East Asia as an object for Russia-Mongolia energy cooperation

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***Abstract* — The paper analyses the role of the Asia Pacific Region and East Asia, in particular, for both Russia and Mongolia as energy exporters. A quantitative assessment of coal, oil and natural gas markets demand of East Asia countries is made. The assessment relies on our outlook, and the outlooks of Russian and foreign organizations. The prospective directions of energy cooperation between Russia and Mongolia, which allow harnessing the resource, geographical and economic potential of the two countries and expanding energy cooperation with the other countries in East Asia, are proposed.**

***Index Terms* — East Asia, energy cooperation, Mongolia, resources, Russia.**

I. Introduction

Primary energy demand projection up to the middle of this century is made for all the countries in East Asia. Regional coal, oil and natural gas market volumes are estimated. The main directions of advancing cooperation between Russia and Mongolia, as primary energy exporters within the region, toward East Asia countries are highlighted.

Asia Pacific Region, Northeast Asia and East Asia: economic and geographical definition

The Asia Pacific Region (APR) is not a clearly defined economic and geographic object. Initially, it included the USA, Canada and the countries bordering the west section of the Pacific Ocean, from Japan to Singapore to Australia and New Zealand. The geography of cooperation expanded when Latin American countries joined. At the end of the XX century, twenty-one countries around the Pacific Ocean established the Asia-Pacific Economic Cooperation (APEC), the regional international organization with the main objective to promote economic integration on the grounds of free trade.

The Northeast Asia region (NEA) is generally assumed in Russian and foreign economic literature as part of Eurasia that includes six countries: Mongolia, the People's Republic of China (PRC) (including Special Administrative Regions Hong Kong and Macao as well as Taiwan Province), the Democratic People's Republic of Korea (DPRK), the Republic of Korea (RoK), Japan and the Russian Federation (Russia). Sometimes Taiwan Province is called "country" outside of the APEC context to underline its high level of political and economic independence from the central government of PRC. To avoid political controversy within the cooperation process in the APEC region all above mentioned economic and geographic objects are called "economies", since Taiwan and Hong Kong by themselves are full APEC members. Here the term "East Asia" means all Northeast Asia countries except Russia.

East Asia (EA) countries, other than Mongolia, provide gas, electricity, and coal markets for Russian and Mongolian exports. In this respect,the energy markets are "objects" of the multilateral cooperation within the EA region. Russia-Mongolia energy cooperation towards such energy markets could be coordinated or independent. On the other hand, Mongolia, being one of EA countries, could be considered as an object for bilateral Russia - Mongolia energy cooperation by itself. Here the first approach is considered to be major driver for Russia – Mongolia collaboration as energy exporters, while energy complementarity issues arise as drivers for bilateral energy cooperation.

II. The current status of Russia and Mongolia energy cooperation with the East Asia countries

Energy sector meets the requirement for energy services from a country's economy and population. Additionally, it plays an important role in the GDP growth, government

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Table 1. Resource potential of Mongolia, Siberia and the Russian Far East.

Indicator	Unit	Russia		Mongolia
		Siberia	Far East	
Coal reserves	Gt	153.8	20.2	21.5
Conventional oil reserves	– " –	3.5	1.0	0.206
Natural gas reserves	trillion m^3	6.1	3.0	-
Hydropower technical potential	TW·h	757	684	9
Wind energy technical potential	GW	900	1200	1100
Solar energy technical potential	– " –	1100	1400	1500

Source: [1].

Table 2. Energy export from Mongolia in 2017.

Importer	Coal		Crude oil		Electricity		Total energy export, billion USD
	million doll.	Mt	million doll.	Mt	million doll.	GW·h	
APR	**2 236**	**34.1**	**362**	**1.0**	**0.3**	**23**	**2.6**
Russia	-	-	-	-	0.3	23	..
EA	**2 236**	**34.1**	**362**	**1.0**	-	-	**2.6**
China	2 212	34.0	362	1.0	-	-	2.6
Taiwan	6	..	-	-	-	-	..
Japan	18	0.1	-	-	-	-	..
World	**2 236**	**34.1**	**362**	**1.0**	**0,3**	**23**	**2.6**

Source: calculated based on [2].

budget revenues, social development and the interaction with other countries when energy resources trading is taking place. In other words, energy sector ensures economic growth, being one of the major drivers for socioeconomic and political development. The role of energy sector in Mongolia and Russia is particularly important: the share of resource export in Mongolian GDP in 2017 is 23 %; the same indicator for Russia is 13 %. These figures are calculated on the basis of foreign trade statistics and the World Bank GDP statistics.

Huge resource potential (Table 1) and the features of geographical location of the two countries predetermine their role in international trade, especially in the APR and East Asia, as the suppliers of energy resources and the providers of related energy services.

