cellulosic material is obtained from variety of the sources, such as agricultural residues, paper and municipal solid waste, wood, energy crops and fast growing plants that could be grown on non-arable land. Considering the world's experience, the most widely used methods of utilizing bioethanol are (ePure, 2014):

- As an additive to motor gasoline fuels in concentration of 5-15% (fuels E5, E10 and E15). For instance E10 contains 10% of bioethanol and 90% of gasoline and is applicable for automobiles with traditional gasoline engines. Bioethanol adds oxygen into gasoline blend, what contributes to minimizing an air pollution;
- In a mixture with up to 85- 100% of bioethanol (fuels E85, E100), for example fuel with 85% of bioethanol and 10% of gasoline is used in motors with the universal fuel consumption systems, so-called "Flex-Fuel" engines. But bioethanol contains less energy per gallon comparing to gasoline, what makes blends with higher addition of bioethanol less competitive on the market. In this regard E85 and higher blends should be sold with a discount in order to motivate sales (Babcock & Pouliot 2013);
- For the synthesis of the methyl tert- butyl ether (MTBE) which is used as high-octane component of the automobile's gasoline.

The "traditional" gasoline engines are suitable for E5 as well as for E10 and do not require additional modifications. According to the Ethanol Producer Magazine (2014), 40% of the Brazilian cars use mixture of bioethanol and gasoline fuel, in USA this share is much lower – 10%, and only 5% in Europe. In most EU countries became widely used E5 (fuel with 5% of bioethanol). And meanwhile the United States are already introducing E15 to the market, France, Finland and Germany recently started transition to E10 fuels (Ethanol producer magazine, 2014).

Biodiesel

Biodiesel is a renewable clean-burning diesel made by combining methanol (or other alcohol) and vegetable oil, animal fats or greases. Initial feedstock for biodiesel mechanical or chemical extraction includes rapeseeds, sunflower seeds, soy seeds and palm oil. However through development the material resource was broaden to animal fats, recycled cooking oils and greases. Biodiesel can be used in normal diesel engines as well as some blends in stationery heat and power applications. The downturn of biodiesel use is that fuel could gel under cold climate conditions. Biofuel may have poor cold flow characteristics depending on

its quality, the feedstock and on the additives. This feature brings risks into biodiesel utilization and its promotion, especially in the countries with cold climate like Russia

The most common type of biodiesel blend is B7 with 7% biodiesel. Regarding Sungate report (2015) the average blend within EU is 5,2% and limited to contain 7% of biodiesel and 93% of conventional diesel. In the USA the biodiesel as well as bioethanol mandates vary from state to state: in Illinois and Minnesota blends higher than B10 are common, in New York current standard is B5, Minnesota is planning to introduce B20 in 2018 (Minnesota Department of Agriculture, 2016) and for instance in Ohio the biofuels mandate was cancelled in 2015 on a state level. . New mandates for B10/B15 are technically feasible for several countries and already under implementation in Argentina (B10), Indonesia (B15), Malaysia (B10 for the transportation sector) and expected to be applied in Brazil within next 2 years (B10) (Biofuels Digest, 2016).

While bioethanol is more widely used in USA, in Europe the biodiesel is more popular. For instance biodiesel reckons 3% (2,8 Million tons produced in 2015) on the German market and only 0,15% (4,8 Million tons in 2015) in USA, which is the biggest producer of the biodiesel by country. The second largest producer is Brazil with 2,1 Million tons of biodiesel (Statista, 2016). Annually more than 9 Million tons of biodiesel are produced in EU by over 256 plants mainly located in Germany and France. Moreover it also reach 80% share on the transport biofuel market in EU which contribute the EU to be the leading consumer of biodiesel (ePure, 2015).

2. Characteristic of biofuel policies in the selected key countries

The rapid development and sustainable growth of the biofuel sector in many cases is primarily motivated by country policies and supportive regulations worldwide. The industry of the biofuels still being in evolving phase, it is lacking competitiveness compared to the traditional fossil fuels. However without a support from the governments, this sector wouldn’t continuously develop worldwide over a past decade. In the next section we would like to provide a reader with a brief overview of biofuel policies in the selected key countries and current trends on global biofuel’s market.

Based on the world's experience and biofuels market overview of the selected countries, for the successful development of the renewable energy sources, it is necessary to set up system of roadmaps aligned by supportive regulations, policies and targets. Policies, that include blending mandates and financial support from the government aligned with secured feedstock supply showed to be essential for the industry growth. Analysis of the policies in the field of renewable energy usage shows that common ways to stimulate investments in biofuels are:

1. Favourable taxation including tax reduction or tax exemption on biofuels for both sides: customer and producer. Biofuels produced commercially tend to have higher costs of production compared to fossil fuels. Moreover these costs are difficult to estimate because of dependency on feedstock prices, technology and other national factors. As a consequence some countries apply zero excise duty that favours production.
2. Legislative and policy framework including introduction of the energy standards, consumption targets (facultative) mandates (obligatory), which represent minimum share in total transport fuel, and such an incentive as Green Certificates (RECs). While application of targets is characteristic for Australia, China, India, Indonesia, and Malaysia, mandates widely used in the United States and EU. The mandates program requires oil companies to blend biofuels with the diesel and gasoline regarding specific mandate. Green Certificate (REC) is a non-tangible tradable energy commodity that represents the environmental value of produced energy from the renewable source. Opposite to traditional supportive programs and policies, certificate encourages biofuel use by providing subsidy for its production. Depending on the market, RECs could have a significant impact on the competitiveness (Osterkorn & Lemaire, 2008)
3. Specific credit lines with favourable conditions that attracts investments into the industry and other forms of financial incentives, including preferential loans and subsidies (Rajagopal & Zilberman, 2007). De Gorter and Just proved in their study ("Water" in the U.S. bioethanol Tax Credit and Mandate", 2008) that combination of the tax credit policy, which works as direct subsidy, with binding mandate is favourable not only for biofuel producers but also for consumers due

to lower price offered. However, if the tax credit is the only obligatory policy established, it does not benefit to the buyer;

4. Direct investments in R&D, technology and biofuels sector;
5. Trade measures, import tariffs in particular;
6. Well-developed infrastructure (transportation, water and electric systems, fuelling stations, etc.);
7. Intentions to stimulate biofuel production efficiency and development on different levels of marketing and supply chain (Blanco et al. 2010). For instance supportive measures in agriculture and encouragement of local farmers;
8. Existence of big experienced players on the market that have resources to invest in technology and promotion of biofuels;
9. For liquid biofuels technologies in the automotive and car industry are crucial. Vehicles, with the engines suitable only for standard-grade fuel, are relevant only for fuel blends with maximum 5% of biofuel. This is sufficient in the early stage of biofuel development, however for further development there is a need for implementation of modifications in engines and usage of higher blends;
10. The capability to create a long-term strategy and accomplish it by continuous development.

2.1.USA

Governments in United States provide various types of support policies on different levels, beneficial to biofuels and renewables in general. Nowadays US policies include mandates along with tax credits, preferential loans and funding of R&D as well as construction of bioplants. Diversified government initiatives have substantially contributed to the leader status in production of bioethanol for the last 5 years: United States along with Brazil, jointly accounted for 85% of global bioethanol production nowadays (Renewable Fuels Association, 2015)

The USA had already started establishment of biofuel policies in 1978 with Energy Tax Act which established tax exemptions and subsidies for a bioethanol blending in gasoline. In 2004 the excise tax exemption was replaced by tax credit for bioethanol and biodiesel that had been extended afresh in 2014 and currently presents the largest subsidy to biofuel producers (RFA, 2016). The main biofuel credit at the moment is The Cellulosic

Biofuel Producer Tax Credit, which allows producers of fuel that was extracted from specific types of cellulose to receive $1.01 per gallon back as a tax credit. In the recent past it was also extended to algae fuels, and of $1 per gallon for biodiesel. Moreover tax credit can be passed further to the consumer in a form of lower price.

Besides, Energy Policy Act initiated binding mandates in 2005. The first renewable fuel volume mandate was introduced by Renewable Fuel Standard program (RFS) and determined the minimum volume use of biofuel in the sector of transport. Since then, the mandate was expended twice: adding the biodiesel mandate along with raising the required annual use of biofuel in transportation to 9 billion gallons in 2008, growing to 36 billion gallons in 2022. In order to contribute to an expansion of the second and higher biofuel generations, mandate for 2022 establishes the requirement of a minimum 22 billion gallons for advanced biofuels and limits conventional biofuels to maximum of 15 billion gallons.

2.2. Brazil

Brazil was one of the first countries, which have developed sustainable biofuel economy. First policies, supporting bioethanol production, pioneered as early as 70s in National Bioethanol Fuel Program (part of National Alcohol program - Proalcool) in response to oil crisis. Proalcool back then was the world's largest program promoting alternatives to traditional fuels and obliging the use of bioethanol extracted from sugarcane. Expansion and development of bioethanol industry in Brazil is a result of successful bioethanol Fuel Program implementation that led the country to the worldwide second place in bioethanol production (7,093 Millions of gallons in 2015).

Since 90s till nowadays the government of Brazil does not control bioethanol sector directly nor over the production volume, nor through price settlement, but manages regulation over mandates and tax benefits. Since 1977 government employs bioethanol use binding mandate, which was renewed lastly in March 2015. The new blending obligation settles higher bioethanol share – 27% instead of 25%, but the increase is mandatory only for regular gasoline, conditions for premium gasoline don't change. Tax incentives for bioethanol fuel include tax reduction of Contribution for Intervention in Economic Domain (CIDE), Contribution to the Social Integration Program (PIS) and Contribution for Financing Social Security (COFINS) to zero and tax credits. Tax credit of 0,3% for bioethanol exporters was applied from 2014, what cheapens Brazilian export and partially pays a

devaluation of an exchange rate. In 2015 the government in several states of Brazil raised Tax for Circulation of Goods and Services (ICMS) on gasoline whereas reduced it for bioethanol what encourages its consumption. Besides for flex-fuel vehicles tax burden is usually lower in comparison with fossil fuel powered cars. Import tariffs were cut to zero from 2010 till nowadays. What's more National Bank for Social and Economic Development (BNDES) offers special credit lines for bioenergy sector as well as bioethanol industry to finance investments into production capacity enlargement and supply chain.

The development and expanding of Brazilian biodiesel market have been started much later then bioethanol, however government pays a lot of attention to promotion of biodiesel. First 2% biodiesel blending target was introduced in 2008 and current obligatory mandate already reaches 7%. As opposed to bioethanol, import tariff for biodiesel is fixed at 14%. The taxation of biodiesel is also more complex and depends on the feedstock, size of producer and region of production. Earlier in 2014 Brazil introduced advanced biofuels to the market, nonetheless due to expensiveness of the technology and enzymes used, the large scale production seems to be unrealistic yet (Barros, 2015).

2.3. EU

In a drive to cut emissions of carbon dioxide, the European Commission came with the Directive 2009/28/EC, which promotes different types of renewable energy sources including biomass. The Directive settles mandatory targets for each country for the share of renewable energy in overall energy consumption and separately in the sector of transport. Furthermore along with Fuel Quality Directive (FQD) it lays down the criteria of a sustainable production of biofuels and bioliquids. Members States are obliged to follow a roadmap and met a target of 27% share of renewable energy from final energy consumption by 2030. The Commission has highlighted need for a focus on advanced biofuels and no public support for a food-based alternative energy sources (European Commission: 2030 Energy Strategy, 2016). According to the Directive 2003/30/EC and Directive 2003/96/EC, entities, that use blends of biofuels in fossil fuels, can apply exemption from EU's minimum excise tax during 6 years period. Moreover Member States can settle national tax benefits separately after EU approves their incentives.

The EU had been producing 90% of the world's biodiesel before 2005. Regardless the fact that USA and Asian producers entered the market followed by decline in the European share, EU stays the world's biggest producer and consumer of the biodiesel.

2.4. China

China has recently become one of the global leaders in production of biofuels and ranks on a third place in production of bioethanol after US and Brazil. Biofuels market development is mainly driven by the goal of GHG reduction since China is world's largest emitter of GHG . According to Statista portal, China contributed to 28,3% share of global energy-related CO2 emissions in 2015.

Chinese biofuel policies are focused on supporting non-grain based biofuels due to the risk of possible grain shortage and China turning into a net corn importer. The government had set its current ambition in 2014 under National Climate Change Plan (NCCP). It had become already 13th Five Year Plan launched later in 2016. The plan settles emission and clean energy targets for 2020 including reaching 130 billion cubic meters of biofuel production by 2020 (approximately 34 trillion gallons). However the target seems to be unrealistic due to the current volumes of production and it stays uncertain how Chinese government plans to achieve the goal (Su &Zhang, 2015).

China, similarly to US, adopted bioethanol blend mandate (E10) in its 6 provinces: Heilongjiang, Jilin, Liaoning, Henan, Anhui, and Guangxi. Meanwhile the price of bioethanol is fixed by the government at 91.1% of the gasoline ex-factory variable price. However government does not have an incentive to determine E10 as national binding mandate in the nearest future because of its aversion to grain-based biofuels and lack of alternative feedstocks. Another unfavourable condition for domestic biofuel production is no tax benefits, it is charged by five% consumption tax. In 2012 China cut off import tariffs for bioethanol with selected countries and keeps free trade agreement (ten ASEAN countries plus Pakistan, Chile, Singapore and Vietnam). For other countries the 5% tariff is applied.

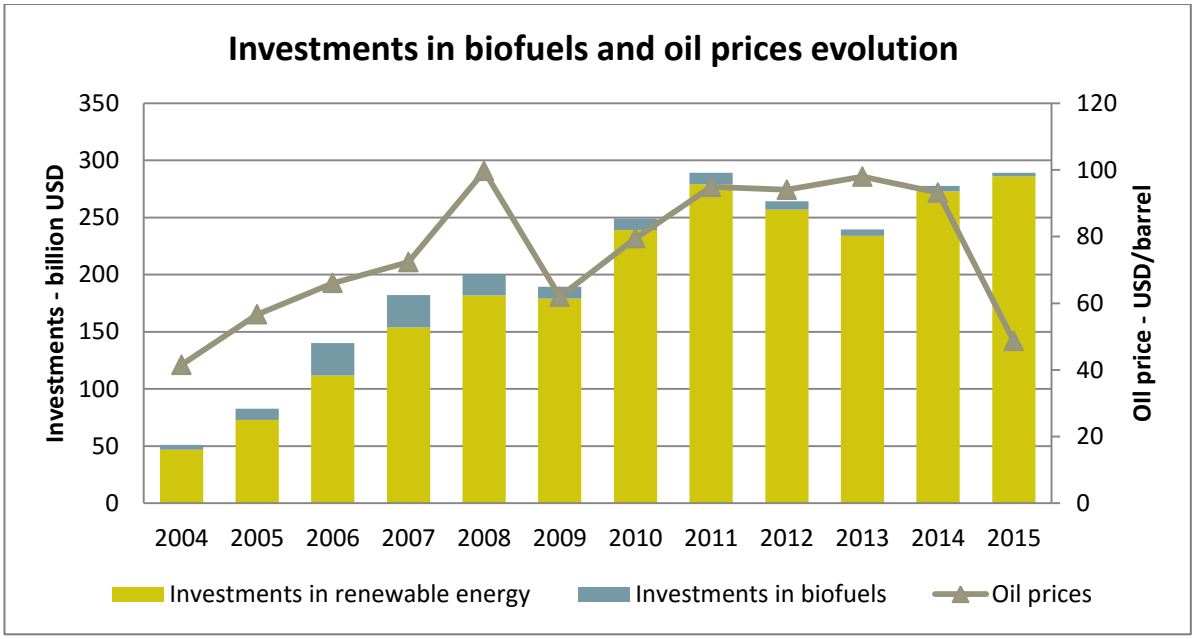
On the opposite side, Chinese production of biodiesel is currently very limited even though there is constantly growing demand for it (Caleb O'Kray & Kang Wu, 2010). The government efforts to support its production have form of exemption from excise duty.

