Energy Market Trends and Scope for Sustainable Development

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Abstract: Sustainable energy development is commonly characterized in terms of economic, environmental, and social components. Sustainable energy development can be considered at 3 levels: State level; Energy sector level; Energy enterprise level. There is no uniform approach to defining sustainable energy development in world practice. Can be identified technological order only for assessing energy sustainability at the State level. Relevance is that the development of a comprehensive assessment of the sustainability of energy is a promising avenue for identifying the energy priorities of countries, implementing more efficient energy policies, analyses the sustainability of energy industries and enterprises.

1 INTRODUCTION

In times of energy crisis, many experts have written about the transition from limited resources to almost inexhaustible or renewable energy resources. Suggestions were made about nuclear power and the establishment of Nuclear Power Plants. From 1980 to 1990, energy market players began to focus on environmental problems by proposing renewable energy (RE) - based cleaner energy systems. At the same time, demands were made for the inexhaustibility of the energy resources used and, at the same time, for a clean environmental policy that is consistent with the principles of sustainable development, i.e. the uninterrupted supply of energy and the development of national energy.

The market economy is now facing new challenges in the area of sustainable development, particularly in the area of energy and the environment. Society needs a global economic transformation that promotes a rapid transition to sustainable infrastructure, technology and a more equitable distribution of resources.

It is the transition to sustainable development that is understood as the establishment of a balanced system that combines environmental security and economic efficiency.

However, sustainable development, as opposed to economic growth, implies the creation of an economic structure capable of generating future economic growth and, of course, of further development. This, in turn, allows the economic system to replace sources of growth that have been depleted (as a result of human activities).

2 METHODOLOGY

According to C. Y. Glaziev's concept of technology (Glaziev, 1993, the period 2010 - 2018 can be attributed to the embryonic phase, and 2018 is the beginning of the growth phase of the technological system, which will continue until 2040 (see fig. 1).

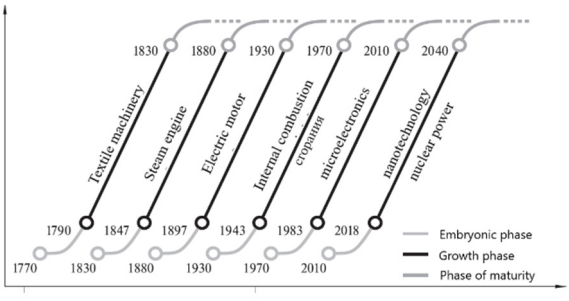

Figure 1: Phases of technological orders.

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New energy for the Sixth technological order will be nuclear power. The Sixth technological order will enter the stage of maturity as early as the 30th to 40th years of the 21st century, and in this context the problem of ensuring the technological safety of Russia is extremely relevant:

- ensuring the State's scientific, technical and technological independence from external threats;
- restriction of penetration into the territory of the State of morally obsolete technologies which 'harm' economy, ecology and human health (Bashmakov, 2009).

Each of the different orders of development went through different stages, which differed as a measure of its impact on overall economic growth in the country (see fig. 2).

It is worth mentioning as a methodology the available models of the technology market, where the following groups of countries can be ascribed to the role and place in the world division of labour in the area of scientific and technological progress: countries that are 'stuck' on the periphery of economic progress and countries - leaders of world technical and economic progress. The latter create the most advanced production technology and the most efficient economic mechanisms, in terms of the rate of growth of national wealth.

The catch-up model is characteristic of countries in the 'level' of world technical and economic progress. The main feature of this model is that development is based on technologies and economic mechanisms that have in turn been developed in the lead countries. For example, such as Japan, which has achieved high levels of economic development in resource-constrained environments, while relying on borrowed technologies. That is the historical factor in Japan's economic miracle.

The next model is a 'simulation' model of economic development. The model is based on the premise that simulation policy favours the selection, rather than the creation, of technologies that have been developed by economically more advanced foreign countries.

Experience has shown that the specificity of such development or technology policy has allowed many countries to avoid the high cost of developing innovative technologies (investment in the relevant sector of the economy), it also avoided the commercial risk that inevitably accompanies all innovation in a market economy.

