Transformation of business of a company like Gazprom in new conditions.

Challenges and opportunities for Gazprom in current transforming energy world.

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Abstract

Currently we live in extremely changing world with subsequently changing energy sector. Used for centuries energy deriving from the fossil fuels is now shifting by new technologies and new societal demands. During the last decade there was a sharp increase of renewable energy sources usage (mostly solar and wind power). In 2015 year a new global agreement was signed concerning decrease of greenhouse gases emission (COP 21). In these conditions traditional energy companies like Gazprom face with a number of challenges which can affect its business. So the essay has the following aims:

- To describe current tendencies in energy transition and transformation worldwide which can affect Gazprom's business.
- To assess future changes and their implementation pace in countries – biggest energy consumers.
- To discuss possible consequences for Gazprom's businesses: threats and opportunities.
- To propose possible changes in Gazprom's business in order to be successful in new conditions.

Content

1. *Introduction.*

Those change in energy sector, which were described in most lectures of seminar in Nyenrode are significantly influencing now and will influence in the future the energy sources balance worldwide. These changes in turn have an impact all energy market participants: consumers as well as producers. Main tendencies in consuming energy are based on increase of energy consumption from different sources due to increase of world's population and increase of welfare in big number of densely-populated developing countries on the one hand, and efforts in energy efficiency (already widely used in developed OECD countries) on the other.

Fundamental changes in different energy sources usage appear in transferring to more clear energy sources, especially in increase of renewables' share in energy balances. These changes connected mostly with social demands for life conditions improvement in different countries and on the whole planet .

The last significant document, which should shape the future of energy sector worldwide, is an agreement which was signed in Paris at the end of 2015 - COP 21. Stated agreement combined commitments of almost all the countries to decrease greenhouse gases emission. Subsequently COP21 provisions should be implemented in each countries' regulatory legislation and through economic stimulation and by means of direct emission restrictions it will influence the structure of energy consumption and production worldwide.

Above mentioned changes in turn will impact the volumes and economic efficiency of consumption and production of different energy sources and, consequently, it will impact most energy companies' business. And so these changes lead to new general risks and opportunities which can change energy sector's landscape. In order to be successful in these circumstances all the risks and opportunities should be properly defined, estimated and addressed.

2. *Aims.*

Takin into account current tendencies, briefly stated in Introduction, I've chosen the following main aim for the essay: analysis of impact of outside conditions on the company in which I'm working now – PJSC "Gazprom", and definition of possible company's activities which can lead to success in changing energy industry sector.

In order to reach this goal below in this essay I've tried to discuss following topics:

1. Description of current business model of Gazprom.
2. Analysis of commitments, taken by countries in COP 21 in order to determine impact of these commitments on energy consumption and energy sources structure.
3. Evaluation of gas consumption in countries – biggest energy consumers.
4. Analysis of current tendencies in energy production technologies, actual achievements and problem questions in the area of transition onto more clear, especially renewable, energy sources.
5. SWOT analysis of PJSC «Gazprom». Determination of main risks and possibilities for PJSC «Gazprom» in the future considering identified tendencies in gas consumption and current position of Gazprom. Formulating of propositions for Gazprom's possible actions in order to keep and even strengthen company's position in energy market.

3. *Description of current business model of Gazprom[1].*

Gazprom's mission (as it stated in annual report[1]) is:
"PJSC "Gazprom" sees it's mission in reliable, affective and balanced supply of customers with natural gas, other types of energy resources and products of their processing."

Gazprom's strategic goal (as it stated in annual report[1]) is:
"Strategic goal is establishment of PJSC "Gazprom" as a leader among global energy companies by means of diversification of markets, ensuring of distribution reliability, increasing of operation efficiency, exploiting of scientific and technical potential."

Gazprom combined many activities, which are necessary for reliable supply of energy resources to customers. Gazprom's business model consists of wide range of different business processes, related to classic big energy company. Main of these processes are gas extraction, transportation and marketing. Other business processes, which play significant role in whole company (usually connected to above mentioned three main processes) are: exploration, oil and condensate extraction and marketing, gas and liquids processing, electricity generation and marketing, etc.). So main elements of Gazprom's business are complement each other.

Main parameters of Gazprom's group of companies operation in terms of production volumes, main markets, revenues and financial results are provided in the following table.

Table 1. Main operation indications of Gazprom's group of companies (2014).