Energy export accounts for 42 % of Mongolian total export; 86 % of it is coal export (Table 2). China is a monopolistic importer of Mongolian oil and almost a monopolistic importer of Mongolian coal. Import prices for Mongolian coal are the lowest for China. Besides, China provides transit services for Mongolian coal [3].

There are several power transmission lines between Russia and Mongolia, including Selenduma-Darhan transmission line to the Central Energy System of Mongolia [4], while 76 % of electricity comes from China (Table 3). In total, Mongolia imports up to 20 % of electricity consumed [5].

Petroleum products import makes up the biggest part (85%) of energy imports, and almost all of the petroleum products are imported from Russia (96%). The first Mongolian refinery in Altanshiree (Dornogovi Province in south-eastern Mongolia) with crude oil throughput of 1.5 million ton per year is planned to be put in operation in 2022 [6]. After this important turning point, Mongolia can substantially reduce petroleum product import from Russia by abandoning crude oil export to China.

East Asia is also an important region for Russia, as it is an export market for Russian coal, oil, petroleum products and LNG (Table 4). In 2017, being part of the APR, East Asia countries, including Mongolia, imported 92 % of Russian coal exported to the APR, which in turn represented 44 % of total coal export from Russia. That year the share of East Asia countries in Russian oil export to the APR was 97 %, which accounted for 25 % of Russian total crude oil export. The similar indicators for Russia's export of petroleum products were 46 % and 15 %, respectively.

While 100 % of pipeline gas goes in western direction – to Europe, Transcaucasia countries, and Turkey, almost 99 % of Russian LNG is exported to the EA region. After the commissioning of the Power of Siberia gas trunk line later this year, the East Asia region, represented by China, will become the importer of Russian pipeline gas too. In addition, new LNG projects on the Russian Arctic will expand the already established LNG export to EA, and provide exports to the USA and Europe.

Nevertheless, the cooperation between Russia and East Asia countries should not be limited by the role of Russia as energy resources supplier. The prospective directions for multilateral energy cooperation enhancement are the diversification of supply routes, energy transition issues, energy services export and energy-related machinery production.

Table 3. Energy import to Mongolia in 2017.

Exporter	Petroleum products		Electricity		LPG		Total energy import, million USD
	million USD	kt	million USD	GW·h	million USD	kt	
APR	**835**	**1509**	**137**	**1574**	**14**	**29**	**986**
Russia	777	1455	27	380	11	28	815
EA	**51**	**52**	**110**	**1194**	**2**	**1**	**164**
China	29	31	110	1194	-	-	140
RoK	21	21	-	-	2	1	23
Japan	1	-	-	-	-	-	1
World	**843**	**1514**	**137**	**1574**	**14**	**29**	**994**

Source: calculated from [2].

Table 4. Energy export from Russia in 2017.

Energy carrier	Unit	World	APR	EA
Coal	Mt	181.4	80.6	74.0
Crude oil	Mt	252.6	64.2	62.1
Petroleum products	Mt	148.4	31.3	14.4
Natural gas (pipeline)	billion m^3	212.9	-	-
Natural gas (LNG)	Mt	11.0	10.9	10.9

Source: calculated based on [2, 7].

III. Quantitative assessment of energy markets of the East Asia countries

In 2017, global primary energy consumption accounted for 19.3 billion tce, with a 2.2 % year on year growth rate. The East Asia countries, holding 22 % of the World's population, provided 25 % of the World's GDP in purchasing parity power (PPP) terms, and consumed 30 % of primary energy. From the perspective of energy exporting countries, the most important characteristic is their niche on the energy markets. In 2017, EA countries imported 42 % of coal, 32 % of oil and 28 % of natural gas sold at the international markets. The dependence of Japan, RoK and Taiwan on energy imports is absolute in the case of coal, crude oil, and uranium, and almost absolute in the case of natural gas. Such a huge market is attractive to the countries with large and excessive energy resources. EA energy market includes China as the first World's economy in PPP terms, which is characterized by sharply growing shortage of domestic oil, gas, uranium and even coal. Moreover, even if the switch from fossil energy to renewable energy sources in the energy mix is fast enough, there is still a room for import of "clean energy" and energy services. This import could be based on solar and wind energy in the southern regions of Mongolia, the hydropower resources of Siberia and the Far East, and wind energy along the Arctic and Pacific coasts of Russia, to EA countries.

China is the undisputed leader of primary energy consumption in the EA region and in the World, accounting for 23.2 % of the World's energy consumption in 2017. Japan is the second in the EA region after China with 3.1 %. Along with the DPRK, Japan has demonstrated a decline in total energy consumption since 2000. The RoK is the next largest consumer of primary energy in East Asia, representing 2.6 % of the World's energy consumption in 2017. The share of the DPRK and Mongolia is negligible, as their total primary energy consumption accounts for approximately 0.12 % of the World's one.