Nonetheless no mandates were established so far and only a few biodiesel plants managed to stay in business, many of them became unprofitable.

2.5. Current trends on global biofuel market

While countries all over the world are working on the development of sustainable biofuel economies, each for their own reasons, United States and European Union are debating about impacts of 1st generation biofuels on the environment. The argument of the negative influence from conventional biofuels on food supply, biodiversity, land use and water was especially in the center of attention after world's food price crisis in 2007-2008. Meanwhile unpublished report from the World Bank claims that, food products could cost up to 75% cheaper, if not production of biofuels (Chakrabortty, 2008). Nonetheless concerns about conventional biofuels led some governments to revise their ambiguousness and targets for next years and shift focus onto advanced biofuels.

After series of challenges facing biofuel's market including mentioned food crisis and rise of feedstock prises, it is necessary to mention current lower oil price environment and its impact. The recent drawdown in oil prices to five years minimum was the last negative influence on global renewable industry in the recent years. As shown in the Graph 2 below: investments into biofuels have followed decreasing trend for the five years, from 10.3 billion USD in 2011 to 3.1 billion in 2015. However the biggest slide in the investments took place in 2015 caused by drop in oil prices. Investments had declined by 34% in comparison with the previous year and reached only 1% shares in the total renewable energy investments. According the Medium-Term Renewable Energy Market Report (IEA, 2015) the negative effect on the sector of biofuels seems to be overestimated in comparison with reality. Oil usage in energy production is quite limited in the power sector, but utilization in transport and for renewable heat extraction is the same as biofuels. This makes them competitors in latter. The interest in biofuels depends more on the government's leaning towards strengthening legal support and market's structure in this industry.



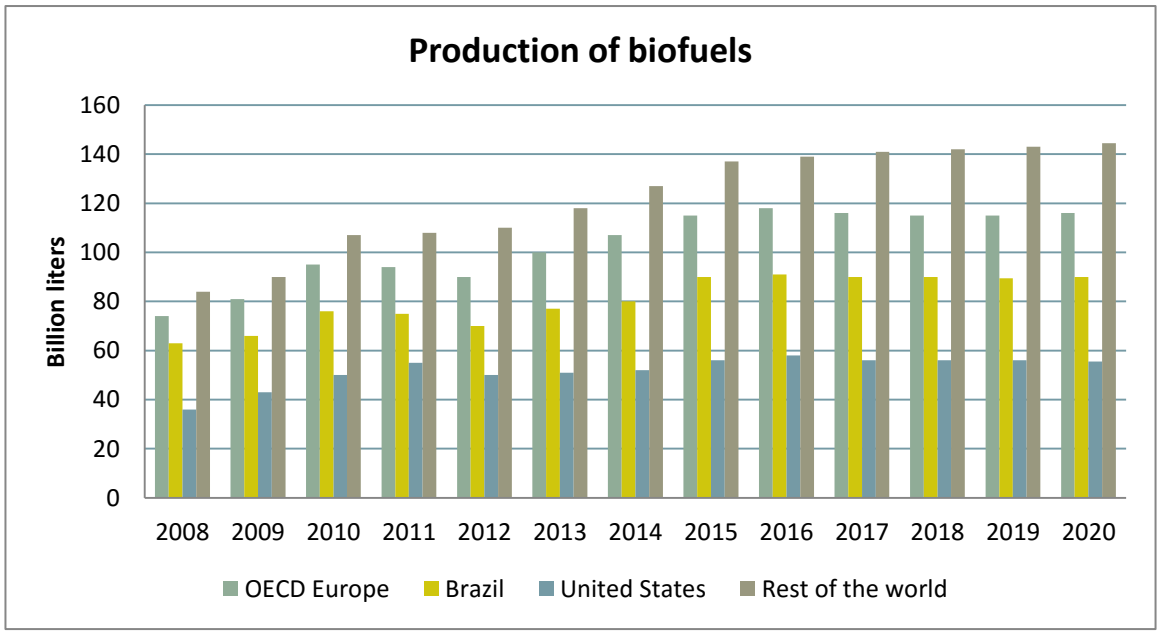
Graph 2: Investments in biofuels and oil prices evolution 2004-2015
Source: UNEP, 2016; Statista, 2016; EIA, 2016

Mandates and government's policies in general have evolved in the key markets over recent years. Brazil has raised both biodiesel (7%) and bioethanol (27%) mandates as was mentioned earlier in the paper. To support local producers, governments of Argentina and Indonesia decided to increase the blending mandate for biodiesel up to 10% as well. Actually drop in oil prices partially have had a positive effect on biofuels, because of fossil fuel subsidies abolishment in several countries. Meanwhile there are still risks challenging the biofuels growth. Potentially continued low oil prices conditions will place development of biofuel's policies under critical observation. The industry has already dealt with structural obstacles in stagnating bioethanol demand in the United States; meanwhile EU announced 7% cap on the first generation biofuels share in the 10% target for RES used in transportation for 2020.

The biggest challenge facing biofuels nowadays is shortage of investments into research and development of new generation technologies (Bland, 2015). Especially it concerns the feedstock, whether food or non-food based. The amount of feedstock for biofuels is normally 15-20 times lower than is required for chemicals production. Therefore the aim is to produce with low costs with secured feedstock supply (Bari, 2014). This area requires extra attention from the technology developers in the nearest future and we could already see some of them going out of the business. Recent example was BP's announcement

in 2014 to halt cellulosic bioethanol business and sell out its related assets. Strategic decision was made after investments over $750 million since 2008, pushed by the challenging external environment of low oil prices (Tullo, 2014).

However International Energy Agency in its Renewable energy medium-term market report (2015) estimates biofuels production for the next four years to remain stable, see Graph 2. In 2015 worldwide production had achieved the slowest growth rate of 0.9% since 2000 (BP Statistical Review of World Energy, 2015). But despite low oil prices, blending mandates hold biofuels consumption and production on the same levels in the sector of transport. In this regard production of biofuels did not experienced noticeable drawdown even in 2014: biofuels contribute to 4% of global road transport fuel and production volumes reached 127 billion litres. The forecast for to 2020 remains 144,5 billion litres and biofuels growth is expected to reach 4,3% share in transportation.



Graph 3: Production of biofuels and forecast to 2020

Source: Renewable energy medium-term market report, OECD/IEA, 2015

In line with the industry prosperity, forecasted by OECD/IEA, the majority of biofuels growth is foreseen to come from Asia and South America regions, which are still enthusiastic in asserting volume targets. The situation on biofuel market in America and Europe is quite different. Consumption there is motivated by legislation, which is continuously changing. And uncertainty about future changes in the policy framework brings much higher risk for renewables in general. There is still a room for strengthening the policy

support, which is also risk prone to decline in oil prices. Therefore for these markets, it is vital to clarify the energy strategy and develop sustained long-term policy commitment, which brings confidence in future investments and secures growth in biofuels industry (Bland, 2015).

3. Russian Federation: an overview of biofuel policies

While in the developed countries biofuels slowly but surely replace traditional fossil fuels, Russian economy does not move in in line with the development of this global emerging industry. It is commonly known, that Russian Federation is the largest natural gas exporter as well as the second biggest producer and exporter of crude oil. Besides it has huge renewable energy sources. However mainly due to the huge reserves of traditional energy resources and no obligations established from Kyoto's protocol on reducing CO2 emissions, the development of the renewable energy policies and incentives, especially in biofuels industry has been given very little attention. This is despite the fact that Russia is one of the Top 5 biggest emitting countries with the share of 5% in 2014 (Trends in global CO2 emissions: 2015 Report). Moreover, for the last four decades, the average year-round temperature in Russia has increased by 0.04°C per year, more than twice the global average. While climate in Russia is getting warmer, it is also getting rainier: every decade the annual average rises by 2% (Katona, 2016). Even though the solution of environmental problems is not the government's priority, the current consequences of Russian apathy force changes in the approach to the environment.

Table 2: Russian Federation key indicators 2015

Population (millions)	143.82
GDP (billion 2015 USD)	1326.02
Energy production (Mtoe)	1305.68
CO2 emissions from fossil-fuel use only (Mt of CO2)	1467.55

The situation had changed in 2006, moved by the need of energy sources diversification and new opportunities for agricultural commodities. Participation in the global development of advanced technologies, the desire to improve the energy efficiency and international cooperation – these and other considerations pushed Russia to development of low carbon economy and green energy support.

Table 3: Biofuels in the balance of the total primary energy supply (TPES) in Russia

Supply (ktoe)	2007	2008	2009	2010	2011	2012	2013	2014
Liquid biofuels	0	0	0	0	0	0	0	0
Primary solid biofuels	3757	3159	2902	2948	3023	3180	3025	2762
Industrial waste	2920	3074	3466	3996	4066	4254	4208	4311
Biofuels and waste*	6676	6233	6368	6944	7089	7434	7233	7073
Biofuels and waste, % of TPES	1.0%	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
TPES	672590	688464	647001	688397	721871	739925	728818	710883

*Total primary supply of biofuels taking into account stock changes and net export
Source: IEA, 2016

Since 2006, numbers of government incentives in promotion of biofuels have been established on federal level as well as in selected regions with highest production potential that are rich with the feedstock. Based on the International Energy Agency (IEA), estimated share of biofuels in the total primary energy supply (TPES) in Russia is 1% in 2014 with zero contribution from the liquid biofuels (see Table 3). Throughout last 7 years percentage of biofuels has never achieved higher level than current. Volume of bioethanol and biodiesel produced in Russia is meagre. According to the GAIN report, biofuels correspond to 5% of heating energy and 1% of electrical power (2016). Apart from IEA/OECD data represented in the table above, there is no official Russian statistics providing the exact number of produced biofuels or available data from the different sources contradict with each other.

3.1. Feedstock potential

The potential sources for renewable energy in Russian Federation are vast; however their usage is very poor. As reported by the Federal Forestry Agency: biomass production is the main alternative for developing biofuel sector. The second largest, after hydro energy, source of renewable energy is biomass and waste. Estimated volumes of biomass, accessible for bioenergy extraction contain 800 million tons of wood, 250 million tons of agricultural wastes, 70 million tons of wood wastes from forestry and pulp and paper industries, up to 60 million tons of municipal solid wastes and 10 million tons of sewage wastes annually. From these sources could be produced 70 Mtoe of biogas (120 billion m3) and 21- 28 Mtoe of ethanol per year (IEA, 2003). In the table below are given technical, economic and gross potentials of RES in Russia excluding potential from energy crops. Gross potential is total

volume of available renewable sources for further production of biofuels. Technical potential corresponds to part of the gross potential, which can be productively used based on the known technologies, social and ecological factors. And economic potential represents part of the technical potential, which utilization is economically adequate considering current fossil fuels prices, heat and electricity, equipment and materials, transportation and wages. However, nowadays the economic potential is expected to be lower, taking into account current low oil prices environment. The biomass utilization in the energy balance is extremely low and corresponds to only 1% from the total primary energy supply (Strukova, 2008).

Table 4: Potential of biomass energy sources in Russia

Indicator (million tons of coal equivalent per year)	Gross potential	Technical potential	Economic potential
Biomass energy	10 × 103	53	35
Share of biomass in TRES potential	0.4 %	1.2 %	12.8 %
Total Renewable energy sources	2.34 × 106	4593	273.5

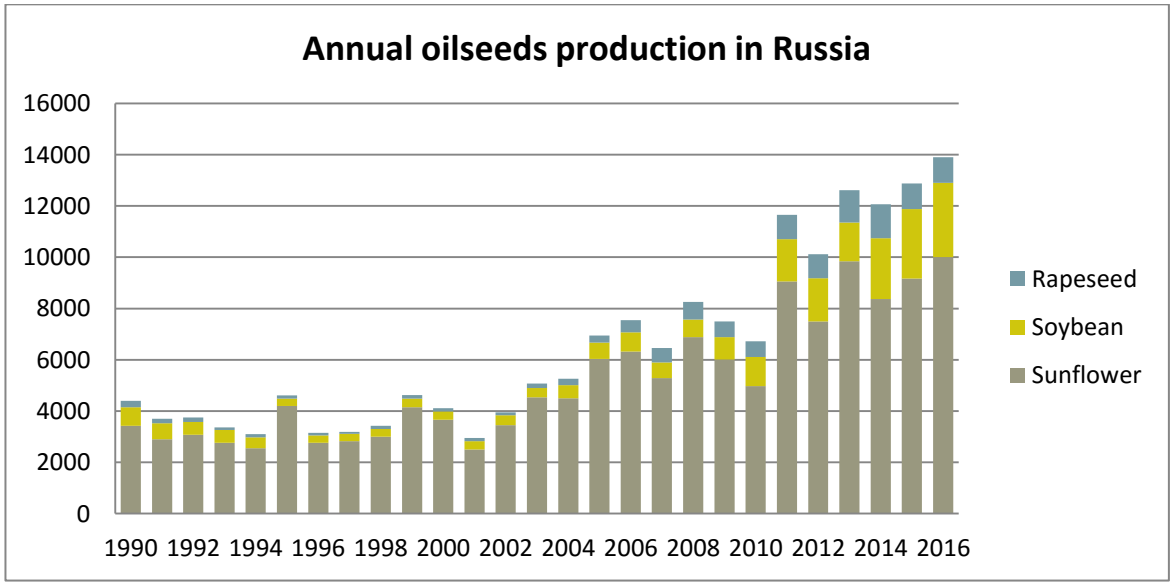
Source: “Renewable energy in Russia: from opportunity to reality”, OECD/IEA, 2003

Particularly attractive region for production of advanced biofuels from lignocellulosic material is north and north-west of the European part of Russia. The region focuses on the timber and pulp and paper industries because of its rich forest resources. These industries are big potential suppliers of biomass wastes as well as potential users of biofuels for their own needs. In Finland, where the climate and resources availability are similar to the north European part of Russia, lignocellulosic fuels extracted from wood have 20% share in the total energy consumption. The development of biofuels utilization from wood wastes would increase energy security and reduce costs in the mentioned industries (IEA, 2003). Nonetheless the availability of wood resources is restricted by number of obstacles such as problematic transportation, outdated technical equipment and the remote access to domestic and foreign markets (Pristupa, 2010).

Availability of arable land brings opportunities for sowing of energy crops, which was not taken into account in the table above. The main potential feedstock for bioethanol production in Russia is grain. In 2016 Russia harvested the record volumes of wheat in the recent years - 62.03 million tons, up 32% from the same period of last year (Demaree, 2016). Total grain yield in 2016 was about 110 million tons; meanwhile the storage capacity is only

120 million tons, which is distributed unevenly with the manufacturing. In 2015 30 million tons of grain was exported and large portion of it goes to feed animals or bioethanol production in Europe (Ministry of Agriculture Russia, 2016). The wheat export is expected to rise due to the government's incentives to lift the export duties. Therefore excess of wheat won't contribute to the stimulation of bioethanol production but it will be exported. By 2030 the grain yield should increase by 30% approximately compared with the current amount. That figure is based on the Grain market development strategy until 2030 from the Russian Ministry of Agriculture (Ministry of Agriculture Russia, 2015). Nonetheless increases of the grain yield will not necessary change the situation with bioethanol production. The growth in the volumes of grain could be consumed by the expansion in livestock (growth of livestock in first half of 2015 reached 5, 2% in comparison with the same period 2014).