Parameter	Domestic market	Export
Sale volumes		
Gas sales, billion cubic meters	232	208
LNG sales, million tons	-	3.4
Oil sales, million tons	4.7	11
Petrochemicals, million tons	41.5	33.9
Electricity sales, billion KWt*h	164	1
Heat, million GCal	118	-
Revenues, million USD		
Gas marketing	22	57
Gas transportation	4.5	-
Oil and condensate marketing	1.4	4.2
Petrochemicals marketing	25	18
Electricity marketing	10.7	0.5
Financial result, million USD		
Gas extraction and marketing	27	
Gas transportation	0.6	
Oil and condensate	1.2	
Petrochemicals	4.4	
Electricity and heat	0.9	

As it can be derived from the table, main financial indicators of the company determined by revenue from extraction and marketing of natural gas. Main market for natural gas in terms of sale volumes is Russian Federation (slightly more than 50% of all sale volumes). Meanwhile, due to gas price regulation, revenues from natural gas sales on local Russian market is relatively small. In the same time the biggest revenue provided by export of gas due to much bigger prices and despite of smaller volumes. All gas export to Europe actually goes through pipelines.

Separately should be outlined the only currently operated LNG plant in Russia, which was built within the scope of Sakhalin-2 project by joint venture of Gazprom, Shell, Mitsui and Mitsubishi companies. LNG from this plant is sold mostly on markets of Japan and South Korea. Meanwhile, due to relatively small cost of transportation, LNG can be retransferred to other markets in case of major changes in pricing environment, or any other circumstances.

Moreover, other major Gazprom's projects, which will influence company's parameters in the future, should be noted:

- "Power of Siberia" gas pipeline is building now to provide natural gas volumes to north-east regions of China, including Beijing area, which currently suffer significant problems with city ecology due to smoke from coal power plants.
- Increase of LNG production capacities: LNG plant expansion within Sakhalin-2 project, Vladivostok LNG and Baltic LNG projects.
- Development of projects outside of Russia, for example in such countries as Iraq, Algeria, Vietnam, Bolivia, Kazakhstan etc.

Another major activity is gas transportation. Gazprom owns the biggest gas transportation system, called Unified Gas-supply System (UGS), which consist of 171 thousands kilometers of pipes, 250 compressor stations with 3 829 compressor aggregates and combined power more than 46 thousands of megawatts. Also UGS contain 22 underground gas storages with accumulated volume more than 76 bcm.

The other major Gazprom's activities are oil extraction and electricity production, which performed by Gazprom's subsidiaries "Gazprom neft" and "Gazprom energoholding". In 2015 oil production was at level of 53,6 million tons, and with condensate it reached 73,6 million tons (along with associated companies).

«Gazprom energoholding» company is the biggest Electricity producer in Russia: total capacity of it's power plants is more than 38 GWt or 16% of established capacity in Russia, electricity production in 2015 was at level of 17,6 Billion kWh. Most of installed capacity of the company consist of gas power plants, but there are also significant share of coal and hydro power plants.

In spite of Gazprom actually is a big energy holding which consists of wide range of diversified activities, it's main business, which provided more than 80% of financial result, relates to gas extraction and marketing. So further I'll look mostly on gas market.

4. Analysis of commitment, taken by countries in COP 21 agreement.

Worldwide agreement on climate change was developed during 21st conference performed within UN framework convention about climate change. Main goal of the conference was preparation and signing of agreement with aim to keep average temperature increase below 2^{o} C[2].

Eventually the agreement was signed by 187 countries representing above 95% of global emission [3]. In agreement each of the countries is taken commitments on restriction (decreasing) volumes of greenhouse gases emission. Mentioned commitments are unique for each country and submitted as an "intended nationally determined contribution" (INDC).

Meanwhile there is no penalty mechanism in the agreement[2]. Thus for the moment main goal of the agreement is rather involvement of as much UN members as possible into a process of climate saving rather than put formal mechanism to set obligatory pledges and monitor their achievements. INDCs of main energy consumers, stated in agreement COP21, are presented in the following table.

Table 2. INDCs of 5 main energy consumers[3].