The structure of primary energy consumption in EA countries differs significantly from the global one. The World's primary energy consumption in 2017 demonstrates the share of crude oil, coal and natural gas for more than 34 %, 28 %, and almost 23 %, correspondingly (Table 5). The share of fossil fuels in the East Asia region was 25 % for crude oil, 53 % for coal, and just 9 % for natural gas.

The positions for Russia and EA countries on energy markets are characterized by their complementarity. While East Asia is the World's largest regional energy importer, Russia is the World's largest single energy exporter (Fig. 1). In order to estimate future energy markets in the East

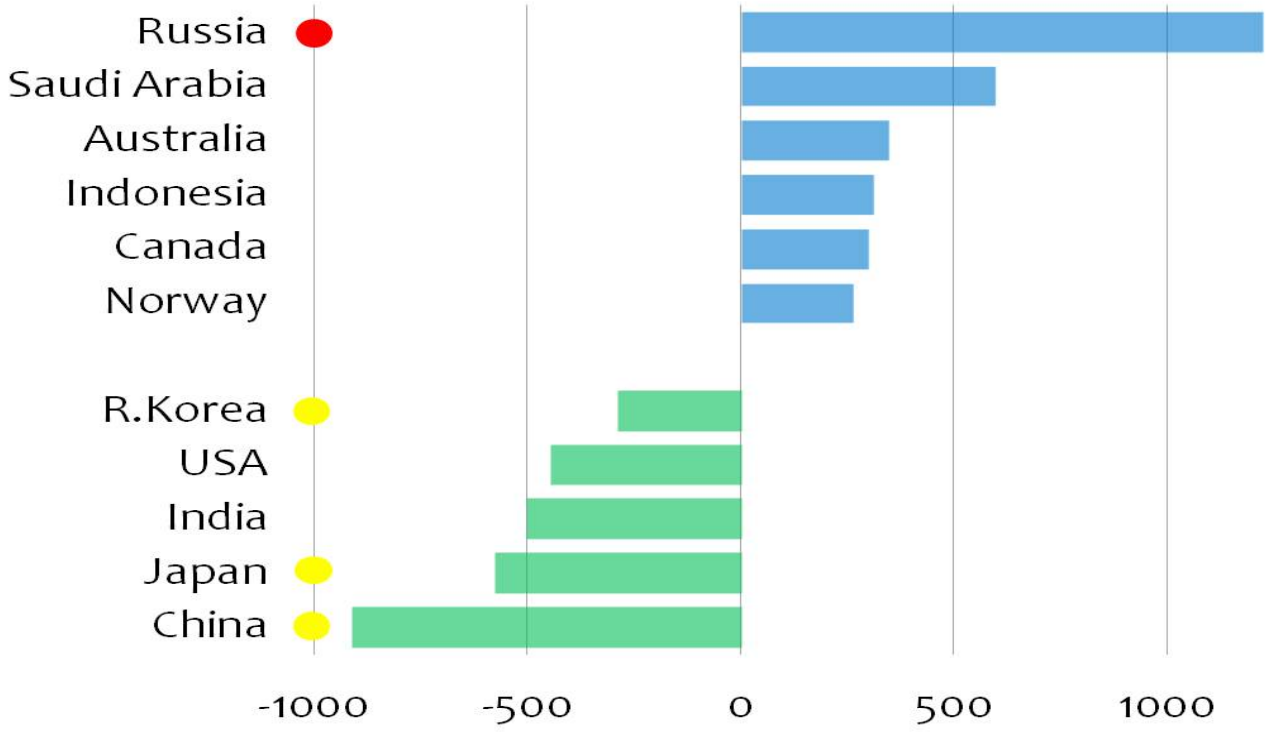

Fig. 1. World's largest energy exporters and importers in 2017, MTCE. Source: calculated based on **[9].**

Asia countries, the studies focused on energy consumption outlooks in these countries up to 2050 were carried out by the Melentiev Energy Systems Institute (MESI) SB RAS. The studies also took into account similar outlooks presented by a number of reputable international organizations, companies, and research centres that are accessible in the public domain. Within the expert community, the most recognized organizations are the International Institute for Applied Systems Analysis (IIASA), the International Energy Agency (IEA), and the Energy Information Administration of the US Department of Energy (EIA). In recent years, they were joined by the Institute of Energy Economics of Japan (IEEE), which focuses on the Asian region. Some large oil and gas companies, such as Shell and British Petroleum (BP), also have begun to provide qualitative outlook information on the open access basis as a supplement to the scenario description of their internal researches on long-term energy market outlooks. From the global studies, of special interest is the Global energy outlook developed jointly by the Energy Research Institute of the Russian Academy of Sciences (ERI RAS) and the Analytical Centre under the Government of the Russian Federation from 2012 to 2016. This particular outlook includes an in-depth analysis of the future Russian energy systems development.