Besides there is huge capacity for the production of ethyl alcohol which is not fully utilized and could be used for production of bioethanol (Karpov, 2007). According to Baklanova (2007) about 190 plants are operating only at two thirds of their capacity and have obsolete technical equipment. Even though Russia has already long-term experience in the production of ethanol by hydrolysis technologies, the scientific knowledge base along with technologies are yet obsolete in spite of current continuously developing global biofuel industry (Pristupa, 2010).



Graph 4: Annual production of crops for biodiesel extraction in Russia
Source: United States Department of Agriculture, 2016

The main source of the feedstock for biodiesel production in Russian Federation is the same as in Europe - the rapeseed; it is prevalent in the Volga region, Central and Siberian Federal districts. Potentially up to 5,5 Mt of rapeseed oil could be annually produced in Russia, from what 0,5 Mt can be directed to satisfaction of all food needs, 2 million tons to be exported in the form of methyl ester and the rest is for domestic biofuel production (based on the draft of Russian Federal Law "About the development of production and consumption of biofuels", 2014). Graph 4 below shows production of oilseeds from potential feedstock in the country. Last six years were successful for all three potential feedstock crops. Meanwhile Russia exports more than 60% of rapeseed oil annually. In the 2014/15 season 240 kt were exported (from 365 kt produced), less than 337 kt (495 kt produced) in the previous year. Biggest consumers of Russian rapeseed oil are Norway, Lithuania and China (UkrAgroConsult, 2016).

3.2. Russian incentives in the biofuel industry

3.2.1. Energy strategies

After dissolution of USSR in 1991 Russia started to work out on drafts of long term energy policy. Concept of the new energy policy appeared first in 1992, followed by Main Directions of New Russian Energy Policy till 2010 submitted in 1995 and Main provisions in the structural reform of natural monopolies in 1997. After these documents, in last decades there have been formulated and approved 3 official Energy Strategies for the periods until 2020, than 2030 and last one till 2035. Between 1995 and 2000 a few policy documents were formulated, which for the first time have acknowledged renewable energy sources; nonetheless the priority was addressed to attain stability in mining of fossil fuels. Moreover as a result of poor functioning of the whole economy during last decade of the 20th century, many goals had not been accomplished (Russian Energy Survey, 2002). Overall, promotion and developing of renewables sector was not a country's priority in 90s, while the privatization took place, including oil and gas companies.

The most important is that Russian strategies do not have aspect of direct actions; however they include guidelines and highlight priorities for further development. Thus it is necessary to review the documents regularly. Appropriate changes are supposed to be

implemented every five years in order to cover new trends, technologies and challenges in the economy and the energy complex.

Russian Energy Strategy till 2020

In 2003 Energy Strategy (ES) was approved for the period up to 2020, which reflects both the new economic program and the restructuring of the economy. Therefore considering fiscal and price reform, the strategy depended on the successful fulfilment of Economic Development plan from the Ministry of Economic Development and Trade.

The main objective of the new strategy was achieving a qualitatively new status of fuel and energy complex, increasing the competitiveness of its products and services on the global market and formation of adequate policies, taking into account forecasted results of its utilization. For the above listed purposes, the document indicates the projected role of renewable sources of energy including biofuels.

The strategy outlines strategic goals regarding development of renewables as reducing the consumption of traditional fossil fuel (oil and gas), minimazing the environmental strain from fuels and energy field activities, and securing the reliable and sustainable biofuels supply to remote regions along with reducing costs on imported fuels. Meanwhile the strategy examines only few of biofuels as an alternative to traditional fuel; particularly it indicates peat and firewood as most favourable. However utilization of peat produces higher GHG emission than natural gas, crude oil and coal depending on the energy generated. Framework Convention on Climate Change of United Nations treats combustion of peat in the same way as combustion of fossil fuels, based on its negative impact and amount of GHG emissions. Firewood was also estimated as very demanding fuel, based on the fact that it is used by more than 5 million families in Russia. Thus its demand is far above the production level. Therefore the strategy rather inadequately concludes guidelines to overcome the Russian backwardness in development of RES. The document infers that the important aim is to secure the state support for creating enough reserves of peat and firewood, what seems laggard, considering set up objectives. Nonetheless strategy also acknowledges the need for new legislation on renewable energy sources.

Altogether Russian Energy Strategy till 2020 not only doesn’t set up certain targets and roadmaps in the RES sphere, but also doesn’t acknowledge more progressive biofuels

such as biodiesel, biogas, bioethanol etc. In consequence the lack of the legislation base as well as guidelines for further development of RES did not attract required investments into this sector.

Russian Energy Strategy till 2030

In 2009 Russian Parliament approved new Energy Strategy for the period until 2030, which was triggered by the remarkable changes in the external indicators of energy sector. In particular: rise in oil prices from 27$ US to 94 per barrel during first 5 years of implementation, which was 4 times higher than projected parameters. Although, the global economic crisis 2008-2009 returned most of the indicators back to the forecasted levels, it pointed at the need to take into account higher possible fluctuations in the variables. The new guidelines of the Energy Strategy were influenced by the "Conception of Long-Term Socio-Economic Development of the Russian Federation up to 2020" affirmed in November 2008 and that supposed to help the economy follow an innovative and socially oriented rout. Disregarding the consequences of crisis in 2008, the main goals and guidelines for the economy's transition to the innovative stage were established as fixed parameters (Energy Strategy of Russia for the period up to 2030, 2010).

The new strategy was planned to be fulfilled in 3 stages:

- 2010- 2015: recovery from crisis and building the foundation for the new economy. The main focus in this stage was to achieve sustainable economy and energy sector development including renovation and modernisation of the Russian fuel and energy complex.
- 2016- 2022: stage of transition to innovative development and establishing the infrastructure of the new economy. Dominant role is increase of energy efficiency in energy complex as well as in the whole economy, resulted by fulfilling the objectives of the first stage of this Strategy.
- 2023- 2030: phase of the development of innovative economy and accordingly the gradual transition to the highly efficient usage of traditional resources and new no-hydrocarbon energy sources.

Certainly the new strategy provides bigger role to RES in comparison with the old Energy Strategy until 2020. The total investments projected to the sector of renewables

during 3 stages reach around 124 billion USD. It is approximately 5% from all investments planned for the Strategy implementation. The target set up for the RES is to attain during first stage 0,3% in the total energy balance, 0,7% in the second phase and 1,4% till 2030.

Table 5: Investments of Russian Energy Strategy till 2030 (in billion USD)

	Phase 1	Phase 2	Phase 3	2009-2030 Total
Renewable energy	7-9	24-28	82-97	113-134
Total for the Strategy Implementation	534-554	516-665	1.308-1.552	2.366-2.765
Share of RE investment (%)	1.5 %	4.4 %	6.3 %	4.8 %

Source: Russian Energy Strategy till 2030, 2010

Based on the document, the Strategy also settles the objectives for non-carbon energetics, which, apart from hydropower stations and nuclear power, contains renewables (wind, solar, geothermal, hydro and bioenergy). The forecasted percentage of non-carbons in the energy balance will rise to 4% during the implementation and reach 14% in 2030. Therefore this target incorporates 1,4% from RES, however main contribution will be made by expansion of hydro- and nuclear energy. Meanwhile the document observes electricity generation maintained from the renewables including projected targets and roadmaps for its fulfilment. Specifically, forecasted electricity production from RES will increase from 1,5% in year 2010 to 8% in 2030. The revised Strategy also includes the expanding of the production and usage of different types of biofuels, produced from biomass as one of the objective to deal with on the path to innovative policy in energy sector. Nonetheless, this ambition will take action only in 3rd stage of the exertion and is not supported with certain quantitative goals or guidelines for its fulfilment. In this regard biomass isn't supposed to play influential role in energy complex.

As reported by the professor Bushuev, who was working on the creation of all three Energy Strategies, the scenario of the strategy up to 2030 was too optimistic, thus it proved to be unrealistic. In reality the stagnation of global economy dragged, what affected low level of energy demand. Over and above the forecasted development needed additional analysis and substantial revision due to geopolitical crisis began in 2014, which entailed financial, technological and other sanctions against Russia along with deep and continuous fall in oil prices on the world market. These and other events had affected a fracture of several long-

term trends in global development and the beginning of a new phase of deteriorated competition for resources and markets. In this regards, priorities, objectives, projected scenarios and implementation indicators of the Energy Strategy until 2030 were adjusted into the draft of the new strategy.

Draft of the Russian Energy Strategy till 2035

The draft of the Energy Strategy until 2035 had been created in 2015 during difficult time for Russia. And the role of the energy sector became questionable considering the further development of the country. The new ES revised objectives and guidelines of the development of Russian fuel and energy sector and it is aimed to support the evolution from the "resource-extraction" to "resource-innovation" stage, including energy sources diversification, technological growth and reducing barriers in the infrastructure.

Based on the document, the projected structure of domestic consumption is supposed to be relatively stable (in terms of gas and oil consumption) with small decline in solid fuels (2,5- 3%) that will be compensated by non-carbon sources (RES and nuclear power). The updated Strategy implementation is divided into 2 stages: first stage roughly until 2020 (with possible extension until 2021) and the second approximately from the year 2021 up to 2035. The production forecast for non-carbon sources assumes a rise for 12% during the first stage of implementation in comparison with the base year and for 65% during the next stage (2014 was settled as the base year).

The blueprint of the next Strategy pays much more attention to the electricity generated from renewables. The electricity growth in production from power plants based on RES is set on 10-14 times higher than in the base year. Although the biogas installations are mentioned, the growth would be mainly affected by development of solar and wind energy resources. Among that, the local fuels (peat, municipal solid and wastes from the wood production and agriculture) are highlighted as promising sphere, especially their utilization in the remote areas of Russia.

The objectives determined in ES till 2035 are: introduction of new generating capacities based on the RES and development of scientific base and advanced technologies in this sector. Yet again the revised draft of the new strategy does not consider more advanced biofuels as a part of energy balance and their contribution to further growth of the RES. The

fulfilment of all incentives of the ES will require total investments in the amount of US $2550 billion roughly. And the volume of investments particularly into RES in final stage is projected to be 5-7 times higher than in first stage. The share of renewable energy financing from the total investments into the strategy will increase up to 10-12%. In conditions of geopolitical crisis the chances to attract foreign investments for Russian companies became prominently lower. Thus the main sources of investments are planned to be companies own funds and loans.

There are formed two forecasted plans in order to evaluate prospects of further development: “conservative” and “target” scenarios. The conservative scenario takes into account US and EU sanctions of 2014 against Russian banking and energy sector and assumptions about fall of oil “Urals” (main product of Russian export) down to US $55/Bbl. in 2015. The growth of Russian economy was expected to be moderate, on average 1,9% annually till 2035. Meantime the target scenario presumes using maximum potential from energy complex in order to accelerate economic growth, followed by optimistic forecast regarding global demand and oil prices. In the process of developing scenarios numerous risks were reviewed and analysed, including increasing of competition on global energy market, limitation of access to key technologies and markets in the energy sector, a sharp decline in the prices of hydrocarbons and the uncertainty about their future dynamics, and slowdown of Russian economy. The document claims that in case the internal and external risks would not allow accomplishing of the target scenario, it still be possible to run the conservative scenario.

Although the revised draft of the strategy offers two possible scenarios of the strategy implementation and it considers various risks, it still looks quite optimistic, considering the real dynamics in the economy. In 2015 the average decline in GDP growth reached -3,7% (Trading Economics, 2016). Furthermore, forecasted “Urals” oil price in the conservative scenario turned up to be far away from the actual number, which was US $29,69/Bbl. in January- February 2016 (Minprom, 2016). Not only reality does not allow employing the target scenario offered in the draft, but also the fulfilment of the conservative plan became uncertain. In this regard it is understandable, that new version was not approved yet and the draft of the Energy Strategy until 2035 is about to be revised.

Despite all Energy Strategies documents analysed, none of mentioned programs and projects, aimed to develop biofuels sphere and RES sector in general, is not accomplished.

3.2.2. Legislation in the Russian sphere of biofuels

Nowadays bioethanol is not used in Russia for production of biofuels since it is highly expensive in comparison with gasoline. In fact 80% of Russian ethanol is used to make alcoholic beverages (Medvedkova & Trudajeva, 2013). An excise tax on bioethanol, as on alcohol-containing liquid, reaches 102 RUB ($1.62) per litre, what represents approximately 90% of its production costs and is three times higher than current average price of gasoline (37-38 RUB/liter in April 2016). In addition, ongoing legislation does not provide a definition of bioethanol; in this regard it does not allow introducing specific governance of its turnover.

First attempt to change the ongoing taxation was part of the federal target program "Energy-Efficient Economy" in 2006. The draft legislation, offered by number of deputies in Russian Parliament (Duma), supposed not only lift the excise tax but also ease the regulation on biofuels blends with less than 10% of ethyl alcohol. This initiative should make bioethanol more attractive for alcohol producing factories. After all, due to upcoming national elections and the change in Duma, the draft had not become a law (USDA, 2007).

For many years Russian bioethanol supporters have been lobbying for the reduction of excise tax that hinders development of the industry. Meanwhile government has not been ready to make a controversial decision with a risk of increase in production of vodka under the guise of bioethanol. The consumption of alcohol is a big problem in Russia, especially in the conditions of unstable economy after the recent crisis and weak ruble. Recently the initiative to reduce an excise tax on bioethanol became an objective of amendments in Federal Law №171, regulating the production of bioethanol, which should come into force in 2017. Ministry of Economic Development supported the idea of differentiation of the bioethanol and bioethanol as motor fuel as separate products. Thus the excise tax for the biofuels containing alcohol is expected to be cancelled in 2017 (Infobio, 2015). The aim of the changes proposed for the Federal Law №171 is to create favourable environment for the development of bioethanol and motor fuels with the addition of bioethanol. The draft introduces the definition of bioethanol as an alcohol-containing non-food product and excludes it from the Law №171 force. Moreover the new act will repeal the floor for

bioethanol prices and contribute to resolving obstacles for companies planning to produce bioethanol in Russian Federation. As reported by the Russian Biofuels Association, realization of the Federal Law №171 would increase bioethanol production potential to 2 million tons. Besides the potential for utilization of bioethanol in E95 blends with fossil gasoline would rise up to 5%. Nonetheless the document has not been approved so far and taking into account previous experience in the similar projects, there is a possibility that the amendments won't be finalised.

Standardisation of biofuels

Earlier in 2009 standard had been developed that introduces key definitions and terminology in the biofuel sector (GOST P 52808-2007). However first technical standard for motor fuels with addition of bioethanol was already developed in 2002 (National Standard GOST P-51866- 2002), which permitted the mixture of gasoline with 5% of bioethanol. Next followed standard in 2004 that is applied to liquid motor fuels containing bioethanol from 5% up to 10% (GOST P 52201- 2004). Nowadays new interstate standard on bioethanol is being developed; it is based on the ongoing GOST 53200-2008 and settles the technical specifications, taking into account:

- The draft of amendments into Federal Law №171 about turnover of ethyl alcohol;
- New editions of foreign standards on bioethanol (ASTM D 4806-2014, EN 15376-2014);
- New Russian and interstate standards on test methods of bioethanol;
- Proposals from bioethanol producers, consumers and technical experts.