Country (region)	INDC
China	Target to peak CO2 emissions by 2030 at the latest, lower the carbon intensity of GDP by 60% to 65% below 2005 levels by 2030, increase the share of non-fossil energy carriers of the total primary energy supply to around 20% by that time, and increase its forest stock volume by 4.5 billion cubic meters, compared to 2005 levels.
USA	To reduce net GHG emissions by 26–28% below 2005 in 2025 incl. land use, land use change and forestry (LULUCF).
European Union	Formal binding, economy-wide target of at least 40% domestic greenhouse gas emissions reductions below 1990 levels by 2030. INDC confirms the inclusion of LULUCF accounting into the 2030 GHG mitigation framework
Russian Federation	To reduce its emissions of net greenhouse gases (GHG) by 25% to 30% below the 1990 level by 2030. This target is subject to the maximum possible account of absorbing capacity of forests.
India	The targets are to lower the emissions intensity of GDP by 33% to 35% by 2030 below 2005 levels, to increase the share of non-fossil based power generation capacity to 40% of installed electric power capacity by 2030 (equivalent to 26–30% of generation in 2030), and to create an additional (cumulative) carbon sink of 2.5–3 GtCO2e through additional forest and tree cover by 2030 capacity of forests.

Based on the data from the table it can be derived that countries' commitments significantly differ by type, as well as by resulting digits and base year to compare. Most developing countries formulate their commitments in terms like «compared to Business as usual» or «lower carbon intensity». Base year of each

INDC also has quite a big range of values and, most probable, it was chosen by each country as the year with peak or near peak volume of emission, which is equivalent to decrease country's commitments. As a result only relatively small number of countries, primarily developed, have taken strict obligations to decrease absolute amount of emission, and for many countries taken commitments can lead also to increase of total emission from the current levels (e.g. for China, Russia, India). Even more complex problem is a calculation of total world's emission and, consequently, determination of achievement of pledges in greenhouse gases emission decrease.

Main conclusion from these data for the purposes of the essay is that currently it's quite difficult to explicitly define an impact of COP21 on energy sector of each country and in total. It seems that most countries followed already existed plans of energy sector reshaping when they formulated and signed their commitments for the agreement. It means that the main tendencies in energy consumption, types of energy sources and their mix should be already reflected in various forecasts, which have made during recent years.

5. *Analysis of gas consumption in countries, which are biggest energy consumers.*

As Gazprom is the biggest gas producer in the world it's very useful to analyze gas consumption in different parts of the world in order to determine the nearest and mid term perspectives of the company.

Main countries (regions) which were analyzed are: China, USA, Europe, Russian Federation, India. For this analysis following sources of information were exploited: Shell [4], BP[5], IEA[6], US Energy Information Agency[7], PBL Netherlands Environmental Assessment Agency[8].

Most of forecasts (including reference cases) are mostly common in general tendency's forecast. Below digits from BP's forecast are presented[5].

Table 3. Energy mixes by 5 biggest energy consumers in 2014 [9] and in 2035 according to BP's forecast[5].

	China	North America	European union	Russian Federation	India
2014					
Overall primary energy sources consumption, billion tons of oil equivalent	3,0	2,8	1,6	0,7	0,6
Oil share, %	17,5%	36,3%	36,8%	21,7%	28,3%
Gas share, %	5,6%	30,7%	21,6%	54,0%	7,1%
Coal share, %	66,0%	17,3%	16,7%	12,5%	56,5%
Nuclear share, %	1,0%	7,7%	12,3%	6,0%	1,2%
Hydro share, %	8,1%	5,4%	5,2%	5,8%	4,6%
Renewables share, %	1,8%	2,6%	7,4%	0,0%	2,2%
2035					
Overall primary energy sources consumption, billion tons of oil equivalent	4,4	3,0	1,5	0,8	1,5
Oil share, %	19,4%	32,9%	31,3%	23,1%	26,2%
Gas share, %	11,2%	39,7%	27,6%	52,1%	7,7%
Coal share, %	47,1%	8,2%	8,4%	10,3%	52,9%
Nuclear share, %	6,1%	6,4%	9,3%	6,8%	2,3%
Hydro share, %	7,9%	5,7%	5,8%	5,7%	3,9%
Renewables share, %	8,4%	7,2%	17,7%	2,0%	7,0%

consumption will be ***increased*** in 2035 compared to 2014 by absolute value
consumption will be ***decreased*** in 2035 compared to 2014 by absolute value

Results of analysis show, that in all of above mentioned countries (regions) gas consumption will rise. Moreover gas is the only fossil fuel which consumption will be increased in all these countries (regions) in considered 20-yr perspective. Let's look at each country (region) in detail.

China.

First of all it should be outlined that commitments of China by COP21 formulated in terms “carbon intensity”. It means that the overall emissions will grow along with energy consumption grow followed by country’s GDP rising.

