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ENERGY TRANSITION AND GEOPOLITICS

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Abstract: The transition of world energy to renewable energy sources is changing the geopolitical importance of both countries exporting fossil fuels and importing ones. The energy map of the world is being redrawn; the geography and structure of energy supplies are changing. The essence of energy security is changing radically.

Keywords: energy transition, renewable energy sources, energy digitalization, smart grids, rare-earth metals, energy cybersecurity.

The increase in energy efficiency of the world economy leads to a lag of the energy consumption growth from GDP growth. Unlike the second half of the 20th century, when the world energy consumption grew on average by the same 3% per year as world GDP, over the past two decades, with an average annual GDP growth of 3.8%, the primary energy consumption in the world grew by only 1%[1]. In the period 2016–2050 with a projected growth of world GDP by 130% an increase in primary energy consumption can be only 1% (more than a double increase in GDP can occur almost without an increase in primary energy consumption) due to a 2.4-fold drop in the energy intensity of global GDP[2]. At the same time, global financial costs in the energy sector will increase by 33% during this period, however, despite the fact that global GDP will grow by 130%, its energy component will decrease from 5.5% to 3.1%[3].

With the stagnation of the need for primary energy carriers by 2050 the generation of electric power will more than triple. The increase will occur mainly due to renewable energy sources. Since 2012 the annually commissioned capacities of renewable energy-based electrical generation have exceed the commissioned capacities of traditional thermal power plants. In 2017 only solar generation accounted for more commissioned capacities than coal, gas and nuclear generation combined[4].

Electricity still accounts for 19% of global energy consumption, but this figure has begun to increase rapidly and, according to forecasts, will reach 56% by 2050[5]. The growth will be due to the replacement of fossil fuels by electricity

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[1] DNV-GL Energy Transition outlook 2018. Novik, Norway. 2018 P. 187.

[2] Ibid.

[3] Ibid.

[4] Wold Energy Outlook. IEA, 2018. P. 51.

[5] Ibid.

from transport (primarily automobile) and the housing sector. The reason for the displacement of fossil fuels by renewable energy sources is the fact that the latter have achieved price competitiveness due to a series of technological breakthroughs of the last decade. During 2010–2018 the price of electricity generated by solar stations fell by 73% and by wind power plants – by 22%[6]. By 2020 electricity generated by solar and wind power plants will become cheaper than electricity produced at any thermal power plant. Over the same period the price of lithium-ion batteries for electric vehicles fell by 80%[7]. As a result, a stream of investment poured into this promising business. Moreover, the International Renewable Energy Agency (IRENA) considers these impressive changes to be just the beginning: by 2025 a further decrease in the cost of generation is forecasted – by 26% at onshore wind farms, by 35% – at offshore, at 37% – concentrating solar stations, at 59% – on photovoltanic; the cost of a vehicle battery will decrease by another 60% and the prices of an electric car and a car with an internal combustion engine will be equal[8].

The multiplier effect of renewable energy is extremely high. According to IRENA, doubling the share of renewable energy in the global fuel and energy balance by 2030 will lead to an additional annual increase in global GDP of 0.6-1.1% ($1.3 trillion) and increase the level of well-being of the world's population by 3.7%[9].

The growing competitiveness of renewable energy combines favorably with public opinion in favor of clean energy. In 179 countries of the world there are state programs for the development of green energy, and 57 states are developing plans for the complete rejection of fossil fuels[10].

The expressed desire of most societies and states to accelerate the transition to renewable energy is due not only to economic and environmental considerations but, not least, to a factor of geopolitics. Energy resources have long been used as a policy instrument. World history remembers how coal and steam power led to the industrial revolution, which, in turn, shaped the geopolitics of the 19th and 20th centuries. For two centuries, the geography of world reserves of oil, natural gas and coal directly influenced the formation of the international geopolitical landscape, the alignment of forces and zones of influence. Control of oil production and trade has become a key feature of the power politics of the 20th century. Similarly, the transition from fossil fuels to renewable energy sources can transform global politics no less than the historical transitions from wood to coal and from coal to oil. However, when energy starts to develop on the basis of technology rather than resources the latter may completely lose their value as

[6] A New World. Global Commission of Energy Transformation. IRENA, 2019. P. 180.

[7] Ibid.

[8] Ibid, P. 181.

[9] REN21 – Renewables 2018. Global Status Report, Renewable Energy Policy Outlook for the 21 Century 2018. P. 18.