Regarding biodiesel: the technical standard allowing blends of 5% biodiesel with conventional fuel was authorized already in 2005 (GOST P 52368- 2005). Nonetheless, technical standards do not obligate to use a mixture of a gasoline and bioethanol or biodiesel blends.

3.2.3. International collaboration

Earlier in 2005 Russian Ministry of Economic Development and Trade along with World Bank cooperated on the "Russia Sustainable Energy Finance Program" (RSEFP). The program is subsidized by Russian Government, International Finance Corporation on behalf of the World Bank and the Global Environment Facility. The initiative was to increase the

capital flow to energy efficiency programs from Russian financial institutions and deal with main obstacles for the further development of renewables:

a) Institutional barriers: the shortage of legislation abutment, inefficient regulations in the field of environmental regulations, insufficient presence of private sector in the power and heat producing sectors, rigidity of municipalities etc.;

b) Information barriers identified as lack of information available regarding RES in general;

c) Financial shortage of domestic as well as foreign investments; high transaction and preparation costs of project along with the inadequacy of conditions for long-term debt financing, expensive required equipment for project implementation and finally loss of competitiveness because of low prices on fossil fuels;

The project includes three main parts: technological assistance, investment support and activities focused on improvement of investment environment. The expected program's outputs are improvement of Russian knowledge base, development of framework and market for the further RE growth; and investment boost into RE projects by implementation of credit lines for Russian financial organizations. The RSEFP was initially introduced as five years program; nonetheless it was extended twice till June 2012 and further to December 2012. As a result, 342 projects were financed through RSEFP with expected outcome in reduction of 559 kt of CO2 annually (Terminal Evaluation of the Russia Sustainable Energy Finance Program, IFC, 2013).

3.2.4. Local incentives

After 2006, during period of biofuel excitement in Russia, a number of local investment projects focused on production of biofuels was initiated. These intentions originated in different districts of the country and most investments were motivated by growing demand from Europe. Local utilization and derived share in demand for biofuels was insignificant, thus did not play significant role in business decisions (Pristupa, 2010).

The Russian Ministry of Energy confirms that there are no operating biofuel projects supported by Russian federal government. Most of biofuel businesses in the country are financed by regional governments or foreign investors. There is no large-scale production of bioethanol or biodiesel, except few facilities backed by regional authorities or private

companies. Majority of these projects is only at the development stage and manage to extract volumes of biofuel sufficient only for their own operation (USDA, 2016).

Currently there only four projects on production of bioethanol in Russia: only two of them are operational and others are in the stage of development. For instance Kirov "BioChemPlant" Co., Ltd. focuses on the bioethanol production from the waste timber industry, and is the only manufactory, producing bioethanol from renewable non-food raw materials. In cooperation with Russian center of science «Applied chemistry» in St. Petersburg company creates the technology for the production of the green gas - biomethane. The future production of biomethane by BioChemPlant is estimated to reach 4 million m^3. "Miranda" Ltd. is located in the Republic of North Ossetia-Alania and it is supplied by bioethanol feedstock from sugar mills in Krasnodar region. The company has production potential of 100 tons per day of bioethanol and additional products including wood pellets and plans to export to Turkey, Poland and Sweden in the nearest future.

The extraction of rapeseed oil on a commercial scale has begun only in 2007. And there is no national government program for the support of biodiesel production so far. Meanwhile regional program have been already created in 2006 in Altai region, called "Rapeseed – biodiesel". This region was chosen due to its high potential in production, which is estimated to provide 170- 200 thousand tons of biodiesel per year. Unfortunately first regional program from 2006 did not succeed, but recently in 2016 new program based on development of energy-closed cycle industrial agglomeration have been modelled (Farkov, 2016). Regional program have been also created in Lipetsk, where exists an Association of rapeseed oil producers.

3.3.Issues on biofuel production, distribution and consumption

Since the 2008 until nowadays, there were no noticeable changes and improvements on liquid biofuels market in Russia. It is similar in policy framework, where none of introduced incentives and policies have been finalized and actually came into practice. Available literature sources both in Russian and English usually lack real empirical data and in most cases contain outdated information about the development of biofuels sector in Russia, observing only theoretical potential in this area.

The development of bioethanol production in Russian Federation is currently constrained by regulation of its manufacturing and handling, namely due to standards established by federal law about the state regulation of production and turnover of ethyl alcohol, alcohol, alcoholic products and about the limitation of the alcohol consumption. The cancellation of the excise tax on bioethanol, as on alcohol- containing liquid, would be the first required step for the development of bioethanol production in Russia. Besides, for the vital grow in the industry it is necessary to build specialized plants with the high automation level, which Russia still lacks.

While production of bioethanol is not profitable in regard with high taxation, there is no such an obstacle for biodiesel manufacturing. Nonetheless no functional supporting government program does exist and delays in the collection and processing of rapeseed also hinder biodiesel industry expansion (Medvedkova & Trudajeva, 2013).

In conclusion, the main factors holding up the Russian biofuel industry expansion and finalization of initiated supportive programs are:

- Lack of functional regulatory framework that stimulates production of biofuels and their utilization on a retail market. The main reason is low prices of traditional energy sources and sufficiency of oil and gas reserves;
- Outdated technological and scientific base in the sphere of biofuels;
- High excise taxation on bioethanol as the liquid containing alcohol;
- Technical obsolescence of the equipment in the transport sector, which is not prepared to utilize such energy sources;
- Consumers market is not prepared for deep biofuels implementation, in particular absence of cars with flex-fuel engines suitable for higher biofuel blends;
- Lack of experience in the development of renewable energy projects. As a result low level of projects suitable for bank financing;

In addition the development in sector of biofuels without supporting measures in agriculture could bring risk of increase in prices of grain, corn and other crops due to rise of demand from the side of biofuel producers. Thus it could lead to the shortage of crops on the domestic market and the fall of profitability in animal breeding. Due to the August 2014 food embargo, the support of agricultural sector is major priority for Russian government. After fall of oil prices and government interventions, the ruble had been weak and extremely

volatile. This led to accelerating inflation that reached 12.9% in year 2015. Central Bank of Russia reacted by increase of key interest rate, which have been holding on at 11% since August 2015 till nowadays. Main priority of Russian government of 2016 was managing to hold the budget deficit under the 3% target of GDP. At the end of 2016 - beginning of 2017 fiscal and monetary authorities in Russia are focusing on the mid-term goal to keep inflation on 4% in 2017. Clearly, taking into account current economic condition and recent crisis, development of bioethanol and biodiesel production has paid even less attention from the government nowadays (USDA, 2016).

One of the many barriers that historically have been hinder biofuel development is strong oil and gas lobby, which productively cooperate with Russian government. The main obstacle for the development of biofuel's sector in Russia is considered significant lack of coherent policy and regulation. Creation of healthy biofuel's sector requires authorities to found a new governing body, owning adequate rights, staffed with qualified personnel and resistant to the external influence. In order to reduce the uncertainty in biofuels sphere, the government should sign up for sustained long-term policy commitment and clarify the energy strategy. These actions will bring confidence in investments into sector of biofuels and motivate the growth within industry. Until the proposed incentives are not established on the legal base, the progress in the sector of biofuels is not possible. In conclusion: according to experts, even in case of the growing support from the government, the rapid flourishing of the sector is not expected. And biofuel production in Russia will be not fully developed in the next decade (USDA, 2016; personal interview).

4. Biofuels market in Ukraine

Due to unique geographical position and the energy dependence, Ukraine plays essential role in European energy market. It became an important gas and oil transportation junction from Russia to Western and Eastern Europe. Since the gaining independence in 1991 Ukraine had gone through recession in the industrial sector, agricultural productivity as well as energy use. Despite the ongoing recovery, some industries still had been in the stage of reconstruction before the annexing the Crimea followed by war. In 2015 industrial production in the country had declined by 21,4% and the whole economy had shrunk dramatically. Meanwhile winter 2015/2016 was the first Ukraine spent without buying

Russian gas. Instead it bought gas from Europe, which was by 30% more expensive than Russian (Petro, 2016).

Table 6: Ukraine key indicators 2015

Population (millions)	42.5
GDP (billion 2015 USD)	90.62
Energy production (Mtoe)	63.95
CO2 emissions from fossil-fuel use only (Mt of CO2)	193.19

Ukraine with 42.5 million population consumes around 4.5 mt of gasoline per year. Domestic production of oil and natural gas can provide only 20% of this amount; the rest of consumed gasoline is supplied from neighbour countries or produced from imported oil. This pattern of traditional energy sources consumption is economically unfeasible and risky for energy and national security. Thus the Ukrainian energy infrastructure is defined by low efficiency and high dependence on imported energy sources. Alternative sources of energy would play a significant role in the achievement of energy and gasoline independence. Nowadays as a replacement, on the first place are considered biofuels. And Ukrainian potential for biomass and bioenergy in general is very large.

Table 7: Biofuels in the Balance of TPES in Ukraine

Supply (ktoe)	2008	2009	2010	2011	2012	2013	2014
Liquid biofuels	0	0	0	0	0	60	28
Primary solid biofuels	1711	1624	1666	1763	1738	2155	2383
Export*	-39	-57	-87	-65	-75	-340	-502
Import*						4	25
Biofuels **	1689	1549	1597	1682	1695	1879	1934
Biofuels, % of TPES	1.3%	1.4%	1.2%	1.3%	1.4%	1.6%	1.8%
TPES	134642	114536	132428	126557	122512	116140	105683

*Export of biofuels relates to solid biofuels, while import to liquid biofuels

**Total primary supply of biofuels taking into account stock changes and net export

Source: IEA, 2016

The country had already become one of the exporters of biofuel feedstock to Europe. Ukraine provides European countries with the rapeseed for biodiesel extraction and wood pellets for electricity and heat supply. Meanwhile EU is lobbying the cultivation of the

rapeseed in Ukraine as well as Russian Federation and Kazakhstan. The main reason of import of Ukrainian feedstock stays low labour and energy costs and more fertile land.

Among the former Soviet Union countries Ukraine became the most successful in implementation of the Kyoto Protocol requirements. In 2015 Ukraine submitted the implementation of Intended Nationally Determined Contribution (INDC) under the United Nations Framework Convention on Climate Change. INDC establishes the target to reduce GHG emissions by at least 40% by 2030 in comparison with 1990s levels (940 MtCO2e). However the GHG emissions in Ukraine are forecasted to increase in the nearest future to 533-776 MtCO2e despite the committed INDC level (Climate action tracker, 2015). Therefore Ukraine should revise its energy policy strategies in order to meet the targets, where supportive measures for renewable energy development will make a change. And while the share of biofuels and waste in the total primary energy supply reaches only 2% and policies are under development, the Ukrainian interest in biofuels is slowly increasing (State Statistics Service of Ukraine, 2016).

4.1.Feedstock potential

The Ukraine, same as Russia, has huge potential in biomass production, especially for first generation biofuels extraction. Main promising feedstock sources are agricultural commodities, primarily grain and corn for bioethanol, rapeseed, sunflower and soybean for biodiesel. Regarding lignocellulosic biofuels as well as electricity and heat supply, the range of feedstock sources is much larger due to high availability of agricultural residues and by-products.

The volume of biomass energy potential for conventional biofuels varies from year to year, is difficult to forecast and depends mainly on the crops harvest. Gross potential is estimated on 61 million tons of coal equivalent per year. Meanwhile technical potential reaches 40 million tons and economic potential – 28 million tons. Last five years was especially plenteous for the country in crops production, however grow of biomass energy potential was compensated by the oil prices downturn.

Every year Ukraine utilizes approximately 2 million tons of different kinds of biomass for energy production. Main contribution is made by wood wastes that represent

biggest share of 80% in annual biomass consumption. 16% of Ukrainian territory is covered by forest, mainly Carpathians and Polissia regions. Estimated volumes of wood wastes for further processing into biomass include 1.4 million m3 of felling residues, 1.1 million m3 of wood processing waste, and 3.8 million m3 of firewood annually (Geletukha, 2006, 2013).

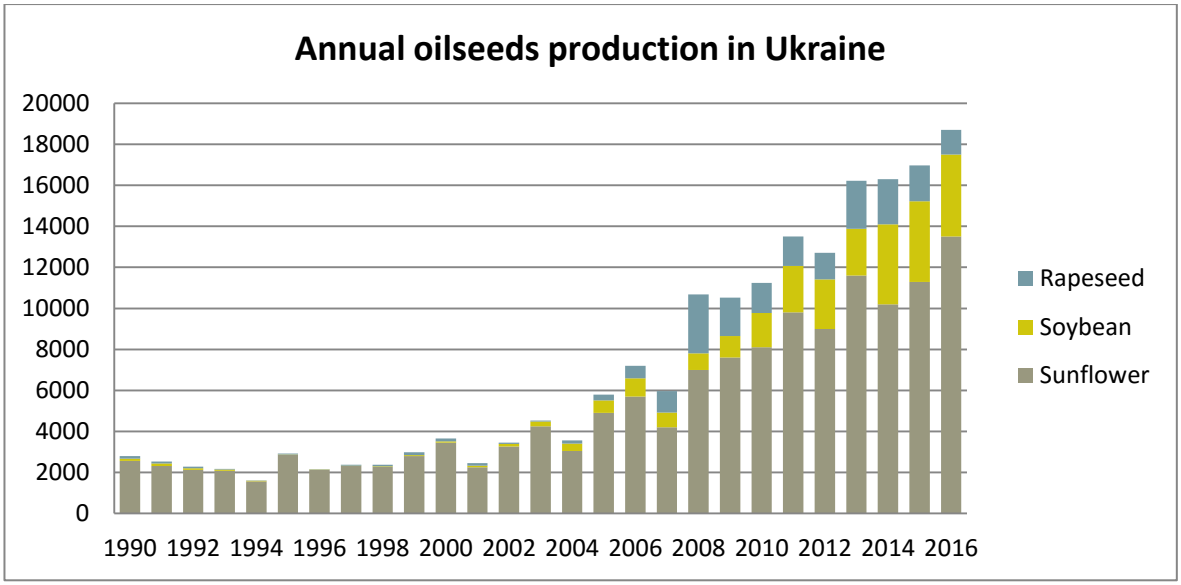
Table 8: Biomass and biofuel utilization for energy production in Ukraine

Type of biomass/biofuel	Annual consumption (ktoe)	Usage of economic potential
Straw from grain and rapeseed	43	1%
Biomass from wood	1296	80%
Sunflower husk	343	42%
Bioethanol	53	6.70%
Biodiesel	0	0%

Source: Bioenergy association of Ukraine, 2014

Ukraine is one of the leading producers of grain worldwide and ranked fifth in the corn production with 28.45 mt annually. Domestic corn consumption is considered insignificant since most of it is being exported. Overall Ukraine exports 41% of its gross grain production, meanwhile United States exports 18.5%, China – 0.3% and EU – 9.3%. Taking in account the Ukrainian dependence on imported energy sources and recession in agriculture, exporting of almost half of grain production does not seem to be vital for economy. In opposite, these amounts of exported grain could be used for bioethanol production, contribution to the domestic energy supply and for initial boost of industry's development.