A comparative analysis of five outlooks compiled by a number of well-known organizations, research centres and companies has been made. Two of them were published in 2018, the outlook by EIA was published in 2017, the others - in 2016. Table 6 demonstrates Total Primary Energy Supply (TPES) and the estimates of oil, coal and gas imports for East Asia countries corresponding to the baseline scenarios of the outlooks under consideration. Since the IEA's 2018 outlook was not available, the outlook for 2016 was analyzed. The ERI RAS outlook was not updated after 2016. None of the outlooks considered Mongolia and DPRK, thus they were not presented in Table 6. As the Table shows, the results for Japan, RoK and Taiwan are not consistent and logical.

The MESI SB RAS has been carrying out studies on the long-term energy demand and supply for all the countries of East Asia for a number of years. The major purpose of such studies, among other things, is to estimate the potential demand of East Asian energy market for energy resources from Russia [10]. The MESI methodology for long-term projections up to 2050 is based on the holistic approach to the energy system analysis – from technological to social and economic factors, from final energy consumption to primary energy production [11]. This approach starts from the assessments of final energy demand, based on elasticity of the specific useful energy consumption of aggregated economic sectors and end-use industries in terms of GDP (in constant prices). Then, as a result of the model-based optimization process, the structure for energy transformation sector is assessed. The assessment process incorporates the outcomes of institutional research at the

Table 5. Primary energy consumption structure in 2017, %.

Country, region	Crude oil	Coal	Natural gas	Nuclear energy	Hydropower	Other renewables
Russia	22	13	52	7	6	..
Asia-Pacific Region	29	48	12	2	6	3
East Asia	25	53	9	3	7	3
China	19	60	7	2	8	3
Hong Kong	71	20	9	-	-	..
Taiwan	43	34	17	4	1	1
Japan	41	26	22	1	4	5
RoK	44	29	14	11	..	1
North America	40	13	29	8	6	4
Central and South America	46	5	21	1	23	5
Europe and Eurasia	32	15	32	9	6	6
Near and Middle East	47	1	51	..	1	..
Africa	44	21	27	1	6	1
World, total	34	28	23	4	7	4

Source: calculated based on [8].

national level in order to provide the constraints within the models. Such constraints are supposed to reflect the "most probable" energy policy provisions for each East Asia country.

In 2018, energy consumption was estimated by the MESI SB RAS for all the six countries of East Asia, considering the so-called "reference" scenario, and the "gas" scenario made additionally for Mongolia. The base year assigned for the outlook was 2013, with sequential reference years 2025, 2035 and 2050. Then further analysis was made to provide energy market assessments.

Due to its scale and impact on energy markets development, China is the most interesting object, considering the prospects of the global and regional energy demand. The major drivers for China's energy policy, after the need for energy services, are the economics of coal supply and the impact of air pollution on social development. The coal supply economics relates to the depletion of highly profitable resources and rising cost of labour, combined with fierce competition at the metallurgical coal market due to the industrial stagnation – the decline of pig-iron production, or the processes that involve iron ore as an input. As the recent analysis made by the CRU consulting company indicates: "In China, we believe the authorities will continue to deliver a managed slowdown in economic activity. And that will lead to gradual slowing in the construction and auto sectors. Economic growth in China may slow to 6% in 2019.

Hot metal production will fall steadily in contrast with stable crude steel production, because of an increase in EAF-based production and greater scrap consumption in the BF-BOF steelmaking. Meanwhile, hot metal production

Table 6. Outlooks of total primary energy supply and import of coal, crude oil and natural gas for east asia countries.

Outlook	China	Taiwan	RoK	Japan
Total Primary Energy Supply, Mtce				
IEA (2016 | "current policies"), 2040.	6446	n.a.	n.a.	565
EIA (2017 | "reference"), 2050	6543	n.a.	652	659
ERI RAS (2016 | "basic"), 2040	5839	n.a.	n.a.	n.a.
IEEJ (2018 | "reference"), 2050	5533	150	410	524
BP (2018), 2040	6170	n.a.	n.a.	n.a.
Energy Import Estimations				
coal, Mt				
IEA (2016 | "new policies"), 2040	36	n.a.	n.a.	149
EIA (2017 | "reference"), 2040	112	n.a.	231	154
IEEJ (2018 | "reference"), 2050	23	55	125	137
crude oil, Mt				
IEA (2016 | "new policies"), 2040	571	n.a.	n.a.	101
EIA (2017 | "reference"), 2050	619	n.a.	154	151
IEEJ (2018 | "reference"), 2050	569	36	98	107
ERI RAS (2016 | " basic "), 2040	568	n.a.	104	98
natural gas, bcm				
IEA (2016 | "new policies"), 2040	268	n.a.	n.a.	95
EIA (2017 | "reference"), 2050	265	n.a.	85	116
IEEJ (2018 | "reference"), 2050	234	33	80	99
ERI RAS (2016 | " basic "), 2040	193	n.a.	47	94

Source: Calculated based on [12,13,14,15,16].