[10] Ibid, P. 21.

a policy attribute. Unlike fossil fuels, renewable energy is available in one form or another in most regions of the world, while fossil fuels are concentrated in limited territories and waters (for example, the Persian Gulf region holds more than 60% of the world's oil reserves). This reduces the strategic importance of vulnerable energy supply areas of the world, such as, for example, the Strait of Hormuz and the Malacca Strait. Most renewable energy sources are essentially flows, while fossil fuels are reserves. Fossil energy reserves can be stored, which can be useful, but they can only be used once. In contrast, renewable energy flows are not exhausted and cannot be interrupted. RE capacities can be installed practically anywhere on the surface, which makes the generation of electricity extremely decentralized and "democratic". Renewable energy does not require marginal costs, and some of its types (for example, solar and wind energy) provide a cost reduction of 20% with each doubling of power. This is the radical difference between renewable energy and fossil fuels, where increased demand always leads to higher prices.

Stagnation (and in developed countries decrease) in demand for fossil fuels the production of which is not decreasing inevitably leads to lower global prices. IRENA, for example, predicts a decline in oil prices for the period 2017–2040 by 50%[11]. Prices of oil and other fossil energy resources are "tied" to oil prices. But this will no longer increase their competitive advantages over renewable energy in most energy sectors. Oil will retain significance only as industrial raw materials (30% of consumption), in aviation and maritime transport (15% of consumption), coal in metallurgy (7% of consumption), and natural gas will retain its position in the electric power generation longer than other fossil fuels. The net exporters and net importers of fossil fuels have diametrically opposed (to varying degrees) perspectives.

Table 1

Countries with a significant share of fossil fuel rent in GDP and countries with a significant share of fuel in imports

Country	Share of fuel rent in GDP (%)	Country	Share of fuel in imports (%)
Libya	54	Bahrain	39
Kuwait	51	India	37
Iraq	45	Belarus	34
Saudi Arabia	45	Jamaica	33
Rep. Congo	41	Tanzania	31
Oman	39	Pakistan	30
East Timor	38	Rep. Korea	30
Angola	36	Japan	29
Turkmenistan	35	Ukraine	29
Equ. Guinea	34	Malta	28
South Sudan	33	Guyana	28
Qatar	31	Cote de Ivoire	28

[11] Ibid, P. 23.

Country	Share of fuel rent in GDP (%)	Country	Share of fuel in imports (%)
Azerbaijan	30	Guinea	27
Gabon	30	Senegal	27
UAE	26	Fiji	27
Iran	25	Greece	26
Algeria	20	Singapore	26
Kazakhstan	18	Lithuania	24
Uzbekistan	17	Mauritania	25
Nigeria	15	Morocco	24
Venezuela	15	Cambodia	22
Russia	12		
Mongolia	11		
Ecuador	10		

Source: IMF World Economic Outlook Database. W., 2018

The energy transition will, in varying degrees, affect the basic macroeconomic indicators of various countries exporting energy resources. According to IRENA and IMF, the most affected countries are those with a share of fossil fuels in GDP of more than 20% and at the same time with low GDP and lack of financial reserves – Libya, Angola, DRC, East Timor and South Sudan. States with a large share of fuel in GDP, with its high level and great financial capabilities – Saudi Arabia, Qatar, the UAE, Kuwait, Brunei – will be able to adapt to changing conditions, having suffered considerable losses. Countries with a smaller share of fuel rent in GDP and with a relatively diversified economy – Russia, Azerbaijan, Kazakhstan, Uzbekistan, Iran and Algeria – will be able to cope with a transformation of global energy, subject to structural reforms. In the group of countries with a share of energy rent in GDP less than 10% and with a high level of the latter – Malaysia, Bahrain and Norway – the energy transition will be the most painless[12].

Many oil-exporting States subsidize from oil and natural gas exports income many of the basic needs of the population (assuming the subsoil public property). The depletion of income may call into question the legitimacy of the authorities, cause popular discontent, unrest and violence, which can spread to neighboring countries. This, according to many political figures of the world, is the main geopolitical risk of the energy transition[13].

The countries-importers of primary energy are promised through energy transition an improvement in the trade balance, which is critical for many rapidly developing countries. In India, for example, the share of fuel in imports increased from 35% in 2001 to 60% in 2013, which led to an additional trade deficit of $190 billion[14]. Importers will be spared the additional costs caused by surges in

[12] IMF World Economic Outlook Database. W., 2018. P. 37–46.

[13] Remark made by General Tom Middendorp Former Chief of Defense of the Armed Forces of the Netherlands, Oslo, June, 24. 2018.