Second potential source of feedstock for bioethanol production is sugar beet and by-products from the sugar production. The sugar beet production had significantly fallen in early 90s due to the lost export relationship after dissolution of Soviet Union. Nowadays, produced volumes of sugar beet cover only the domestic demand. Based on the Ukrainian Scientific Research Institute of Alcohol, from 1 ton of sugar beets could be produced up to 80 – 100 litres of bioethanol. If the harvest of sugar beet would reach the same level as in 90s, crops, which are not involved in the sugar production, will be as much as 25 million tons. In this regard Ukraine would extract approximately 2 million tons of bioethanol, which is comparable to the Chinese volumes of bioethanol production -2.2 million tons (Kaletnik& Prutska, 2014).



Graph 5: Annual production of crops for biodiesel extraction in Ukraine
Source: United States Department of Agriculture, 2016

Regarding biodiesel: rapeseed, soybean and sunflower are most promising crops for the feedstock. In Ukraine sunflower brings the largest share of the production of oilseeds. However sunflower oilseeds are typical for usage in the food industry and export-oriented, meanwhile rapeseed and soybean could be potentially used for the production of biofuels. The increase in biodiesel demand from abroad has triggered growth of oilseeds production in Ukraine. But almost all yield amounts is being exported to Europe and no industrial production has been established so far. During 2015/2016 season rapeseed prices in Ukraine varied between 10.400-10.600 UAH/mt what is approximately 381 USD/mt (APK-Inform Agency, 2016). At the same time, for instance Hamburg CIF price average for the same period was on 409 USD/mt (USDA, 2016). During seasonal months 2015/2016 from July till April the rapeseed export had reached 1416.5 kt and 1484 kt of soybean had been supplied during September – March to foreign markets (UkrAgroConsult, 2016). Taking into account fact that oil content of soybean and rapeseed is 17–25% and 48–52% respectively, Ukraine could produce about 1070 tons of crop oil that would fully cover the agricultural needs in biodiesel (Kaletnik & Prutska, 2014).

4.2. Ukrainian incentives on biofuels market

4.2.1. Energy strategies

Energy Strategy of Ukraine is a political document, which specifies the purpose and application of Ukrainian energy policy in the long term horizon along with procedures of its implementation. The strategy aims to address public efforts into fulfilment of targets for entire energy sector including renewables. According to the recent Energy Strategies, the main priority of the Ukrainian energy sector is support of energy security and ambition for European integration.

Energy Strategy of Ukraine until 2030

First edition of Energy Strategy of Ukraine for the period till 2030 had been adopted in March 2006. The document provides targets for the development of renewable energy production, which seem to be underestimated compared to analysed potential of bioenergy in Ukraine. Basic scenario of the strategy proposes significant growth in the energy consumption by 25% along with the increase in power consumption by 55% until 2030 compared to 2010. These key indicators are not considered as supportive for energy efficiency and security by saving non-renewable energy resources.

Later the document was revised due to the obsolete targets and trends, but mainly because it was not in line with the National Renewable Energy Action Plan (NREAP). In 2013 Cabinet of Ministers signed new Energy Strategy until 2030. Strategy proposes objects for biomass utilization in electricity generation that should reach 2.4% from the total renewable electricity and only 0.1% from the total electricity produced in Ukraine. Meanwhile it does not cover the usage of biomass in heat supply. The sector of liquid biofuels is the only sector of bioenergy, development of which is described in the document. One third of 33.7 billion m3 (in 2015) of consumed natural gas is necessary to be replaced by biofuels. In the baseline scenario the shift to the usage of gasoline containing 10% bioethanol until 2020 and 15% - by 2030 is planned. According to the ES, the expansion of biodiesel as motor fuel happens after 2020. Further up to 2030, will be made a transition to use of biofuels with 7% of biodiesel.

Table 9: Biodiesel and bioethanol development in the Energy Strategy until 2030

	2010	2015	2020	2025	2030
Bioethanol consumption, million tons	< 0.11	0.3	0.6	0.8	1.1
Biodiesel consumption, million tons	0	0	< 0.1	0.3	0.8
Total consumption of biofuels	< 0.1	0.3	0.6	1.1	1.9
Share of biofuels in motor fuels consumption (%)	**< 1**	**2.5**	**4.5**	**7.2**	**10.9**

Source: Energy Strategy of Ukraine until 2030, 2013.

Total investments estimated for implementation of the strategy increased by 5% in comparison with the previous version of the strategy and reach 1.821 trillion UAH (71 billion USD in the 2016 prices). Approximately 7% from these funds are planned to address for the development of RES. Meanwhile the evolution of renewable energy sector will take place while competing with the traditional sources.

According to Bioenergy Association of Ukraine the development areas and targets proposed in the new Energy Strategy until 2030 are opposite to trends in the energy sectors of leading countries. Taking into account the fact that Ukraine is willing to become a member of EU, its actions and policies do not complement the EU strategy in the sphere of renewables. Moreover Ukraine basically envisages a scenario leading to the stagnation of the renewable energy sector. Based on the 2014 year data, Ukrainian share of biofuels in the final energy consumption in the industry of transport is 0.3%. In comparison, average share of renewable energy sources in transport fuel consumption across the EU-28 was 5.9 % in 2014 (IEA, 2016).

Energy Strategy is the document that should be reviewed every five years and updated taking regarding new trends and opportunities. In order to improve current situation in the sector of renewables, two drafts of the new Energy Strategy until 2035 had been developed.

Energy Strategy of Ukraine until 2035

First version of the new strategy was approved in 2015 by National Institute for Strategic Research and key figures were confirmed with NREAP. Nonetheless the document includes growth in gross final energy consumption by 12.6% by 2035 in comparison with 2013, what is not coordinated with the general European trend of minimising the energy consumption. Updated Energy Strategy proposes an optimisation of the country's energy

balance by increase in share of renewable energy up to 11% in 2020 and to 20% by 2035. Table below shows projected energy balance, including development of renewable energy sources share in the new version of Energy Strategy until 2035.

Table 10: Projected balance of fuel and energy sources until 2035

Consumption, Mtoe	**2013**	**2020**	**2025**	**2030**	**2035**
Coal	41.4	37.69	38.37	37.27	33.78
Natural gas	39.5	37.33	33.57	33.2	34.17
Oil products	9.85	13.97	14.86	15.74	16.48
Nuclear power	21.9	25.31	25.38	27.39	32.86
Biomass, biofuel and waste	1.56	6.38	8.91	11.85	13.1
Solar energy	0.07	0.37	0.56	0.7	0.84
Wind energy	0.08	0.21	0.32	0.43	0.54
Hydraulic power	1.14	0.93	1.02	1.21	1.25
Ambient power	0.05	0.78	1.42	1.86	2.4
Net export	-	-1.03	-1.29	-2.15	-2.58
Total	115.55	121.94	123.12	127.5	132.84
including RES	2.9	8.67	12.23	16.05	18.13
Gross final consumption (TFC)	**69.56**	**78.89**	**80.84**	**85.13**	**88.91**
The share of RES in TFC, %	**4.5**	**11**	**15.1**	**18.9**	**20.4**

Source: Draft of Energy Strategy of Ukraine until 2035, 2015.

The ES pays more attention to the second generation biofuels and envisages growth in the share of biofuels usage in the transport market. One of the tasks of the strategy is to establish technical requirements to the production and utilization of biofuels and put into force mandatory requirements regarding the usage of advanced biofuels in vehicles. According to the Table 9, forecasted gross final consumption of biofuels and wastes will reach 4909 ktoe, only 4.5% of which will be used in transportation, 9.3% in agriculture, 6.9% in food industry and around 77% by population.

Table 11: Targeted supply and consumption of biofuels and waste in 2035

Supply and consumption, thousands tons of o.e. (ktoe)	**Biofuel and waste**
Production	13100
Gross final consumption	**4909**
Industry including	403
Food industry	343
Other industrial sectors	60
Transport	223
Agriculture	459
Services and other consumers	52
Population	3772

Source: Draft of Energy Strategy of Ukraine until 2035

Second draft of the document was named New Energy Strategy of Ukraine and it was proposed by Razumkov Centre in collaboration with the National Institute for Strategic Research attached to President of Ukraine and other key NGOs and research institutions of Ukraine. The main difference of this Energy Strategy is that in the opposite to the first document, it plans decrease of the consumption of primary energy from 115.2 Mtoe in 2013 to 102.6 Mtoe in 2035, which is following general trend of energy efficiency rise.

Both versions of ES are currently sent for approval from state agencies. The Energy Strategy until 2035 was planned to be signed already in 2014, however due to low oil prices environment and ongoing war, its examination was postponed indefinitely.

4.2.2. Investment programs

Even before the main supportive legislation for biofuels had been developed, the government had approved “Ethanol” program in early 2000 followed by technical documents on bioethanol blends. Based on the program, production of bioethanol was established in the number of branches of state enterprise “Ukrspirt”. During development stage, testing and further implementation from 1998 till 2004, “Ukrspirt” entities had produced approximately 54 thousand tons of bioethanol. However, because of the lack of legislative support and mandatory blends, along with the increase in prices of feedstock, production of bioethanol had been temporary stopped in 2005.

In 2005 the Cabinet of Ministers had approved the Program to develop biodiesel production. The program envisages that Ukrainian production and consumption of biofuels

will grow approximately to 520 000 tonnes in 2010. According to the program rapeseed production in 2009 should increase to 6.6 million tons and 7.5 million tons in 2010. Whilst the maximum, rapeseed production had ever reached, was 2.9 million tons in 2008 (see Graph 5 above). Thus the production forecast of the program was based on the inadequate assumptions. As reported by USDA: the program introduces very general and unclear methods to attain established targets and does not provide biodiesel producers with benefits. In this regard the implementation of Program to develop biodiesel production has had insignificant impact on the Ukrainian biofuel industry.

4.2.3. Legislation in the Ukrainian sphere of biofuels

As a member of Energy Community Treaty, on a voluntary basis Ukraine had implemented EU directives on biofuels and other RES for transport (2003/30/EC). An important step in the direction of biofuels development had been adoption of law "On stimulation of production of biological fuels" in 2008. For the first time in the history of independent Ukraine the law states that biofuels could be produced by any business entity. Before its ratification the only legal producer of biofuel was “Ukrspirt” as a state monopolist. Following year the law “On alternative fuels” had been adopted. This law defines legal, social, economic, environmental and organizational principles of production and extraction of alternative fuels, as well as stimulating an increase of their share up to 20% from the total volume of fuel consumption in Ukraine until 2020. Based on the new legislation, all Ukrainian suppliers producing biofuels for selling have to be certified. And all economic subjects that are operating in production, storage and selling liquid types of biofuels and biogas need to be included in the state register.

Government of Ukraine is encouraging investments into the development of biofuel facilities by offering benefits not only to producers but also to consumers. In the following years Cabinet of Ministers had approved number of tax related incentives in the biofuel industry:

Corporate Profit Tax

In 2009 year president of Ukraine signed a law “About amendments to some laws of Ukraine on facilitating the production and use of biofuels”. The significant stimulating effect of which became the temporary cancellation of corporate profit tax related up to 80% of the profits from the heat and electricity production from biofuels, materials and components

which will be used in production, along with production and services in transport and equipment related to renewable energy. The law came into force in 2010 year and it was supposed be in force for ten years. The law requires usage of freed up funds to lower production costs of the entity.

In addition the law encourages not only the producer but also the consumer. In particular bonus depreciation provided for the period until year 2019 related to equipment operating or/and producing biofuels. In this regard in the first reporting period the depreciation of 50% from the book value is allowed. Individuals, who have bought or converted their car's engines for usage of biofuels, can use this tax benefit for the payment of income tax.

Value added tax (VAT) and import customs duties

According to the Tax Code, imports of the certain types of machinery and materials related to alternative types of fuels into Ukraine are exempt from VAT as well as custom duties. Nonetheless, only small number of companies had received exemption from VAT due to lack of transparency in the procedure (Sysoievis & Cherniavskyi, 2013).

Land tax and leasing

Tax reduction is applicable to the land used for RE facilities; it includes 25% of the standard rate and 3% from the annual lease payment value (standard rate reaches 12%) for state and municipal lands.

Law on Alternative Fuels

Next step in biofuel support policies made by the Ukrainian Parliament had been an adoption of law "On introduction of changes to certain laws of Ukraine regarding the production and use of motor fuels containing biocomponents" in 2012, which brought amendments in the law "On alternative fuels" accordingly to the slow increase in production and use of biofuels in motor fuel mix. The law envisages that minimum recommended rate of bioethanol, contained in motor fuels, produced or imported to Ukraine, should reach at least 5% in 2013. In 2014 – 2015 the minimum had become mandatory and gradually achieve minimum of 7% in 2016.

However mandatory rates were not tolerable to engines, which are not suitable for the usage of biofuel blends and require modification. As a result the Ministry of Energy and Coal

Industry of Ukraine had developed new draft of “On changes to the article 2 of the Law “On Alternative Fuels” that decreases obligatory rates of bioethanol in 2014 to the 3% minimum and cap of 5%. For 2016 minimum mandatory rate shall be 5% and not exceed 10%. But as reported by Energy Reforms Coalition in 2014:

“In reality, general transition to bio-fuel has not taken place due to gaps in legal regulation of production, storing and selling of alternative fuel”.

Standardisation of biofuels

State standard of Ukraine (DSTU) №4841 and DSTU №6081 were developed already in 2007 and 2009 respectively. The standards introduce quality requirements for the biodiesel and the gasoline blends with biodiesel. However there is no authority yet, who would issue the approval of fulfilled standards, and the ratification process is not confirmed. Regarding bioethanol, DSTU №4839 for bioethanol blends had been approved earlier in 2007. Nonetheless it sets maximum volume of bioethanol content on 5%, what was not coordinated with changes in mandatory rate for 2014 and therefore was revised in the same year. Separate DSTU №7166 signed in 2010 introduces technical conditions for bioethanol.

Feed-in Tariff

In 2009 first efficient program “The Green Tariff” had come into force, which represents feed-in tariff scheme for electricity produced from all kinds of RES, including biofuels. The tariff allows government, on behalf of state enterprise “Energorynok”, to buy electricity generated from RES from commercial entities and individuals. Meanwhile the enterprise is obliged to purchase offered amount of electricity produced from RES from subjects for whom the ‘green’ tariff is established. The adopted program is developed for the period until 2030. Thanks to this policy, economic objects do not have to pay for the electricity but also sell the excess to the government. According to the National Commission of State Regulation in the Sphere of Energy, by May 2014 green tariff had been received by 5 companies, producing electricity from biomass and 5 entities operating on biogas.

Excise duty

In 2013 the government introduced the separate excise duty for alternative fuels with minimum 5% of bioethanol and biodiesel. The main argument in favour of these changes was an increase in the state revenues, as well as elimination of schemes for tax evasion in the

production of alternative fuels. The amendment in the tax policy settled up price of traditional fuel and biodiesel, ever since Ukrainian biodiesel production is zero (lastly in 2012 318 tonnes of biodiesel was produced). Regarding bioethanol blends with gasoline, the excise tax rate was established at 50% from the standard rate of gasoline and reached 99 EUR/t, what had initiated break in the bioethanol industry.