China is already the world’s leading country in primary energy sources consumption, which is more than in North America or in Europe & Eurasia. Its energy consumption grew faster than in any other big economy in the world following the Cnina’s GDP grows. Actually China has one of the biggest carbon intensity rate.

Currently coal, the most dirty energy source, has the biggest share in country’s energy mix – approximately 66% out of 3 Billion tons of oil equivalent. In the future the share of coal will be decreased to less than 50% of China's mix, but the total coal consumption will remain almost on the same level and even with slight growth.

Actually China’s government install new environment regulation which aimed at transition onto more clear energy sources. Thus shares of gas (currently 5.6%), nuclear energy (1%) and renewables (1.8%) will speed up significantly. E.g. by BP’s projection gas, nuclear and renewables will have the biggest increase in country’s consumption with annual growth rate of 5%, 11% and 10% respectively.

So gas consumption of the country will grow by 193% during next 20 years or by more than 350 bcm per year. At the same time gas import dependency will grow even with more speed: share of import gas will rise from just below 30% to 42% in 2035, or approximately by 180 bcm per year.

Currently Gazprom has no solid gas supply in China. The first gas supply contract was signed in 2014 and under it the first gas will flow from Russia at about 2020. But from above analysis it can be derived that there will be enough possibilities for increasing of gas export to China.

North America

The region is the second biggest primary energy sources consumer in the world after China. The biggest share in region's energy mix has oil with 36,3% and gas has the second place with about 31%.

It should be noted that more than 80% of the regions consumption belongs to USA. In COP21 USA took commitments by decrease absolute amount of emission approximately by 25% from the level of 2005. Taking into account that till 2014 country’s emission already has decreased approximately by 10%, USA needs to obtain just 15% decline in next 15 years. I.e. USA should just save the same speed of emission decrease like it was during the last 10 years, which seems achievable within current energy policies and without significant increase of renewable energy sources share.

By 2035 the share of hydro and renewables energy sources will grow by less than 5 percent points. And in the same natural gas' share will increase by 9 percent points (+34% in absolute consumption value). So natural gas will take the 1st place in North America's energy mix by mid of 20th.

In the same time North America will significantly increase production of oil (+37%) and gas (+53%) with even more rise in USA: +41% and +63%. Due to such situation North America will be energy self-sufficient already by 2018 and will become a net exporter of oil by 2021. USA itself will become net exporter of gas by 2017 and of oil by 2029. BP projected that North America will export as LNG approximately 170-180 bcm per year by 2035, which is by the way equivalent to projected China's import increase. It is one of major factors which will influence overall gas market globally.

Described situation is due to continuation of shale gas revolution in USA. Despite there are many shale gas reserves in the world, e.g. China alone may have even more shale gas reserves in place than USA, North America's shale gas production will represent about thee forth of all shale gas production in the world by 2035.

Europe Union

Region currently has the third energy consumption volume in the world. Under COP21 European Union took commitment to reduce GHG emission by 40% from the level of 1990. In 2014 almost 20% region's emission has been already reducted. This became true primarily due to two tendencies.

First of all region's primary energy sources consumption was peaked in 2006, and from that time it has been declined by more than 12%. This is due to strong focus of Europe's regulations on energy efficiency.

Another strong tendency in region's energy sector is increase of energy production from renewables. Both tendencies will become even stronger in the future: by 2035 decline in energy consumption are forecast at 5% and renewables growth will be at level of +126% (this energy source will be the largest source of power generation in European Union with share of 36%).

Combination of them led and will lead to decline in fossil fuels usage. But this reduction will driven by decrease of usage of coal (-53%) and oil (-20%). At the same time natural gas consumption will increase by 20%. By the way, despite of all these changes oil is expected to remain the dominant fuel in the mix with share of primary energy at level of 31%, followed by natural gas with 28% share, and renewables on the third position with 18% share.

In the same time till now coal plays significant role in energy balance in European Union with share 17% and especially in Eastern Europe countries, like Poland (55%), Chech Republic (39%), Bulgaria (36%) and even in Germany (25%). So it's quite a big room for replacing coal.

Combination of all above mentioned tendencies plus decrease of own Europe's extraction of gas allow to predict that net import will rise for more than 40%, with increase in both LNG supplies and Russian pipeline imports. Moreover Russian pipeline's share of European Union gas consumption is likely to hold steady around 30%, so from 2014th export volume of above 150 bcm it can be increased by 60 more bcm (this volume is equal to projected Nord stream 2 pipeline).