[14] Wold Energy Outlook. IEA, P. 2018. P. 259.

energy prices inspired by external forces. The transfer of financial resources from countries with a modern economic structure (importers of primary energy, as a rule, belong to this type) to states with an archaic economic structure will stop. According to the WTO, in 2015 even with a significant drop in world oil prices, the value of global primary energy imports amounted to $1.9 trillion[15]. The energy security of countries will finally cease to depend on various cartel agreements, sanctions, bloc confrontation, local wars, great-power politics, piracy, and international terrorism.

With a decrease in the geopolitical importance of the countries exporting mineral fuels, the rise of the leading renewable energy countries is possible. This leadership can be of three types. First, the importance of countries with a large solar, wind or hydro-potential. For example, Morocco, which currently imports about 90% of its energy consumption, plans to become Europe's largest exporter of "clean" electricity by 2050[16]. As part of numerous investment projects, the world's largest solar and wind power stations have already been put into operation. Electricity supplied to India from Bhutan hydropower plants already provides 15% of the kingdom's GDP[17]. Laos, which has large hydropower resources, is turning into a "battery" of Southeast Asia[18]. Norway, where 100% of its electricity is generated from renewable energy sources, has become the largest electricity supplier to the Netherlands and Germany, where dirty coal-fired power plants are dismantled[19]. Secondly, countries such as the DRC, Bolivia and Mongolia, which concentrate a significant part of the rare earth metals needed for renewable energy, are firmly integrated into international production and value chains of renewable energy. Thirdly, new "energy superpowers" are appearing, which are no longer the owners of resources but technological leaders. The undisputed leader here is China, which accounts for both the bulk of technology patents granted and the vast majority in the global production of wind turbines, photovoltaic cells and lithium-ion batteries.

Table 2

Share of countries in world production of equipment for renewable energy and share of countries in granted patents in this field

Country	Share in equipment (%)	Country	Share in patents (%)
China	39	China	29
Japan	7	USA	18
Germany	6	Japan	14
USA	6	Germany	7

[15] WTO, International Trade Statistics. URL: data.wto.org.

[16] A New World. Global Commission of Energy Transformation. IRENA, 2019. P. 39.

[17] Ibid, P. 40.

[18] Ibid.

[19] Ibid.

Country	Share in equipment (%)	Country	Share in patents (%)
Rep. Korea	3	Great Britain	3
Taiwan	2	Spain	2
Brazil	2	France	1
India	1	Iceland	1
Malaysia	1	The rest of the world	15

Source: www.manufacturingcleanenergy.org/images/cemac-benchmarks-figures/es-3.jpg.

With the development of renewable energy, the role of the state in energy supply to the population, in the formation of energy infrastructure, and in disposal of resource and financial flows will drop sharply. The current important role of energy in foreign policies of many states may come to naught over time. Each resident of any country can, for example, install a solar panel on the roof of his house and produce electricity both for his own needs and for any grid. Thus, the population is transformed from a passive consumer of energy into a supplier to interconnected grids, that is, into prosumers. With the help of modern telecommunication devices, the "energy Internet" is being formed. The number attached to the "smart grids" devices will grow, according to forecasts, from 26 billion in 2017 to 75 billion in 2025[20].

In this new world of prosumers, access to energy will no longer be the prerogative of large energy companies or the state. Financial gain will also not be concentrated in corporations and governments. The prosumer has the right to choose, the right to a certain share in profits, and may also be an investor. Moreover, all transactions go online and are free of intermediaries. In Germany, for example, in 2016 the share of private individuals accounted for 31.5% of the renewable energy plants[21]

The energy transition initiative is moving from the level of a centralized state to the level of municipalities and cities. Cities in the world consume more than two-thirds of the energy and account for more than 70% of global carbon emissions. All the largest and most developed cities are located on the coast, so they are primarily concerned about a possibility of a higher world ocean level due to global warming. In addition, recent natural disasters (earthquakes and tsunamis in Japan, the accident at the Fukushima nuclear power plant, hurricanes in the United States) have indicated the clear advantages of mini-grids over centralized power supply. The energy transition in large cities is 4.5 times faster than the global average. In 2017 more than 70% of the world's 100 largest cities in the world met their energy needs from renewable sources (in 2015 – only 42). Many large cities (Oslo, Dar es Salaam, Wellington, Yokohama, Rotterdam) implement

[20] Ibid. P. 43.