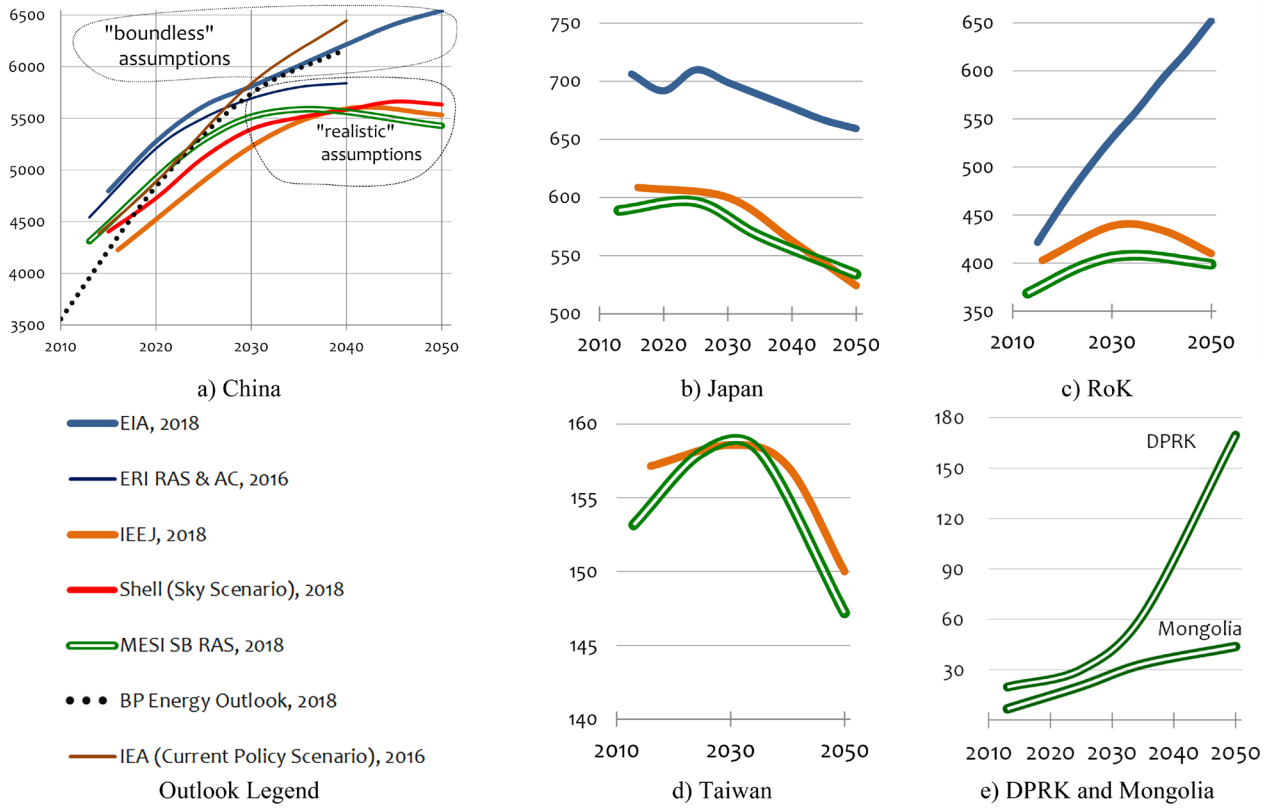

Fig. 2. Total Energy Supply Outlooks for comparison of East Asia economies, MTCE.

will rise elsewhere with rising crude steel production. As a result, the demand for key bulk steelmaking raw materials including iron ore, metallurgical coke and metallurgical coal is forecast to go down in China but pick up elsewhere.

Although China has eliminated some coke capacity over the past several years, domestic coke demand contraction will enable China to continue to be a key coke exporter globally. While Chinese coke demand is predicted to fall, the quality requirement will be higher, meaning that demand for high quality coal will be stable at the expense of demand reduction in weak coal. This will lead China to be a more critical metallurgical coal importer in the global trade market, as domestic coal quality will deteriorate over time." [17]

The impact of air pollution on energy choice in China is rather complex, while rooted in obvious reason that is poor management of air pollutions caused by burning coal for industrial purposes, electricity and heat generation within the industrialized agglomerations.

As shown in Fig. 2a for China, two groups of reference scenarios are distinguished, conventionally corresponding to the "boundless" and "realistic" assumptions on primary energy demand growth. The first group includes the EIA and BP outlooks published in the years 2017 and 2018, as well as the IEA "current policy scenario" (available since year 2016). The second group includes the IEEJ's basic scenario, the Shell's Sky scenario, and our reference scenario, all of them dated by the year 2018.

An intermediate option that lies between the described two outlook groups with a clear trend to stabilization of TPES, belongs to the last of known Joint research by the Energy Research Institute of the Russian Academy of Sciences and the Analytical Centre at the Government of the Russian Federation, published in 2016. It seems that the EIA's and BP's projections tend toward overestimation of future demand, despite the upcoming fundamental shift in the global economic development. Interestingly, such rearrangements within the globalization paradigm are currently actively pursued by tandem of the United States and the United Kingdom.