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As the products became obsolete on the market, licenses for their production were sold to the countries of the 'second technological order'. These include Korea, Malaysia, Thailand, and others. And because these countries have a competitive advantage in the form of cheap labour, a liberal monetary and

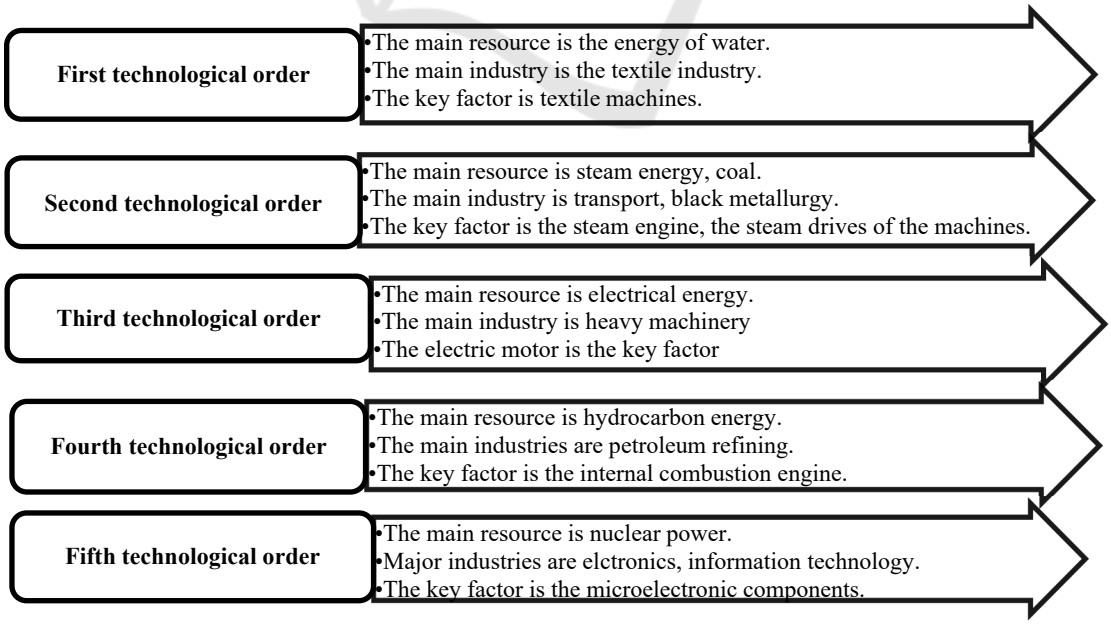

Figure 2: Technological change (Glaziev, 2009).

fiscal regime, they become 'attractive' for TNC investment in mass production. This was the process of setting up and implementing mass production of consumer goods such as electronics, household appliances, automobiles, etc. Such countries follow a strategy of 'catching-up development', but the lack of a developed scientific and research industry is a major weakness in their long-term development strategy.

'The Adaptation' economic development model is oriented towards the adoption of foreign technologies. This is the case for countries at the 'third technological order' where technologies are used to produce low-cost products, in countries with low per capita incomes. 'Transitional' model of economic development developed in the countries of the post-Soviet area. Between industrialized and developing countries (the core and periphery of the world economy), they are characterized by high energy consumption, modern consumer standards, resource-resource orientation of the economy, a high share of labour in industry and construction, and the existence of agrarian underdeveloped regions (Seidakhmetov and Elshibekova, 2011).

3 RESULTS OF THE RESEARCH

Over the past decade, we have witnessed a paradigm shift that has transformed various sectors of the economy, especially the energy sector. The concept of sustainable development has created a modern energy paradigm that responds to current trends in the world economy. Table 1 presents a chronology of the current energy paradigm with the changes and events that caused them.

Table 1: Stages and elements of energy paradigm-building in sustainable development (Spittler et al, 2019).

Year	Development	Concept	Energy
1970s	Stockholm Conference on the Human Environment	The limits of fossil resources and their impacts. Environmental impact. Energy security	The oil crisis; Establishment of the IEA; Establishment of OPEC Energy Modeling Forum (EMF)
1980s	The Brundtland Report, Intergovernmental Panel on Climate Change (IPCC)	Sustainable development	Establishment of the World Energy Council; Cost concept of stored energy and energy supply curves
1990s	UN Conference on Environment and Development in Rio, Brazil Signing of the agreement UNFCCC, Agenda 21 of the 1st IPCC Report	Climate change	Merger of energy and climate studies; Contribution of energy researchers to Special report on Emission Scenarios;
2000s	Millennium Development Goals (MDGs), Report of the 9th UN Session, Commission on Sustainable Development, The World Summit on Sustainable Development, Kyoto Protocol, Creation EU ETS	Energy is a key element for sustainable development. Link between energy and socio-economic development (energy-to-poverty ratio, urbanization, population dynamics). Mutual impacts of energy systems	IAEA, IEA; World Energy Assessment - Energy and Sustainable Development Challenges UNDP First EU Energy Action Plan (20/20/20 goals)
2010-b.c.	Sustainable Development Goals (SDGs), Paris agreement	Short- and long-term objectives Synergies and trade-offs between different development goals Limits of RES and their implications Impact of climate change on energy systems	Launching sustainable energy for all Climate change mitigation strategy; Strategy for adaptation to climate change; Discussions on climate and energy equity; Projects for deep decarbonization