[21] Ibid.

the concept of a "smart city", which implies a complete transition to electric transport, renewable energy sources and smart grids[22]

An energy transition can seriously affect the interstate balance of power. At the same time, the configuration of existing political and trade alliances will inevitably change, as well as new associations will appear. First of all, we should expect a weakening of OPEC (which is already happening). The inability to control world prices due to rising global supply (US shale oil) leads to cartel agreements with other producing countries (Saudi Arabia – Russia), the transition to a more promising fuel (primarily gas), leads to the exit of member countries (Qatar) and, most importantly, the energy transition is steadily lowering the global demand (and the price) with a relatively large supply, which makes cartelization pointless. For the same reasons and in a similar way, long-term bilateral agreements in the field of fossil fuels (for example, the alliance of the USA and Saudi Arabia) will lose their significance.

At the same time, new alliances and associations set up, covering renewable energy sources – the International Alliance of Solar Energy (2015) the Global Geothermal Union (2016), and the Innovation Mission (2016). They connect states, the private sector, non-governmental organizations and are designed not to support prices or provide market share, but to disseminate technologies for the development of public resources.

The energy transition will change the geography of energy trade and the interdependence of countries. Major trade flows will move from global markets to regional grids. Countries that imported primary energy from another region of the world will receive energy through grids integrated with their neighbors. Electrical energy wil be the leader. The introduction of ultra-high voltage power transmission technology will reduce energy losses during transportation over long distances and will make trading in electricity more profitable than trading in oil or LNG.

Electricity trading is more flexible, more rational and mutually beneficial than fossil fuel trading. While oil, gas or coal move in one direction from the exporter to the importer, electricity can follow in both directions when, for example, in one of the two neighboring countries with a predominance of solar energy the weather is sunny and in the other cloudy. Also, unlike oil and gas, the electricity infrastructure is not so exclusive. For example, a pipeline binds the consumer to the seller and, in the event of termination of supplies due to any force majeure or political circumstances, it is extremely difficult for the consumer to quickly provide alternative deliveries. The regional grid provides a lot of opportunities for the rapid replacement of the supplier. This circumstance also deprives energy export of the status of an instrument of possible political pressure or ensuring geopolitical benefits.

The energy transition does not completely eliminate resource dependence. Even the most eco-friendly solutions, such as solar panels or vehicle batteries,

[22] Ibid.

can not be realized without the resources, and they are even more limited and unevenly distributed than the hydrocarbons. We are talking primarily about rare-earth metals.

The market of rare-earth metals is extremely monopolized by China: 80% -98% of their reserves and production are located directly in China, or controlled by Chinese companies[23]. Territories of Africa and the CIS are promising.

The growth of reserves and production of rare earth metals is not keeping pace with the growth of renewable energy. For example, if all automobiles in the world were replaced with electric cars at once, then global lithium reserves (a key element in a vehicle battery) would last only 50 years[24]. Hence the rapid rise in prices. Tantalum, for example, has risen in price over the last 10 years by more than 100 times[25].

The extraction of rare earth metals causes catastrophic damage to nature (acidification of water, radioactive contamination). Often, the transition from carbon- to green energy is more harmful to the environment.

Along with this, production methods and technologies for the extraction of rare-earth metals from compounds are being improved, which expands the resource base. In addition, the recycling of elements is very promising (currently, for example, only 0.2% lithium is reused). Some metals are gradually losing their original value.

As the energy transition develops in parallel with a decrease in the geopolitical importance of hydrocarbon exporting countries, the role of exporters of rare-earth elements will increase. The main struggle for resources is being transferred to these countries (DRC, which controls 65% of cobalt exports, South Sudan, Colombia, Mongolia). In the current economic climate (WTO rules, various arbitrations, penalties) it is almost impossible to cartelize like OPEC.

The energy transition, partially mitigating the old threats to global energy security (maritime vulnerabilities, terrorism, piracy, unilateral supply cuts and conspiracy), brings forward new ones. The main one is threat to cybersecurity of energy systems and grids surpassing the old threats in its destructive power. Nearly $200 million worth of damage from the latest cyber attacks against grids (Western Ukraine, Saudi Arabia, USA)[26]. With the digitalization of energy, the frequency of cyber attacks will increase, and with the decentralization of energy supply the scale of damage will decline; the problem of energy security will drop from the state to the local level. In this case, cyber security of energy supply, as any other sphere of economic activity, is transformed into the general question of "hygiene of Internet using" and becomes a problem for companies, communities and individuals.

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[23] Global Energy Transition Powers Surge in Demand for metals. URL: https://www.mining.com/global-energy-transit.

[24] Ibid.

[25] Ibid.

[26] New cyber resilience report: energy sector prime target for cyber-attaks. URL: https://www.worldenergy.org/news-views/entry/new-cyber-resilience-report-energy-sector-prime-target-for-cyber-attacks.

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