Russian Federation

Commitments of Russian Federation on reduction of emission GHG by 25-30%% in COP21 agreement are taken compared to 1990, which was the last full year of Soviet Union's life with the largest amount of industry production and, consequently, GHG emission. In 2014 emission of GHG was 30% lower than in 1990. So Russia can increase it's emission by approximately 7% and still be within its commitments. Moreover Russia claims that it will take into account absorbing capacity of the forests, which is growing now. So Russia has even more space to increase its emission and has quite little motivation to extensively exploit renewable sources. That's why in 2035 renewables share in Russian's mix forecast at level of 2%.

In the same time Russia's energy intensity will decline by 27% by 2035. Consequently Russia's carbon emission will grow by 7%, which is more slowly than energy consumption rise.

Gas share in energy mix in Russia is one of the biggest in the world – 54% in 2014, and it will be even reduced till 52% in 2035 with increase by 7% in absolute volume. But overall Russia's gas production is forecast to rise by 30%, supported by growing demand on international markets.

India

Country's commitment under COP21 are taken in terms of intensity of GDP. So, due to fastest projected speed of GDP growth in the world among large economies, India's energy consumption and carbon emission will significantly rise by 136% and 122% respectively.

India's energy mix will evolve very slowly till 2035 and all the primary energy sources consumption will rise for 100% and more. Gas consumption will increase by 155%. In the same time country's natural gas production will rise by «only» 68%, so there will be new demand which can be assessed in more than 50 bcm per year.

Worldwide gas consumption also will rise with pace of 1,8% p.a. (same as nuclear and hydro) which is much more than other fossil fuels. Only renewables with growth rate above 6,5% p.a. will increase their volumes significantly faster, but they will start from much lower base, that's why Fossil fuels remain the dominant source of energy powering the global economy, providing around 60% of the increase in energy and accounting for almost 80% of total energy supplies in 2035.

In all 5 biggest energy consumption countries (regions) absolute volume of natural gas consumption will rise and in three of them there will be quite big opportunities to sale new volumes of gas. Meanwhile in different regions will prevail different tendencies, and big energy companies should be ready to provide supplies in most effective and flexible manner. E.g. from Gazprom's point of view India actually can be reached in effective way only by LNG supply as well as many industrial regions of China like Shanghai and Hong-Kong.

6. *Analysis of current technologies of energy supply.*

Natural gas technologies.

As it was mentioned above, Gazprom's natural gas domestic sales and export consist mostly of pipeline supply of conventional gas with small share of LNG deliveries. Moreover in considered future till 2035 it's more probable that gas will remain the main source of Gazprom's revenues and profits. So first of all new technologies in gas extraction, transportation and processing should be reviewed.

Shale gas.

Shale gas is the natural gas which is extracted from the shale formation with low permeability. Till recent time this gas didn't consider as industry meaningful reserves, because there was no economically efficient way of extraction of such gas. In order to recover gas from shale producer should break the collector to provide permeability. In this connection producers use hydraulic fracturing technology. Besides that collector breakage should be done on big square, so directional horizontal drilling technology used for this along with multi-staged hydraulic fracturing, which brings cost saving and economic efficiency in shale gas extraction.

Despite main elements of shale gas extraction (hydraulic fracturing and horizontal drilling) were known from the first half of 20th century, economic efficiency was achieved only by the turn of 20th and 21st centuries[10]. From that time shale gas is the fastest contributor in USA's primary energy mix. Wide usage of these technologies and consequent sharp spurt in shale gas production were started about 10 years ago. It was called «shale revolution» because of dramatic changes in natural gas sector of USA and the whole world. Shale revolution impact also other energy sources and countries, e.g. coal which is extracted in USA was replaced by more cheap natural gas and was sent to Europe, which in its turn led to increase of coal generation on the continent despite of all regulatory's movements to more clear energy mix.

Besides North America shale gas reserves are in place in many different countries in the world. E.g. China by some appraisals may have more shale gas reserves than USA. But in the same time used technologies also have some restrictions during implementation which restrict fast distribution of «shale revolution» on other countries:

- Shale gas extraction needs much more drilling than conventional gas fields. USA has big number of drilling rigs available at relatively small cost, which is not the case in most of other countries, e.g. in Argentina.
- Shale gas extraction in general is more expensive than conventional gas. So in order to have economic advantages it should be consumed near the place of extraction, or transported at relatively low cost. Both are in place in USA, but e.g. in China shale gas plays are far from main gas consumption and there is no available pipelines.
- Hydraulic fracturing is required big amount of water which in its turn not in all regions available in enough amounts, which is also true for China.
- Hydraulic fracturing have some negative ecological consequences mostly connected to water pollution with chemical and natural gas. Another problem relates to instability of subsoil after hydraulic fracturing, which may lead to earthquakes. Both problems lead to social protests against shale gas, e.g. in Europe.