For Japan (Fig. 2b), despite the general decline of TPES, it is an inexplicable "drop" in the next 2-3 years, followed by a short-term growth and then a new steady decline, as the EIA's outlook suggests. In contrast, the IEEJ's outlook seems to be much more reasonable and logical. The most striking difference, in terms of the approaches to projections for East Asia industrialized countries by the researchers from the USA and Japan, is demonstrated by the RoK TPES projection in Fig. 2c. The EIA shows a simple case for the unbundled "growth over the roof", while IEEJ outlook indicates a coming peak after the 2030th, followed by a decline.

The IEEJ and MESI SB RAS projections for Taiwan TPES, which follow the trend established by Japan, RoK, and China, are presented in Fig. 2d.

This is the first time, the long-term projections for

Table 7. Crude oil balance for East Asia, Mt.

Balance	Year			
	2017*	2025	2035	2050
Demand, total	959	720-780	670-710	600-700
incl: China	589	430-460	410-420	360-400
Japan	162	150-160	120-130	95-110
RoK	162	100-110	90-100	80-95
Taiwan	43	40-45	40-45	35-45
DPRK	0,7	2-5	8-12	25-40
Mongolia	-	0-1	0-2	0-3
Production, total	197	155-190	140-190	115-140
incl: China	194	140-160	130-170	110-130
Import, total	770	570-620	530-600	490-570
incl: China	420	280-300	270-290	250-280
Japan	158	150-160	120-130	95-110
RoK	149	100-110	90-100	80-95
Taiwan	43	40-45	40-45	35-45
DPRK	0,7**	2-5	8-12	25-40
Mongolia	-	0-1	0-2	0-3

Source: * – [9]; ** - [2].

TPES of DPRK and Mongolia (Fig. 2e) have been in the public domain. In actuality, they are the improved versions of the MESI SB RAS projections first made in 2015. The major improvements include much higher economic growth rate for the DPRK and the introduction of a natural gas supply option for both countries. For the DPRK, such an option assumes future tight economic cooperation on the Korean Peninsula. For Mongolia, the option for natural gas supply leads to the new "gas" scenario in addition to the compulsory "reference" coal-based scenario.

The main difference between the projections for energy system development in the DPRK and Mongolia is related to the size of economies and the population of the two countries. Mongolia is an agrarian economy with rapidly developing export-oriented mining sector and prospects for large-scale development of export-oriented, environmentally friendly renewable energy production. The DPRK is on the threshold of the domestic market's rapid growth and the country's reindustrialization. The assumption for the DPRK reindustrialization is based on positive assessment for the emerging cooperation with the RoK on their common path to Korea's reunification.

a. General assessment of the EA energy markets

The outlook assumptions are based on the established pricing mechanisms for crude oil and coal. While crude oil is imported to the region at prices determined by spot markets (including the whole set of derivative instruments), coal contracts are fixed-term, following crude oil prices. The pricing of natural gas in East Asia by 2050 will be based on gas-to-gas competition mechanism and determined by the exchange trade instruments.

China is expected to be the largest regional importer for all types of energy, particularly of natural gas. In 2050, China's share in total coal imports to the region can reach 60%, oil – 45-50%, and gas import – 60-65%. The energy transformation paradigm is actively pursuing the shift of the primary energy demand structure towards more gas and renewables instead of oil and coal, as well as the growing impact of the rising energy efficiency through the whole energy supply chain. It appears quite unusual to see such outlooks with sliding oil and coal demand.

It is worth reminding that for the MESI SB RAS energy outlook, the base year is 2013, which means that the holistic energy balance tables and actual trends for energy system development for the years 2014-2017 were missing from the analysis. However, energy development has proved to be very important for the last five years, as it is in line with the very start of the "new energy paradigm" and institutional changes at the international oil and gas markets. One of the lessons learned is that long-term outlook in a short run could have controversial implications, if the latest trends are missed. This is one, but important, explanation for some odd comparisons between factual data for the year 2017 (2016 in the case of coal balance) and assessments for the year 2025. The second explanation is statistical failures. Even for such respected statistical sources as BP's World Energy Statistics and Enerdata's Global Energy Statistical Yearbook, the difference for RoK oil demand in 2017 is more than 39 million tons, or 32 % [8, 9].

b. An assessment of the crude oil market for the East Asian countries

In 2017, East Asian countries imported 48 % of oil sold in the world crude oil market (Table 7). The likely decline in crude oil consumption is associated with the very core of the "energy transition" paradigm, which is characterized by the requirement to reduce consumption of so-called "carbon" primary energy, such as coal, crude oil, and even natural gas. In addition, oil demand will decline due to the switch from petroleum products to natural gas, electricity and hydrogen in transportation and construction.