Further in 2015 another powerful change in the Tax Policy was approved, which set back the progress in Ukrainian biofuel market to the early stage of development. Parliament had raised excise tax on motor fuels and differentiated two tax rates for bioethanol blends. In case of biofuels with minimum 5% of bioethanol excise duty had increased by 42% from 99 EUR/t to 141 EUR/t (70% from the standard rate). Besides for alternative fuels with higher levels of bioethanol (minimum 30%) was introduced tax rate of 50% from the new gasoline rate (114 EUR/t). The excise tax increase for traditional motor fuels was accepted only for half a year, whereas for alternative fuels – on a permanent basis. As confirmed by director of Ukrainian association of alternative fuels producers "Ukrbiopalivo" Taras Nikolaenko, due to amendments in the Tax Code, all of bioethanol plants had stopped their production. Because of the downturn in oil prices and increase of excise tax, production of biofuel in Ukraine became disadvantageous. The association is now dealing with the implementation of requirements based on the signed Directive 2009/28/EC and the employment of European excise law, which claims the production of fuels that reduce emissions, should be taxed at a preferential regime.

Further amendments in the law “On alternative fuels” were made recently in 2016. Previous version of the law required economic entities, which are engaged in the sphere of biofuels, be included in the state register of biofuel producers in the manner prescribed by the Cabinet of Ministers of Ukraine. New amendments cancel this condition and notably simplify doing business in the production of biofuels.

4.2.4. International collaboration

In 2012 Ukraine had been cooperating with China in arranging of biofuel production. The collaboration consisted of exchange of obsolete machinery in the number of unprofitable alcohol plants and conversion their business line into bioethanol production. Later in spring of 2013 Ukrainian Ministry of Agriculture and Finland had agreed on partnership in alternative fuel sources industry. Especially Ukraine was interested in bringing Finnish know

how to production of biofuels and internship of Ukrainian experts regarding latest technologies in energy saving (Ministry of Agrarian Policy and Food 2013). Ukrainian international cooperation is rather stronger in the feedstock production as compared to biofuels (Schaffartzik, 2013). This is explained by responsibilities of Ukraine regarding Renewable Energy Directive that liquid biofuels should comply with standards of sustainability, which are mainly feedstock based. Before all else Germany supported Ukraine in the crop production for years through project of German Society for International Cooperation, seminars and biofuel conferences, which were part of German-Ukrainian Agricultural Dialogue (IER, 2010; APD, 2013).

4.2.5. Association of bioethanol producers in Ukraine

To promote development in production of alternative motor fuels in 2012 "Ukrbiopalivo" – an Association of Producers of Alternative Fuels was founded. It consists of ten distilleries, which belong to state enterprise "Ukrspirt", and three private companies. The association took part in developing of mandatory blends of 5-7% of bioethanol in gasoline and nowadays strive on changes in the current Excise Tax Policy.

Excise tax rate for bioethanol blends with gasoline that came into force in 2014, led to the suspension of eleven distilleries in the same year. With existing excise tax Ukrainian biofuels became non-competitive with the traditional imported fuels. Currently, out of thirteen entities, only one private company "Eko-energiya" is operating, capacity of which is 1500 tons per month.

4.3. Issues on biofuel production, distribution and consumption

Ukrainian energy sector is most challenged sector in the country, which is built mainly based on the interests of oligarchs and lobbyists related to the conventional fuel production (Malygina, 2013). Therefore Ukraine does neither produce nor consume biofuels in the relevant volumes. Whereas country disadvantageously exports feedstock to Europe for cheaper price and purchase expensive gas and oil instead. Despite all mentioned, Ukraine has great competitive advantage in the production of biofuels as availability of the feedstock, fertile soils and support through investments and know-how from abroad. Thus national interest should be a shift from export of raw material to processing them into final biofuel products. Based on the experience of leading countries in the biofuels market, Ukraine should

overcome energy dependence through establishment of biofuel production and its utilization within the country.

In the recent years Ukraine was working on fulfilment of European standards in the sector of biofuels. Most importantly, as opposed to Russia, Ukraine has built legislative base which aims to support the industry development and offer large scale of benefits. But due to high excise duty, low oil prices and no penalties for not achieving established indicators, the biofuel industry currently stays non-operating.

According to Ukrainian Association of producers of alternative fuels, main barriers that hinder Ukrainian biofuel industry from rise are as follows:

- High rate of excise duty that made production of biofuel non-competitive to traditional motor fuels. Because of the Tax Code amendments, production of biodiesel had stopped already in 2013 and 13 bioethanol distilleries suspended their operation in the following years;

- Highly corrupted process of regulation of bioethanol production and fulfilment of standard technical requirements.

Recently Ministry of Agriculture had developed bill for a change of excise duty to zero rate and sent it to the Cabinet to consider. As soon as the amendment comes into force, the bioethanol demand is expected to rise up to 215 - 300 thousand tons. Meanwhile annual Ukrainian bioethanol production capacity reaches maximum level at 25% of the demand (Kalnitskaya, 2013). But so far Ministry of Agriculture in cooperation with “Ukrbiopalivo” plan to focus on bringing national standards of legislation in line with EU norms, simplify regulation of bioethanol production and replace mandatory bioethanol blends by economic incentives.

5. Biofuels market in Republic of Belarus

The Republic of Belarus does not stay away from the global modern trends and directions of development of economy on the “green” principles. Nowadays local energy sources manage to cover only 15% from the total final consumption of energy. Despite the fact that Belarus does not have enough own energy resources, it is suitable for the creation of renewable energy sector because of huge industrial forests, well developed infrastructure of

energy and heat distribution, modern engineering enterprises as well as technically educated population.

Table 12: Belarus key indicators 2015

Population (millions)	9.5
GDP (billion 2015 USD)	54.61
Energy production (Mtoe)	3.67
CO2 emissions from fossil-fuel use only (Mt of CO2)	57.43

Same as Ukraine, Belarus remains the country with a critical level of energy dependence. Moreover 90% of imported energy resources come from a single supplier – Russia. Availability of cheap Russian sources and lack of diversification within energy sector hinder Belarus from expanding the potential of local energy resources. However nowadays energy independence and security, which is defined as share of local energy sources in the total energy balance, stay Belarusian priority. Since 1990, countries has a tendency towards decreasing the share of oil and increasing the share of biofuels and wood waste in TPES, see Table 13 below. Specifically exacerbation of energy relations with Russia and concomitant rise in the cost of imported energy sources had led Belarus to expand its reliability on local, mainly renewable energy in the past. The reason of growth in the biofuels and waste was given by establishment of strong supportive policies for developing this sector from year 2007.

Table 13: Biofuels in the balance of TPES in Belarus, 2014

Supply (ktoe)	2007	2008	2009	2010	2011	2012	2013	2014
Liquid biofuels	0.0	6.7	19.9	33.6	27.3	28.4	23.0	24.2
Primary solid biofuels	1281.2	1289.5	1319.8	1433.0	1513.9	1550.1	1505.1	1399.3
Biogas	0.0	0.4	1.5	2.1	3.1	4.3	9.1	8.9
Biofuels and waste*	1303.0	1329.0	1370.0	1497.0	1575.0	1610.0	1562.0	1460.0
Biofuels and waste, % of TPES	4.7%	4.8%	5.2%	5.4%	5.4%	5.3%	5.7%	5.3%
TPES	27898	27937	26525	27523	29345	30499	27276	27746

*Total primary supply of biofuels taking into account stock changes and net export

Source: IEA, 2016

Based on the National Agency of Investment and Privatisation website, technical potential of RES is estimated at 60 Mtoe, which is higher than the current energy demand level of 23 Mtoe (National Agency of Investment and Privatisation, 2016). In 2014 share of renewables had reached 5.3% in the balance of TPES with the main contribution from biofuels and waste and insignificant part of hydro, wind and solar energy. During last decade share of biofuels and waste has risen by 39.5% that accelerated total growth in TPES accounting for 3.6% (OECD/IEA, 2016). Production of liquid biofuels is represented by biodiesel, since Belarus does not utilize bioethanol as a fuel yet.

Development of biodiesel market for Belarus seems more rational from the point of view that it does not cause the deficit in food production, because rapeseed oil is not used for food purposes in the country. Besides land based issues could be potentially solved by utilization of contaminated area for rapeseed oil production.

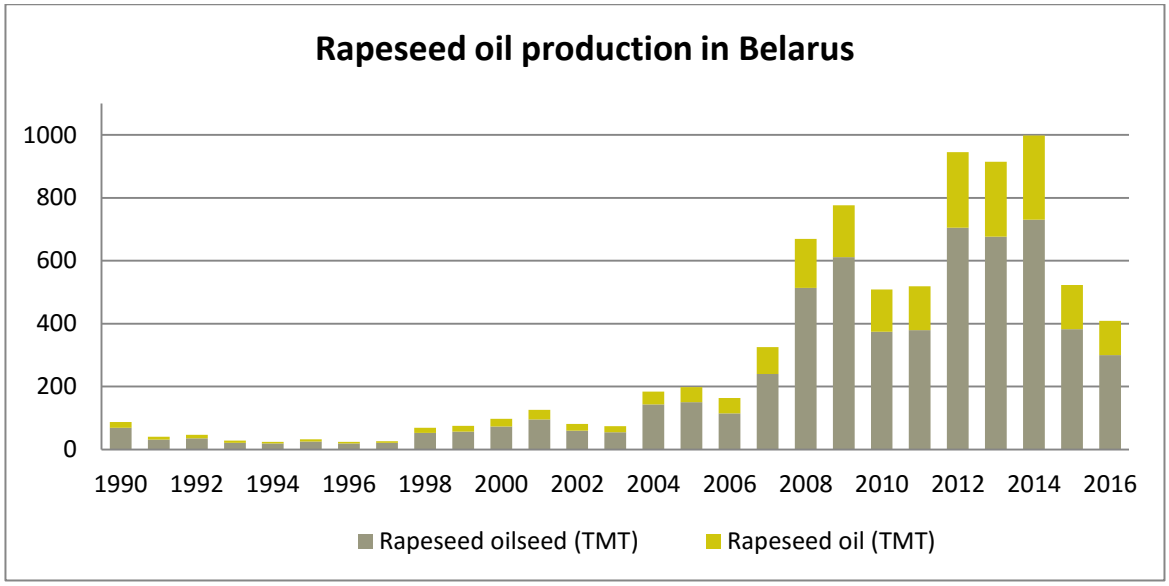
Belarus had signed the Kyoto Protocol only in year 2005 and ranked as emitter below Top 50. It committed to cut fossil fuel CO2 emission in transport by 5 up to 10% from 1990 year level by 2020 and by 12% in total emissions. Nonetheless Belarus does not have general adaptation plan of committed targets, despite adaptation measures having been introduced in the several legal documents and strategy is currently under development (LSE, 2016). For Belarus along with Russia and Ukraine decrease in carbon dioxide emissions is difficult choice, since as transition economies, they continue to grow at the expense of reduction of emissions (Parnell, 2012).

5.1.Feedstock potential

Biomass, biogas and liquid biofuels are most considerable sources of renewable energy in Belarus. Potential for conventional bioethanol and biodiesel are evaluated to be extensive taking into an account amount of arable land and opportunities from sugar production, starch and the cellulose industry for advanced biofuels. Production of bioethanol in the country is still in quite early stage; however biodiesel industry is well developed. Total potential for conventional bioethanol and biodiesel production is estimated to 1 million tons annually (The Energy Charter, 2013). As a feedstock for biodiesel extraction rapeseed is primarily used and its cultivation takes one of the leading places in Belarus, accounting for 5% of total sowed land. Soybean and sunflower are being imported to the country.

According to the Graph 6 below the general harvest of rapeseed in 2016 has decreased to the minimum levels for the last 9 years and reached 300 kt (41% down compared to 2014). However as reported by the Ministry of Agriculture of Belarus, the sowing areas for winter rapeseed increased to 360 thousand ha and will contribute to the rapeseed yield growth in 2017 (APK-Inform Agency, 2016).

Belarus does not export rapeseed; all harvested volumes of oilseed are further produced within the country. The capacities of oilseed processing factories exceed harvesting volumes, what leads to downtime and imports of rapeseed from the Russia and Ukraine. Meantime Belarus exports extracted rapeseed oil primarily to the EU countries and up to 5% to the Commonwealth of Independent States (CIS). Based on the 2015 data from the National Statistics Committee of Belarus (BELSTAT), the following countries were the main buyers of rapeseed oil: Lithuania - 80.1 kt (86.9 kt in 2014), Norway - 24.1 kt (45 kt in 2014) and Poland – 9.1 kt (7.1 kt in 2014).



Graph 6: Rapeseed oil production in the Republic of Belarus
Source: United States Department of Agriculture, 2016

Belarus has huge potential not only for production of first generation of biofuels but also for advanced biofuels such as lignocellulosic bioethanol. As estimated in the National Programme on Local and Renewable Energy Development for 2011-15, potential of crop waste accounted for 1.0 Mtoe annually and potential from straw is 0.7 Mtoe annually. Wood resources and related residues are generous as well considering large forest areas covering

40% of Belorussian territory. Energy potential from wood and wood processing waste is appraised approximately to 2.2 Mtoe per year. Crop waste potential is estimated on level of 1.0 Mtoe annually and straw potential - 0.7 Mtoe.

An unusual benefit of Belarus is vast land areas available for growing feedstock without negative impact on food security. This circumstance was caused by nuclear disaster in 1986 which happened in Chernobyl in neighbouring Ukraine. As a consequence approximately 23% of the land area of Belarus was polluted by radioactivity and became inappropriate for agricultural use. Nonetheless contaminated land is suitable for sowing biofuel crops and brings advantage in the form of disposal of radioactive elements from the soil (Rahu M., 2003; Atomic Energy Agency, 2006).

5.2. Belorussian incentives in the biofuel industry

Belorussian consideration to develop biofuel industry was encouraged by President Directive №3 "Economy and frugality - the main factors of economic security of the state", signed in June 2007. The Directive considers the implementation of indicators for energy saving, increase the use of local, alternative and renewable energy sources, an important criteria for evaluating the work of state organizations. The provisions of Directive № 3 were expanded in the Strategy of Energy Potential Development, National Program for Energy Saving for 2011–2015 and further for 2016-2020. Examination of these documents let us to identify the priorities of the republican energy policy related to the biofuels. In general current policy and strategy of the Republic of Belarus in the field of energy and energy efficiency are aimed to make structural changes in the national economy and its modernization, based on energy-efficient technologies.

5.2.1. State program for the production of biodiesel for the period 2007-2010

Due to the necessity of creating sources to ensure the economy of Belarus with automobile fuel at stable prices, stable market for raw materials and reduction of energy imports, government has developed the program to ensure production of biodiesel in the country for 2007 – 2010 years. The strategy was focused on the provision of transport sector with competitive biodiesel by its production on the domestic raw material base. The state contractor of the program is Belarusian State Concern for Oil and Chemistry (Belneftekhim),

which brings together the main organizations of chemical and petrochemical enterprises in Belarus.

Table 14: Performance targets of the Program for production of biodiesel in Belarus

Indicator (kt)	2007	2008	2009	2010
Rapeseed oil production	66.7	78.5	151.3	228.3
Biodiesel production	1	4	20	39-50
Biodiesel blends (minimum 5% of biodiesel)	20	80	450	780-1000

Source: State program for the production of biodiesel for the period 2007-2010, 2009

According to the program production of the rapeseed oil in 2009 was supposed to reach 151.3 kt and further 228.3 kt in 2010. Based on Table 14, showing actual annual yield of rapeseed oil, targets of program has been unfulfilled neither in year 2009 nor in 2010. In fact, "Belneftekhim" had managed to produce only 45% from the objective of 2010 - 450 kt of biodiesel blends (Charter'97, 2009). Thus Belarus did not achieve goal for biodiesel output of 1000 kt, established in the program.