Combining all the above it can be concluded that shale gas will not replace conventional gas during considered period till 2035.

Gazprom has the biggest reserves of conventional gas (more than 25 000 bcm), so it's more efficient for the company to develop technologies to bring all these volumes to the market. But tendencies in shale gas industry should be monitored.

LNG & GTL and their usage in transportation.

Both technologies are considered as alternative to pipelines way of gas transportation as well as new types of more clear fuel for ships, airplanes, automobiles etc. Both technologies are known for relatively long time. Actually LNG is more widespread as a technology of gas transport to long distances due to its economical efficiency.

As gas is more clean fuel compared to widely used oil products, both technologies can be used in changing energy mix in areas where air purity has a value, especially in big cities.

Thus these technologies are additional to natural gas marketing and it should be valuable for Gazprom to have own technologies and strong expertise in both, which is not the case at current moment.

Gas hydrates.

Gas hydrates are ice-like substances that form in deep-sea sediments. When gas molecules are trapped in a lattice of water molecules at temperatures above 0°C and pressures above one atmosphere, they can form a stable solid. These solids are gas hydrates. Most gas hydrates are formed from methane (CH_4) and can be used as energy source[10].

The problem with development of gas hydrates is that they are very unstable in atmosphere. There is no known industrial and economically efficient technologies of gas hydrates development. Gas hydrate deposits along ocean margins are estimated to exceed known gas reserves.

Development of industrial, economically efficient technology can take very long time and it's unlikely become available during considered period of time, e.g. it was taken almost 100 years to make shale gas extraction economically feasible after first gas extraction from shale. So for Gazprom it will be most efficient to just monitor situation with such technologies.

Low-carbon technologies.

Second big part of probably disruptive for Gazprom technologies is (of course) low-carbon technologies and especially renewables which is the fastest growing energy source. In recent years more than 50% of additional energy production capacities are already renewables.

Variable renewables: solar panels and Windmills

Solar panels and windmills both represent current base for plans of transition to low carbon economy worldwide. Actual sharp rise in renewables usage also fully connected to them. Both are constantly improved worldwide in terms of decreasing cost of kWh. But still it should be noted that great increase of renewables was helped by regulations' and political incentives. Cost of energy from renewables in most cases are still bigger than from fossil fuels.

But the main problem with solar and wind power is in reliability of power supply which depends on ability to match demand and supply in real time. This task will become more difficult with the increase of penetration levels of renewables [11].

There can be a range of solutions, both on the supply and demand sides, that can help to overcome the integration challenges. On demand side main initiatives connected to rebalancing demand in accordance with supply outcome which can be represented by cost of electricity. From the infrastructure side main solutions are connected to improving integrity and flexibility of power grids. On supply side main solutions

are represented by improving flexibility of other energy sources and by various types of storages which can combine electricity during surplus on supply side (i.e. at low price levels) and output the power during demand peaks (i.e. at high price levels). Actually the biggest share of overall storage capacity represented by pump storage hydropower (which is most cost efficient), supplemented by mix of batteries, compressed air energy storage, flywheels and hydrogen storages [11].

Another type of balancing variability of solar and wind is an implementation of special flexible generators for producing energy from reliable energy source, e.g. natural gas. Actually, despite of recent declines in battery costs, gas-fired turbines can at present meet support function for variable energy sources for a fraction of the cost of batteries[11].

Installation of above mentioned technologies to handle variable character of solar and wind energy sources will directly or indirectly (e.g. through the investments in improvement of flexibility of electicity system) increase cost of renewables for the whole society.

Gazprom's possible interest in development of these technologies can be considered from two points of view: 1) to develop gas-based technologies to supplement variable renewables during decline of output from them in order to integrate gas into renewable energy, and 2) to develop own expertise in variable renewables in order to take advantages from participation in the fastest-growing energy source and to be prepared for fast transformation of Gazprom's business in case of necessity.

Carbon Capture & Storage (CCS).

CCS is a family of technologies and techniques that enable the capture of CO_2 from fuel combustion or industrial processes, the transport of CO_2 via ships or pipelines, and its storage underground, in depleted oil and gas fields and deep saline formations. CCS can have a unique and vital role to play in the global transition to a sustainable low-carbon economy, in both power generation and industry.