c. An assessment of the coal market for the East Asia countries

The Asia-Pacific region is the world's largest coal market. This is explained by both the scale of demand, and the practical lack of own coal production in Japan, Taiwan and RoK. In the long term, the coal market will be highly competitive both for steam and metallurgical grades of coal. However, in ten years only Mongolia will maintain, or even improve its export capacity. It is supposed that coal export from DPRK will change to net import long before 2050 in order to feed emerging domestic power generation, (Table 8).

d. An assessment of the natural gas market for East Asia countries

The natural gas market in East Asia countries will be characterized as one of the fastest growing among other energy markets. China, Japan and RoK will be the major regional natural gas consumers. The Chinese segment of the regional market has the greatest potential for development in the next twenty to thirty years (Table 9). The Chinese gas market will have complex technological structure of gas production, import and national transportation system, complemented by sophisticated pricing instruments.

A new gas-related energy market is likely to emerge at the junction of "green energy" trade, power grid services and load management for Japan, RoK, Taiwan and China, including Hong Kong. This is a large-scale market of hydrogen produced on the basis of renewable energy. Economic estimations for new market can be made along with an analysis of real hydrogen infrastructure development at the national scale. Such an activity is currently underway in Japan, which is associated with the preparation of this country for the Tokyo Olympic Games in 2020.

The DPRK's skyrocketing demand for natural gas will be observed after 2035, when the economic situation on the Korean peninsula improves in general, and its energy system gets mature. Supplemental gas pipeline from the Sakhalin Island will be instrumental for such development.

e. An assessment of electricity market for East Asia countries

The prospects for power interconnections development in the EA region were updated after the establishment of the Global Energy Interconnection Development Cooperation Organization (GEIDCO) in 2016. However, for more than twenty-five years a lot of research activities have been done to promote international power interconnections and even integration of the national electric power systems in

Table 8. Coal balance in East Asian countries, Mt.

Balance		Year			
		2016	2025	2035	2050
Demand, total		3816	3890-4150	3000-3300	2000-2150
incl:	China	3420	3550-3750	2700-2900	1700-1800
	Japan	187	140-160	110-125	90-100
	RoK	135	110-120	100-110	90-100
	DPRK	n.a.	25-30	30-50	60-80
	Taiwan	66	45-60	40-45	20-30
	Mongolia	8	20-25	35-40	35-40
Production, total		3093	3350-3670	2450-2780	1250-1600
incl:	China	3058	3300-3600	2400-2700	1200-1500
Import, total		666	520-650	540-630	585-685
incl:	China	289	220-300	280-330	350-400
	Japan	185	140-160	105-120	90-100
	RoK	126	110-125	95-105	85-100
	DPRK	(11)*	2-5	20-30	40-60
	Taiwan	66	45-60	40-45	20-25
	Mongolia	(24)*	(40-45)*	(50-80)*	(50-80)*

Note: * coal export.
Source: IEA data 2016 [18].

the NEA region. According to the recent estimations for interstate power pool in the NEA region, the total transfer capability of interstate transmission lines will reach tens of GW, and international electricity trade will be tens and hundreds of TWh [20], [21], [22], [23].

Bilateral electric power cooperation in East Asia has already been established between the continental countries (with the exception of RoK), while island's countries within the EA region are looking for the advantages it may provide. At present electric power from Russia is exported to China and Mongolia; and the latter is importing electric power from China. One of the greatest prospects for multilateral energy cooperation in East Asia is associated with the development of the so-called Gobitec, which is essentially a trilateral Russia-Mongolia-China power interconnection. The Gobitec project is expected to create a significant synergy of the use of Mongolian wind and solar resources, storage and peak-shaving capacities of the Siberian hydroelectric power plants, and thirst for clean energy in the Eastern and Northern Chinese provinces.

In addition, the idea to create a new electricity market for the unified Korean Peninsula has become more sensible and attractive. Such a market will require not only export of basic power load to the North of the Peninsula, but will also involve existing hydropower plants as system's storages, and will naturally integrate the national power systems in China, Russia, Mongolia, and Japan into a regional power pool.

However, the main obstacles in the East Asia region, outside the international power grid project economics, will be institutional issues, and energy security is one of the most important. The implications of the research study on power import possibilities to the Japanese electricity market [19] show few economic and institutional grounds for import from Russia to the northern Island Hokkaido.