5.2.2. National Energy Saving Program

In December 2010 National Energy Saving Program (NESP) for the period from 2010 till 2015 was adopted by Council of Ministers. As the main objectives, the program determines the deployment of alternative and renewable energy sources in conjunction with minimising GHG emissions, increase of energy efficiency, support of R&D in energy technologies and others. By accomplishment of sectional targets, the program assumes to lead to reduction of energy intensity of national GDP by approximately 30% within following period.

In the framework of NESP 2011-2015 on 10 May 2011 secondary bill was adopted - National Program of Local and Renewable Energy Sources Development for the period from 2011 until 2015. The focal point of the program is replacement of imported energy by local sources and substitute up to 2.4 billion cubic meters of imported natural gas along with compliance with the emissions level set by Kyoto protocol. Thus renewable energy sources have been paid attention in the programme, however without specific goals for its share. Target for utilization of local sources of energy including RES was forecasted to achieve no less than 28-30% in 2015 in the balance of heat and electricity energy production. In 2010,

the use of local ES and RES in the Republic of Belarus accounted to more than 3 mtoe (14.7%). Based on the resource potential and economic feasibility the extent of their use was predicted to increase till 2015 almost twofold to 5.7 mtoe (28%). Considering biofuels national program introduces resources potential and their economically feasible utilization volumes only for crop residues and wood waste, not taking into account other available feedstocks. Meantime it includes targets for biogas, hydro, wind and solar energy, strategy does not contain specific goals for liquid biofuels.

The strategy's target was projected to be reached by installing heat and power generation facilities using renewables in conjunction with ensuring development in specialist's qualification and introduction of normative legal acts. According to the results of 2015, NESP has proved to be successful and share of local energy sources achieved 29.5% in comparison with forecast of 28-20%. In this regard target of 11.2% decrease in energy intensity was fulfilled as well and has fallen by 12.6% to the 190 kg of oil equivalent per 1000 USD.

Recently in March 2016 new NESP for 2016-2020 was adopted, which includes an updated version of Local and Renewable Energy Sources Development Program and Program for Increasing of Energy Efficiency (IEE). The revised NESP emphases the increase of wood fuel use, rather than advanced biofuels. The reason is that wood fuel requires the least capital investments and provides shorter payback period compared with other types of renewable energy.

Table 15: Targets of National Energy Saving Program till 2020

Local/Renewable Energy Sources	2015_R	2016_F	2017_F	2018_F	2019_F	2020_F
Share of LES in TFC, %	13.6	14.2	14.5	14.7	15.6	16
Share of RES in TFC, %	5	5.7	5.9	6	6	6

*R- Reality, F-Forecast.
Source: The Department for Energy Efficiency of the State Standardization Committee of Belarus, 2016

The projected target for RES in 2020 is set up on the level of 6% in the gross total consumption of fuel and energy sources (TFC). Based on the results of 2015, share of RES has reached 5% in the balance of TFC. Table 15 above provides reader with the annual objectives of the program for the period until 2020. Besides, IEE program foresees growth in

the consumption of biodiesel as one of the steps to achieve savings of energy resources, but does not contain specific target for it.

5.2.3. Strategy for energy potential development in Belarus

In 2010 came into force the strategy, which aims to ensure the efficiency in the energy sector development and increase of energy security of republic till 2020. The strategy defines major changes to be done in the settlement of tariffs that have direct impact on RES growth. It became the first document in Belarus, which introduces definite objectives for the biofuels. The strategy introduces target for biodiesel and bioethanol use on the level not less than 2 million tons in 2020 together with the implementation of technologies for adaptation of internal combustion engines to run on gasoline with an ethanol content of more than 10 per cent.

The strategy also mentions the necessity in the reconstruction of distilleries, what would minimize required investments into the production of fuel ethanol. And as first step in the development of bioethanol potential requires to work out the cost-effective technology, which Belarus is missing so far.

5.2.4. Legislation in the Belorussian biofuel's industry

Standardization of biofuels

In early 2007 the government of Belarus approved a broad-ranging programme in order to develop technical regulations and standardisation in the sector of energy together with RES. In the interest to encourage use of alternative energy sources, standardisation supposes to improve the quality and efficiency of renewables. Before the programme came into force, in 2006 two approved STB 1657 standard on biodiesel (fatty acid methyl esters from rapeseed oil) and STB 1658 on mixed fuels based on petroleum diesel fuel with biodiesel content up to 5% were approved. Since Standardization program has been incorporated, numerous standards for ethanol as a blending component for petrol have been passed. Most recent standard GOST EN 15376 for petrol blends with bioethanol, which is identical to European standard, was accepted in 2014 and defines technical requirements for the fuel blends with maximum 5% of ethanol.

Value added tax (VAT) and tax reliefs

In 2009 the Belarus government had introduced Tax relief for renewable energy investors. The decree implies the right to deduct full amount of VAT paid by investors for the purchase of property right or goods. In addition it exempts RES investors from land tax, from rent for land payments provided that land belongs to the state and VAT and income tax in connection with a property transfer. The decree does not target directly RES projects but it is valid for them as well.

Import custom duties

Amendment of the Law № 2151-XII "About Custom Tariff" came into force in 2008. This law establishes the procedure of formation and use of the Customs Tariff and from 2008 exempts from customs duties imported equipment, used in the production, use, transformation, accumulation and transfer of energy produced from alternative and renewable energy sources.

Law on Renewable Energy Sources

Essential legislation in the sphere of RES was signed in December 2010 - Law on Renewable Energy Sources regulates sector of renewable energies in Belarus. The Law characterize essential legislative definitions in the RES sector, determines rights and responsibilities of producers, introduces competent authorities responsible for control over the sector and defines legislative basis for economic support for renewables. The Law implies obligatory promotion of RES and following facilitation of their development to the government bodies on both national and local level. Besides it includes governmental support to research in the sphere of renewable technologies including educational programmes.

The Law imposes mandatory registration for all RES producers maintained by governmental authorities and certification, which proves renewable origin of generated energy. It establishes a base for creation of financial support legislation for producers as well as investors in the form of tax reliefs, feed-in tariffs and other incentives. It also settles the procedure for establishing prices of renewable energy and tariffs for energy, generated from such sources. Meantime the Law consists of all necessary legislative support for the development of RES, it covers only solar, wind, geothermal, hydro, fuel wood, biomass and in particular focuses on sector of renewables generating electric energy, however does not consider liquid biofuels.

5.2.5. International collaboration

In order to bring foreign direct investments into biofuel sector, Belarus has considered creating joint ventures with foreign companies in the country as well as outside (Akulova, 2010; Raslavičius, 2012). From 1990s World Bank has cooperated with Belarus in rising energy efficiency and use of renewables through different encouragements as investments, assistance regarding policies establishment and technical advisory. In 2014 World Bank had approved loan in the amount of US$90 million that aims to increase the efficient utilization of biomass in heat and electricity generation (World Bank, 2014). Department of Energy Efficiency in different years signed memorandums on cooperation with Austrian (2009), German (2010) and Russian (2011) Energy Agencies in the sphere of RES. Nonetheless, according to available information, no biofuel projects have been registered in cooperation with listed agencies so far.

In 2007 government of Belarus and Greenfield Project Management Ltd, an investment and project development company incorporated under the laws of the Republic of Ireland, had signed a framework agreement to establish ethanol plant with 550 million litres production annually. Belarus was selected for this project establishment due to several competitive advantages such as low feedstock prices and labour costs, state support, well developed infrastructure and logistics. According to the Greenfield official page the agreement defines that arable lands in the region contaminated by the Chernobyl nuclear disaster are to be used for the purpose of the project. This supposed to ensure a stable supply of feedstock to the plant, meantime providing farmers a market for crops that cannot be offered to the food production. The project was aimed to produce wide range of ethanol blends from E5 till E85 which further to be exported to EU market and support achieving targets in transportation by 2020. Unfortunately the project proved to be fraud that was attracting funds from the Netherlands. It has collapsed in 2009 after government of Belarus refused to increase financing and withdrew financial support (The Greenfield Creditors Group, 2016).

5.3. Issues on biofuel production, distribution and consumption

Bioethanol industry in the Republic of Belarus doesn’t exist; biodiesel production had already started in 2007. Overall there are 6 major organizations for the production of rapeseed oil, which is the main raw material for the production of biodiesel. The main

producer in the country is "Belneftekhim". Total capacity of all 6 producers is approximately 100 thousand tons per year, which makes it possible to produce about 95 kt of biofuel (State program for the production of biodiesel for the period 2007-2010, 2007). Current level of biodiesel production accounted only for about 30% from the capacity (28 kt in 2014), see Table 16. However, the potential of these organizations is still not sufficient for the widespread production of an alternative type of motor fuel. Moreover available capacities won't allow Belarus to accomplish projected targets until 2020 stated in the Strategy for the energy potential development, taking into the account that country does not promote fuel ethanol as yet.

Table 16: Liquid biofuels production and consumption per sector in Belarus, 2014

Liquid biofuels (kt)	2008	2009	2010	2011	2012	2013	2014
Production	8	23	38	31	33	26	28
Consumption	8	23	38	31	33	26	28
Agriculture	0	13	25	22	27	23	25
Transport	8	10	23	9	6	3	3

Source: IEA, Energy Balances of Non-OECD countries, 2014

Regardless unsuccessful state program from the period 2007-2010, the country hasn't succeeded in the expanding of biodiesel production to the industrial volumes. Despite the low price of B5 blend and supportive government policies, sales of biodiesel in Belarus since March 2011 has been stopped (Joffe, 2011). This was reflected in the usage of biofuels in the sector of transport, shown in the Table 16. Concern "Belneftekhim" refers to low rapeseed yield in 2010 (see Graph 6), resulting in a deficit in oil for biodiesel extraction, but this is unlikely the only reason, constrained biofuel production. According to several sources, the reason behind discontinuation of B5 from the market had been dual opinion about vehicles, operating on this type of biofuel. Many customers believe that biodiesel blends negatively affect the fuel system of vehicles. Meanwhile B5 fuel does not require any modifications of engines; depending on the quality of biodiesel and its additives, it could clog engine and gel during cold weather. Thus we assume that dual opinion on the market together with the lack of technical support and advisory services related to seasonal usage of biodiesel had also impacted the decrease in the domestic demand. After 2011 biodiesel has not returned to the domestic market, despite the growth of rapeseed yield in the following years.

With established production of biodiesel, availability of feedstock but weak domestic demand on the other side, Belarus has recently started to export biodiesel blends. Taking traditional diesel fuel from Russia and rapeseed oil extracted domestically or imported from Russia and Ukraine, Belarus supplies foreign markets with biofuel. According to the BELSTAT in 2015 the country has supplied 15 kt to the foreign markets, what is significantly less than in 2014 – 35.6 kt. Lithuania remains the main consumer of Belarusian biodiesel throughout last three years. Graph 7 shows all buyers of biodiesel blends from Belarus in years 2014-2015. Average price of exported alternative fuel had decreased from 973 USD/tonne in 2014 to 766 USD/tonne in 2015 and currently attains level of 872 USD/tonne. Based on the operational data from January till October of 2016, export has reached only 5 kt.

Graph 7: Export of biodiesel blends from Belarus in 2014-2015 per country
Source: National Statistics Committee of Belarus, 2016

After analysis of current Belarusian policies in the sphere of biofuels, main constraints and incentives to be introduced for the growth of biodiesel production are considered:

- Outdated legislation framework with lack of definitive targets for liquid biofuels in the state programs. Most of Belarusian incentives are non-mandatory and do not contain any following sanctions that will motivate their further accomplishment;
- Low capacity of manufactures in case of biodiesel production. For bioethanol extraction there is a need for modifications made in the distilleries, which are not prepared for the production of fuel ethanol;
- Lack of promotion of liquid biofuels in the consumers market.

After discontinuation of biodiesel in 2011, liquid biofuels sector hasn't experienced any development in Belarus, despite all mentioned established state programs in force (NESP for the period 2016-2020 and Potential Development Program until 2020). In addition Belarus doesn't have institutional authority in the form of biofuel association that promotes biofuels in the country's energy market and contributes to the increase of energy security.

6. Analysis of potential and future prospects of biofuels in selected countries

Consumption and related development of biofuels in the country generally depends on numerous crucial determinants including legislation, infrastructure and feedstock availability. In the analysed countries, an establishment of biofuel industry is even more complicated due to the lack of modern technologies, reliance on traditional sources of energy and risks from unsuccessful biofuel's market formation, nonetheless they are well provided with the feedstock.

According to the Doku and Di Falco (2011) study, land availability is more significant as a driver of biofuel policy than impact of GDP for the developing countries. In opposite way, GDP is crucial factor for OECD countries while impact of land availability is insignificant. Countries, selected for analysis, have originally promising comparative advantages for the development of biofuels. Thus naturally endowed in the land factor, Russia, Ukraine and Belarus have a precondition to be successful in the sphere of biofuels. Taking into the account only conventional types of liquid biofuels and relevant feedstock, investigated countries have high availability potential in at least three out of six most promising crops for production, as shown in the Table 17. In fact Russian Federation is 3rd in the world in wheat production (exported 30 thousands kt in 2015), Ukraine is 7th (10.9 thousands kt exported) and Belarus is 22nd (35 kt exported). These countries also have placed within ten biggest producers of rapeseed oilseed (Ukraine–6th place, Russia-7th and Belarus is 9th). Availability potential is considered high if production of selected crop is sufficient for the domestic consumption and excessive volumes are being exported.

Table 17: Feedstock availability for producing biofuels in Russian federation, Ukraine and Belarus

	Feedstock for bioethanol			Feedstock for biodiesel		
Country	Wheat	Sugar beet	Maize	Rapeseed	Sunflower	Soybean
Russian Federation	H	L	H	H	H	H
Ukraine	H	L	H	H	H	H
Belarus	H	H	L	H	L	L

H - high availability potential; L - low feedstock availability for biofuel production

As was mentioned earlier in the thesis, most of crops, exported from Russian Federation, Ukraine, and Belarus to the EU are used for further processing into biofuels. In this regard we would like to calculate the potential of exported crops and contribution it could bring to the balance of each country's TPES. We would like to analyze the potential only for the six crops, which have high potential for the investigated countries. Thus sugar beet will not be considered for Russian Federation, same as for Ukraine and maize with sunflower and soybean for Belarus. Due to lack of official data for each of these countries and difficulties to find required statistics in one place, we have compiled the table below from a number of different sources, which were used above in the work.

6.1. Biodiesel and bioethanol potential from exported feedstock

For biodiesel, the calculation of "Total oil export" is taking into account the export of specific crop oilseeds as well as export of extracted oil from this crop. Annual data for both indicators are available for Belarus at BELSTAT, for Ukraine – UkrAgroConsult and Russia – GAIN reports (2016). As in case of Belarus, rapeseed oilseed is not being exported in the opposite to rapeseed oil. To estimate percentage of oil in the crops yield and biodiesel in oil yield data from the study of Shrestha (2012) were used. The content of oil in the crop represents the maximum amount of oil that could be extracted. In addition the extraction should be processed by solvent, since mechanical extraction will contribute 10% in the form of food.