In power generation sector CCS aimed at cardinal decrease of CO_2 emission from fuel combustion and hence prevent decommissioning of gas (as well as coal) facilities. This technology of course will increase the price of energy from gas, but it should be compared with full price of renewables, including costs of electricity storage and smart distribution. And the result of such comparison is not evident.

For Gazprom this technology can save market for its main source of profits – natural gas. So it should be interesting to develop an expertise in it, despite it also can be used for main gas competitor – coal.

Biofuels. Biogas.

A biofuel (biogas) is a fuel that is produced through contemporary biological processes, such as agriculture and anaerobic digestion. Biofuels (biogas) can be derived directly from plants, or indirectly from agricultural, commercial, domestic, and/or industrial wastes, as well as from biomass. Renewable biofuels generally involve contemporary carbon fixation, such as those that occur in plants or microalgae through the process of photosynthesis[10].

There are various social, economic, environmental and technical issues relating to biofuels production and use, which have been debated in the popular media and scientific journals. These include: the effect of moderating oil prices, the "food vs fuel" debate, poverty reduction potential, carbon emissions levels, sustainable biofuel production, deforestation and soil erosion, loss of biodiversity, impact on water resources, rural social exclusion and injustice, shantytown migration, rural unskilled unemployment, and nitrous oxide (NO_2) emissions [10]. E.g. Some scientists have expressed concerns about land-use change in response to greater demand for crops to use for biofuel and the subsequent carbon emissions.

Gazprom's interest to these technology can be driven by two possible goals: 1) to try to make biofuel (biogas) industry in Russia which has the biggest territory among other countries and some of it can be used for plants of respective agricultures, and 2) to mix biofuels (biogas) with respective fossil fuel in order to improve societal and environmental image of Gazprom's production.

Hydrogen.

Hydrogen in ecologically clear fuel. Currently the most cheap way to get hydrogen from methane, which is used, for example, in chemical industry. But this way is connected to CO_2 emission, that's why such hydrogen cannot be sustainable. Another way is to get hydrogen from the water by electrolysis process, but it takes more energy than can be obtained from derived hydrogen. But electrolysis can be performed with cheap electricity when there is a surplus of variable renewables, what can be viewed as an energy storage.

Another possible way of using hydrogen is a clear fuel for automobiles, which can replace fossil fuels and can compete with electric cars. But actually there are many technological problems with safe use and transportation of hydrogen, which is more flying and more dangerous than methane.

Hydrogen has wide ways of use in energy industry and is interesting for most energy companies, but due to no economically applicable and safe technologies it seems that this theme should be monitored.

Technology conclusion.

The main conclusion from this chapter is that there are still many problems with renewables to be solved with their economic efficiency, usability and other aspects. But in case if all or most problems will be solved it will lead to minimize of fossil fuel usage what is dangerous for companies, main business of which is hydrocarbons extraction.

7. Identification of main risks and opportunities for Gazprom.

Identification of main risks and opportunities for different time intervals was performed with slightly modified SWOT+ analysis[12].

Table 4. Results of SWOT analysis for Gazprom.

Parameter	Current situation	10-years perspective	20-25 years perspective	30+ years perspective
Weaknesses/ risks/ Threats/Night mares	1. Restricted number of markets: gas transportation mostly by pipelines, gas export mostly to Europe with stagnated gas market, electricity production and marketing mostly on local market. 2. Absence of existing expertise and perspective plans to transfer to low-carbon energy.	1. Decline in competitiveness of Gazprom's gas in Europe. 2. Replacement of gas as an energy source in Europe.	1. Substantial decline of gas consumption in Europe, refuse from Russian gas, at it has significant negative environment footprint. 2. Tightening of competition and fall of prices/volumes on Asia markets.	1. Significant fall of gas consumption worldwide due to implementation of renewables. The displacement of Gazprom from export markets. 2. Transformation of Gazprom into local Russian company, which provide restricted volumes of gas and electricity from fossil fuels on domestic market only, or even end of Company's life.
Strenths/ Opportunities / Dreams	1. Biggest conventional gas reserves among other world companies and available possibilities to sale them to Europe and Russian Federation. 2. Diversified structure with company's divisions in different energy subsectors, including electricity generation, what allow to build full chains in order to combine knowledge from different areas.	1. Substantial increase of revenues due to start of export to China. 2. Securing share on Europe's market due to low cost of gas extraction and transport as a main competitive advantage.	1. Rise export supply widely in the world, including reorientation onto LNG and GTL sales, especially in big city agglomerations, which suffer from air pollution. 2. Development of «clear» technologies portfolio in order to significantly improve company's image and securing supplies in regions, which actively move onto renewables (e.g. CCS, biogas and biofuels, hydrogen production for marketing in mix with natural gas).	1. Development of technology portfolio, which can allow to secure gas as a supplement fuel on main energy markets. 2. Reorientation of the company on electricity production from various energy sources, with ability to flexibly change their balance depending on market conditions and to provide competitive decisions in scope of energy transformation.