IV. Cooperation between Russia and Mongolia

An analysis of the current state of the Mongolian energy system and the recent trends in the energy infrastructure development within the East Asia region made it possible to identify the following promising areas of energy cooperation between Mongolia and Russia, considering multilateral cooperation of these countries as net energy exporters:

1. Transit. Transit of Russian gas through Mongolia to China will not only reduce the costs by optimizing the supply logistics, but also provide conditions for Mongolia's switch to gas and the improvement of the country's fuel and energy balance by switching from coal to gas. The transit of Mongolian coal through Russia and its export through the ports of the Far East will allow diversification of markets and supply routes, which is important for Mongolia as a landlocked country. This approach seems rational given the long-term policy of the main importer of Mongolian coal, i.e. China, to reduce the share of coal in the total energy consumption. In this regard, an important cooperative effort for Russia and Mongolia will be the creation of international energy cooperation institutions in East Asia, to establish the legal and regulatory framework within this area. Currently, such a framework is being

Table 9. Gas balance in East Asian countries, bcm.

Balance		Year			
		2017*	2025	2035	2050
Demand, total		435	720-780	950-1050	1100-1300
incl:	China	238	480-510	680-730	880-910
	Japan	129	130-140	130-150	140-160
	RoK	48	70-80	85-95	90-100
	Taiwan	20	40-45	50-60	50-60
	DPRK	-	1-2	4-8	30-40
	Mongolia	-	-	-	-
Production, total		151	195-215	280-380	410-480
incl:	China	147	190-210	270-350	380-430
Import, total		288	540-590	650-730	760-840
incl:	LNG	255	420-480	550-650	620-750
	China	88	300-320	400-440	480-520
	Japan	117	130-140	120-130	120-130
	RoK	50	70-80	80-90	80-90
	Taiwan	20	40-45	50-60	50-60
	DPRK	-	1-2	4-8	30-40
	Mongolia	-	-	-	-

Source: *- [9].

established in the region on a bilateral basis, while the creation of a single format of interaction at the regional level would significantly simplify trade in energy goods, energy equipment and services within the region and would facilitate multilateral cooperation.

2. "Green" energy. The rich resource potential of renewable energy and the urgent need for Mongolia's energy sector to shift from coal to cleaner energy resources are important prerequisites for the development of solar and wind energy in Mongolia and for the export of "clean" energy resources to other EA countries. A widely discussed project is the creation of the so-called "Asian super-ring", which will connect the power systems of Russia, countries of Central Asia and East Asia. In addition to the technical and economic aspects of such a project, the creation of an institutional framework for cooperation is also a prerequisite: the distribution of responsibility for the management of technical conditions, a common approach to the formation of tariffs, the rules of the "green certificates" trade for renewable energy, corresponding financing mechanisms, including "green bonds", etc.

3. Export of energy services and equipment from Russia to Mongolia. Russia and Mongolia have a rich experience in the energy cooperation, which goes beyond the trade in energy resources and includes joint implementation of projects for the extraction of minerals, Russia's participation in the construction of Mongolia's energy sector, Mongolian energy staff training, etc. The accumulated potential, as well as the established transport corridors and friendly relations between the countries at the political level, provide a solid basis for expanding the cooperation into such areas as uranium mining and the creation of oil refining industry in Mongolia.

4. Development of multilateral legal regimes. Russia and Mongolia, as well as the countries of the Korean Peninsula, the Maritime States of the Asia-Pacific region are interested in China's commitments to ensure the energy transit from Siberia and Mongolia to the ports of the Eastern coast of the country. Thus, transport costs when transiting through the Russian territory (up to 3-4 thousand km) can be reduced. Although Russia and Mongolia are competitors in the export of metallurgical coal to East Asia countries, in the event of China's refusal to provide access to its ports, Mongolia immediately becomes completely dependent on Russia's transit. There is a risk of diversification issue for Mongolian coal consumers due to China's monopsony in the case of refusal or inability of Mongolia to use access to seaports through the Russian territory.

V. Conclusions

Russia, Mongolia and DPRK are the only net energy-exporting countries in the East Asia region. Growing need of China, Japan, RoK and Taiwan to import coal, oil and gas is essential for these countries both for development of their economy and for improving technical and economic efficiency of their energy industries. As energy exporters, Russia and Mongolia have coinciding interests in regional energy markets and can be competitors at the same energy markets.

Based on the primary energy demand outlooks for all East Asia countries up to 2050, we have estimated the scale of regional markets for coal, oil and natural gas in East Asia.

The focus is made on the priority directions of Russia and Mongolia's joint efforts to develop energy cooperation with the rest of East Asia. A number of priority projects that require joint efforts from Russia and Mongolia in energy cooperation development in East Asia region are proposed:

1. The utilisation of Mongolia's services for transit of Russian pipeline gas to the Chinese central provinces, while enabling Mongolia's large-scale switch to gas as associated project;

2. The development of joint energy system with China, to allow significant synergy from the integration of solar and wind energy sources in Mongolia, large hydropower in eastern Russia, and coal generation within all participating countries, including CHP in winter season;

3. The study on the scope of hydrogen infrastructure development as a complementary segment of the International Power Grid in Northeast Asia, with primary purpose to improve security of energy supply in East Asia;

4. The integration of efforts of the energy research centres in the Northeast Asia countries to improve mutual understanding and increase trust by information exchange on energy policy issues.

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