Table 18: Biodiesel potential from the exported crops and oil in Russia, Ukraine and Belarus, 2015

	Russian Federation			Ukraine			Belarus
Feedstock crop	Rapeseed	Sunflower	Soybean	Rapeseed	Sunflower	Soybean	Rapeseed
Exported amount of crop (kt)	2000	60	350	1416.5	0.789	1484	-
% of oil yield	48-52%	40-50%	17-25%	48-52%	40-50%	17-25%	48-52%
Export of extracted oil (kt)	240	1446	415	152	4000	122	133
Total oil export (kt)	1240	1473	489	860	4000	434	133
Conversion rate (L/t)	1082	1087	1080	1082	1087	1080	1082
Biodiesel potential (10^6 l)	1342	1601	528	931	4348	468	144
Biodiesel potential (ktoe)	1015.38	1211.75	403.36	704.59	3290.85	354.40	108.91
Share of TPES per crop	0.15%	0.17%	0.06%	0.56%	2.62%	0.28%	0.39%
Share of TPES per country	0.38%			3.47%			0.39%

Biodiesel potential (in litres) is estimated, using conversion rate that represents how many litres could be produced from 1 tonne of extracted oil. In order to be able to measure the contribution of biodiesel potential from the exported crops to the balance of TPES, we need to convert litres to the tonnes of oil equivalent. First step is to transform volume of biodiesel to the mass units of measure, using density, which is equal to 0.880 kg/L for biodiesel. Next step is to evaluate the energy content by multiplying tonnes of biodiesel potential by 0.86 toe (1 t biodiesel = 0.86 toe). Because of unavailability of TPES data for year 2015, for an estimation of biodiesel share in the TPES, its average level for the last ten years was taken.

Table 19: Bioethanol potential from the exported crops in Russia , Ukraine and Belarus, 2015

	Russian Federation		Ukraine		Belarus	
Bioethanol	Wheat	Maize	Wheat	Maize	Wheat	Sugar beet
Export (kt)	30000	12500	10900	321	35	1600
Conversion rate (L/t)	390	410	390	410	390	80-100
Bioethanol potential (10^6 l)	11700	5125	4251	131.61	13.65	144
Bioethanol potential (ktoe)	5908.0	2587.9	2146.6	66.5	6.9	72.7
Share of TPES per crop	0.85%	0.37%	1.7%	0.1%	0.02%	0.26%
Share of TPES per country	1.22%		1.8%		0.28%	

Similar analysis was done for the bioethanol production from the wheat, maize and sugar beet. Exported amounts were converted to bioethanol potential in litres, based on the rates from the Ukrainian Scientific Research Institute of Alcohol and study of Patni, Pillai and Dwivedi (2013). Litres of bioethanol potential measured in units of mass are calculated, using density of bioethanol- 0.789 kg/L. Energy content for bioethanol reaches 0.64 toe/t, which is lower than for biodiesel. Than bioethanol potential, measured in kilo tonnes of oil equivalent is investigated, considering energy content. As in previous calculations for biodiesel, share of bioethanol per crop and country took into account average TPES during recent decade (see Table 3, 7, 13).

Table 20: Total bioethanol and biodiesel potential per country, 2015

Potential production (mtoe)	Russian Federation	Ukraine	Belarus
Biodiesel	2.6305	4.3498	0.1089
Bioethanol	8.496	2.213	0.0958
Total	11.126	6.5629	0.2047
Total % of TPES	1.6%	5.2%	0.7%

Based on the estimation of biofuel potential from the exported crops, Ukraine has highest revealed potential in the balance of TPES for both bioethanol and biodiesel among three selected countries. It is leading in the potential production of biodiesel with the main input from sunflower oil. In 2014 Ukraine has imported overall 34.4 mtoe of different types of energy sources including natural gas (16 mtoe), coal (10.3 mtoe), oil products (8.2 mtoe), crude oil (0.2 mtoe) and biofuels and waste (0.02 mtoe) (IEA, 2016). Based on provided estimations, revealed potential of bioethanol and biodiesel would bring additional 5.27% to the TPES. Thus Ukraine would be able to achieve approximately 7.1% of Biofuels and waste in the balance of TPES including current share of 2014. In this regard Ukraine would reach

highest share of biofuels and waste in the energy balance among analysed countries. Average final consumption of energy in the sector of transport from 2005 till 2014 was 12.7 mtoe (in 2014 - 10.3 mtoe). In this regard approximately 6.6 mtoe of biofuels, which being exported in the form of crops, could potentially cover almost half of needs in the transportation (51.7%) and substitute imported energy sources.

Draft of Energy Strategy of Ukraine until 2035 created by National Institute for Strategic Research, which targets were approved by NREAP, projects to reach 13.1 mtoe of biofuels and waste in 2035 (see Table 11). Despite the fact that both drafts of ES are currently being under discussion and awaiting for confirmation, we assume accepted ES would not differ significantly from the existing drafts. Considering contribution to achievement of target established in the ES: potential from exported feedstock would help country to reach 50% from the 2035 objective. Taking into the account 2014 level of domestic production of biofuels and waste (2.383 mtoe without net export) and investigated potential volumes, Ukraine would manage to attain around 8.95 mtoe that account for 68% from the planned goal. Draft of ES also contains targets for use of biofuels in the sector of agriculture-9.3%, transport-4.5%, food industry-6.9% from gross final consumption of 4.9 mtoe. In spite of feedstock availability, implementation of settled targets would depend primarily on reduction of excise tax for biofuels and its synchronization with European excise law.

Despite low contribution of analysed biofuel's potential to TPES, Russian Federation would gain from the exported feedstock 11.1 mtoe of biofuels in 2015, what is almost twofold higher than Ukraine. However compared to the Ukraine, these volumes would not significantly contribute to the Russian energy supply since their share would reach only 1.6%. Together with current share of biofuels and waste in the balance of TPES it would provide 2.6% supply. Last version of Energy Strategy until 2035 does not include a quantitative object for biofuels and generally Russia does not have any obligations to accomplish in the sphere of renewables. Apart from large-scale hydroelectricity, renewables in Russia are still in the early developing phase. As confirmed by European Parliament report (Russia's domestic energy policy, 2016), even if all planned projects to be implemented, share of renewables and therefore biofuels would remain meagre. Thus involvement of exported feedstock potential won't bring notable change into sector.

Belarusian potential in selected biofuels prevails in biodiesel production given by the exported amounts of rapeseed oil. Investigated potential would provide balance of TPES with only 1.09 mtoe of biodiesel and 0.96 mtoe of bioethanol (in total 0.7% of TPES). If share of biofuels and waste remains the same as in 2014 (5.3%), Belarus would reach not less than 6% by utilization of its potential from the exported feedstock. It will also lead Belarus to a decision to reduce its energy sources imports by 2 mtoe (40.5 mtoe in 2014). Regarding energy needs in transportation, the estimated amounts of biodiesel and bioethanol would cover around 50% of needs in that sector (based on average energy consumption of 3.7 mtoe during period 2005-2014).

Strategy for energy potential development in Belarus established a target of 2 mt as a minimum use of biodiesel and bioethanol by 2020. During analysis was revealed potential of 0.15 mt of bioethanol and 0.13 mt of biodiesel that would be enough to cover 14% of the Strategy objective. In the view of 2014 production of liquid biofuels (0.28 mt) Belarus would be able to reach 28% of its target by usage of exported raw materials domestically for further biofuel extraction.

6.2.Future prospects of biofuels in selected countries

Nowadays growth of biofuel markets is considered to be strongly connected with enacted biofuel policies, crude oil prices and macroeconomic environment. Table 21 summarize policies established in the selected countries. .Based on the experience of biggest biofuel producers, minimum mandatory share of biofuels in the transportation supported by tax reliefs proved to be most efficient policies. None of three countries has settled mandates or any other obligatory objectives in the sector. Besides none of analysed countries have a government body that would track execution of biofuel market policies together with projects, financed by government or foreign investments in the framework of international collaboration.

Meanwhile Ukraine, compared to others, has placed more powerful incentives; it has the same impediment as Russia in the form of high excise tax for bioethanol. Recently Ukraine was facing a dilemma: the government had been actively promoting biofuels and at the same time price gap and high demand from EU has triggered increase in the rapeseed production for the export. Therefore while low oil prices trend continues, export of raw

materials abroad and cheap import of energy sources is more profitable for Ukraine compared to development of biodiesel production.

Table 21: Biofuel policies applied in Russia, Ukraine and Belarus

	Country	Russia	Ukraine	Belarus
Regulatory policies	Feed -in tariff	NA	A	NA
	Biofuel obligations/mandate	NA	NA	NA
	Tradable REC	NA	NA	NA
	Standardisation	A	A	A
Fiscal incentives and public financing	Capital subsidy/ grant	A	A	A
	Investment/ production tax credits	NA	A	NA
	Tax reliefs	NA	A	A

*A – Applied, NA – Not Applied

If not for low oil prices environment, Belarussian and Ukrainian policy gaps may be improved within current policy frameworks, whereas Russia may require the development of new legislation approaches. Meanwhile EU had recently shifted their focus to the advanced biofuels and in the nearest future will change their policies of no support for a food-based alternative energy sources. In spite the fact, that EU had been major importer of feedstock for biofuel production from Ukraine, Belarus and Russia, it inevitably will lead to the fall in countries oil and crops export. Hence countries could foresee the export crisis and reverse the exported feedstock toward domestic conventional biofuel extraction sufficient for the early development stage. However for Russia there is a chance to leapfrog directly to advanced biofuels, since undertaken efforts proved to be incapable to integrate agricultural and energy sectors. Growing demand of EU in biofuels followed by increasing amounts of imported wood pellets keep Russia encouraged for the expanding production of solid biofuels. Russia became third biggest importer of wood pellets to European countries, after USA and Canada (USDA, GAIN Report, 2016). Meanwhile biodiesel and bioethanol could be interesting only in sense of further export, usage in rural areas, reduction of GHG and diversity, what have never been Russian focal points. Thus in the sphere of liquid biofuels Russia has never had clear objectives, proposed incentives were not ambitious and probably remain the same based on the government approach to related topics.

Ensuring energy security was considerable reason for the initial setup of biofuel policies especially for Ukraine and Belarus. Development of biofuel and renewables in

general will have an impact on energy security of all three countries in various ways. Since they have vast sources of feedstock for production of biofuels, the result will depend mainly on the oil prices, policies and investments into R&D of new technologies. Meanwhile current low oil prices do not favour short to the medium-term development of biofuels. In these circumstances questions of energy security get lower priority. However in this environment is necessary to prevent risks from long term point of view. From the perspective of security supply, main benefit of development of biofuels is sustainable utilization of energy resources. That would ensure supply of energy flows, including traditional sources and renewable, for a long period of time. In the terms of security, energy balances of Ukraine and Belarus face bigger issues than Russian. They are considerably volatile because oil and natural gas remain major imported energy sources. Oil products provide up to 85% of energy consumption in transportation and supply is focused in a few countries such as Russia with problematic economic and political environment affecting their stability. Risk caused by vulnerable trade of traditional fuels had already encouraged many countries to support of their own sector of biofuels through regulatory and fiscal policy incentives. Belarus and Ukraine as well need to overcome their energy dependence by expansion of biofuels industry in order to increase diversity, making their economies less sensitive to external disturbances.

Conclusion

During last 15 years there have been waves of interest in biofuels as major producers have been concerned by oil prices, sustainability, environmental impact and other global issues. Many countries have intensively supported their biofuel's industries with ambitions for higher energy security and mitigation of climate change. Their active expansion was prompted mainly by efficient policies and incentives placed through whole supply chain from producer to the consumer. Government policies have set floor for production and price of biofuels that remain rather stable even in the low oil prices environment.

For some countries biofuels became universal solution to the range of national problems from agricultural overproduction to the energy dependence on imported fuels. However for a long time Russia had stayed aside from the global biofuel euphoria. Energy efficiency, diversification and utilization of extensive agricultural commodities had encouraged Russia to support alternative fuels despite vast naturally endowed energy sources. Significant availability of feedstock, arable land and production capacities favor Russian intentions. In 2006 Russia has joined biofuel development with numerous strategies, supportive programs and international projects including subsidies from International Finance Corporation. Nonetheless without any obligations and following sanctions, Russian government has proved its incapability to accomplish developing incentives. Strong oil and gas lobby, that is closely supported by government may play significant role in fulfillment of biofuel projects. Further analysis has shown that huge feedstock potential for conventional biofuels won't notably contribute to the balance of total primary energy supply. Taking into account recent food embargo followed by strong support of agricultural sector and economic crisis, Russia needs to continue R&D and its intentions rather in advanced biofuels sphere then in conventional, in order to have efficient diversification of energy sources and achieving settled goals.

Pushed by strong reliance on imported energy sources plans to join EU and fulfill Kyoto protocol requirements; Ukraine has managed to implement biofuel policies and programs, some of which actually proved to be efficient. As two other analyzed countries, Ukraine has been exporter of biofuel feedstock to EU for a long period. But Ukrainian attention was paid only to bioethanol production while ambitions in biodiesel industry did not succeed. Ukraine has established considerable regulatory policies and fiscal incentives in the

form of tax benefits and “green” tariff; aligned by quantitative targets that have helped Ukraine to achieve 1.8% of biofuels in the balance of TPES in 2014. But last changes in excise law in 2013 and further in 2015 have negatively affected Ukrainian biofuel sector and pushed industry into stagnation.

Based on estimations of Ukrainian exported feedstock, we came to the conclusion that potential of exported raw materials would provide country with 50% from the targeted biofuels share, planned in draft of Energy Strategy until 2035. Despite disadvantages of conventional biofuels and global trend to shift to 2nd generation, potential from the available feedstock would be sufficient for the first development stage of the industry followed by expansion to advanced biofuels energy. But low oil prices trend together with high excise tax rate hinder Ukraine from expansion of the sector and accomplishment biofuels Strategy goal.

While Ukraine or Russia did not succeeded in the projects for biodiesel production, Belarus has been developing only this type of liquid biofuel. Belarus same as Ukraine had also struggled with critical level of dependence on imported energy. Biodiesel has been presented in the balance of TPES from year 2008 and encouraged by State Program for the Production of Biodiesel for the period 2007-2010. To support the market Belarus has also set tax reliefs, nonetheless that were related only to producers. In spite of low rapeseed yield in 2010, weak domestic demand and insufficient capacities of manufactures, volume of produced biodiesel from Belarus remains stagnating and now is exported to EU. Reduction of imported energy is among the priorities for increase the efficiency of Belarusian economy. Investigated potential from exported biofuel and feedstock from Belarus would allow decrease imported energy by 5% and achieve 14% from objective of Strategy for energy potential development. However in order to accomplish set targets of Strategy, Kyoto protocol and to deal with low energy security, in the long-term Belarus would require revision of current policies and expansion of biofuel’s production capacities including bioethanol production.

If analyzed countries leave biofuel sector underdeveloped, they will have to face same energy issues, whether in near future or later. But until oil prices stay on the low levels, supportive policies would not be sufficient for the growth of young industry. While in short-term biofuels could offer limited benefits and serious challenges for Russia, Ukraine and Belarus, the potential for clean energy sources, country’s energy independence and efficiency

is substantial. The aim of the thesis was evaluation of the current status of biofuel market in selected countries, identification of impediments and prediction of future development in this sector. We believe that objectives of diploma thesis were accomplished with the respect to data and information available.

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