So, in short-term perspective natural gas role in energy mixes worldwide will be substantial and biggest risks are connected to changes on local markets, which are target for Gazprom. On Russia's market it's likely will be no major changes in general. Meanwhile competition between gas producers will increase. At the same time, while biggest revenue goes from export, thus main risks and opportunities are connected to changes on Europe's market, which is traditional for the company and China's market, supply on which currently is organized in scope of contract on 38 bcm per year delivery started from 2018. Besides that, currently Gazprom is actively developing new ways of gas supply to China.

In mid-term perspective, in case of further progress of renewables worldwide, main risks are connected to decline in consumption in traditional areas of natural gas usage and significant tightening of competition in most of countries and regions worldwide. In this connection in order to save supply volumes of natural gas it's necessary to widen ways of export on the whole world. At the same time, in order to secure supply volumes on traditional markets it's necessary to develop competition advantages, which allow to meet customers' changing demands during transition phase.

In long-term perspective main «nightmares» for Gazprom, as a company which business in big share is connected to hydrocarbons extraction, is the refuse from fossil fuel and full transfer onto renewable energy sources. In this case in order to make company alive it's necessary to fully reorganize business. Most probably from current point of view is the transition on electricity as the main energy carrier. In this connection one of main opportunities is the development of competencies which are necessary to provide technologies of making gas as a supplement energy source for renewables. The other opportunity is reorientation of the company on base of available electric business.

Taking into account above mentioned, the following opportunities for further development and transformation can be proposed:

1. Development of technologies and building of facilities for LNG and GTL production.
2. Diversification of markets by means of delivery gas, LNG and GTL to new markets worldwide.
3. Participation in «green initiatives» in Europe in order to improve image of natural gas as an energy source, Gazprom itself as an reliable resource provider, who is also aimed at being in place with GHG emission pledges.
4. Development of electricity generation business by means of expansion on foreign markets, especially in renewables sector. Receiving of available technologies and their implementation for the purposes of the company.
5. Development of technologies, which allow to use gas as supplement fuel with renewables.
6. Development of technologies of biogas and biofuels production, integration of biogas and biofuels facilities into supply chains of the company.
7. Establishment of demand on innovation in renewables sector in Russia in cooperation with scientific centers on local market as well as abroad.
8. Set demand on development of technologies aimed at decrease of GHG emission during whole chain from gas extraction, its transportation and till energy production from gas, e.g. development of CCS technologies.
9. To establish within company culture and structure, which are suitable for changes management in the area of fast development and implementation of above mentioned technologies.
10. Development of perspective plans for response to disruptive technologies evolution.

8. Conclusions.

In the essay different factors were analyzed, which may impact Gazprom's operation from the point of view of energy sector transformation in transition to renewables. These factors are: consequences of COP21, changes in primary energy sources' balances of main energy consumers, development of technologies in energy area. Main conclusions are:

1. In near and mid-term perspective worldwide gas demand will most probably increase. Meanwhile there may be significant changes on separate countries' and regions' markets. In this connections, in case of correct reactions on market environment Gazprom should not be significantly affected by negative changes.

2. Available technologies in renewables allowed to replace significant share of traditional energy sources in some regions to the moment. Meanwhile, mentioned technologies still less economically efficient than electricity production from fossil fuel, that's why they sharply rise with help from subsidies. Besides, the problem of handling variable character of most commonly used renewables is still not solved. It does not allow to use renewables as a backbone for the energy system without loosing its stability.
3. Taking into account above mentioned, in 25 years perspective in main regions in terms of energy consumption the rise of gas consumption can be predicted.
4. Based on analysis of above mentioned tendencies in environment, weaknesses and strengthens of Gazprom were analyzed, main risks identified, threats and opportunities for successful development in the future discovered. On this base possible counteractions were formulated.

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