Given the speed with which natural and socio-economic phenomena and the current global energy paradigm are changing, it is necessary to improve the key elements and mechanisms of the energy sector at all levels. The transition to a new energy paradigm in the XXI century will not happen naturally but must be accompanied by the development of innovative technologies and the removal of political barriers by all States of the world.

In 2018, the Club of Rome presented a new report 'Come On! Capitalism, Short-termism, Population and the Destruction of the Planet'(Weizsaecker and Wijkman, 2018). A key idea of the report, which was prepared by the two presidents of the Rome Club Ernst W. von Weizsaecker and Anders Wijkman, is the idea of 'the new Enlightenment', which should result in a holistic world view - humanistic and open development, valued sustainability and looking to the future.

According to E.-W. von Weizsaecker, for the Sixth technological erder, the principle is industrial ecology and green nanotechnology, which allow achieving sustainability and maximum resource productivity.

The analysis of long-term development trends leads to two important conclusions regarding the sources and types of energy of the future:

1) A key factor in the restructuring of world energy - limiting greenhouse gas emissions;

2) The demand for carbon-free energy sources in the world may lead to the abandonment of traditional energy production technologies.

Thus, if renewable energy (RE) can really compete with traditional fuels, governments and large corporations (including global corporations) will turn to the 'green' energy industry for new capacity, which will reduce the demand for hydrocarbon energy.

Renewable energy is currently the fastest growing source of energy. RE development is a critical energy strategy for the future. RE have less impact on the environment and are of strategic importance for present and future generations.

RE in the world continues to grow despite economic recession and political instability. In 2018, RE in the electricity industry increased by 14%, slightly below the 10-year average growth (16%). RE consumption and share of electricity generation vary considerably across regions and countries (see table 2 and fig. 3).

Consider the impact of energy on sustainable development criteria from the perspective of efficient consumption of natural resources and the limitation of negative environmental impacts. The efficiency of the use of any energy resource can be assessed on the basis of the total quantity of resources, their affordability and depletion, the intensity of the energy produced, the degree of water supply and the degree of land use.

Significant quantities of natural gas were used in the electricity sector (37.9 per cent), industrial sectors (34.2 per cent), construction (21.0 per cent) and transport (1.4 per cent), respectively. Coal was consumed mainly in the electricity sector - 2,251.5 million tons (58.6%) and in industry (primarily metallurgy) - 1,374 million tons (38.8%) (see fig. 4).

Table 2: Summary statistics on key indicators of GDP, RE (consumption), TS (traditional sources) (consumption) for the period 2010 - 2019 (billion dollars) (Statistical Review of World Energy, 2019; The Climate Group).

Year	World			Russia		
	GDP (billion dollar)	RE: consumption (billion tons)	TS: consumption (billion tons)	GDP (billion dollar)	RE: consumption (billion tons)	TS: consumption (billion tons)
2010	60168	0.1439	11.4576	1222.6	0.0001	0.6479
2011	65955	0.1701	11.9969	1524.9	0.0001	0.6732
2012	73281	0.2036	12.2517	2051.7	0.0001	0.6948
2013	74890	0.2385	12.3953	2210.3	0.0001	0.6951
2014	76990	0.2807	12.5853	2297.1	0.0001	0.6867
2015	79045	0.3173	12.6715	2063.7	0.0001	0.6891
2016	74760	0.3667	12.7383	1365.9	0.0002	0.6815
2017	75848	0.4196	12.8567	1283.2	0.0002	0.6737
2018	80684	0.4868	13.0243	1577.5	0.0003	0.698
2019	85791	0.5613	13.3036	1657.6	0.0003	0.7205

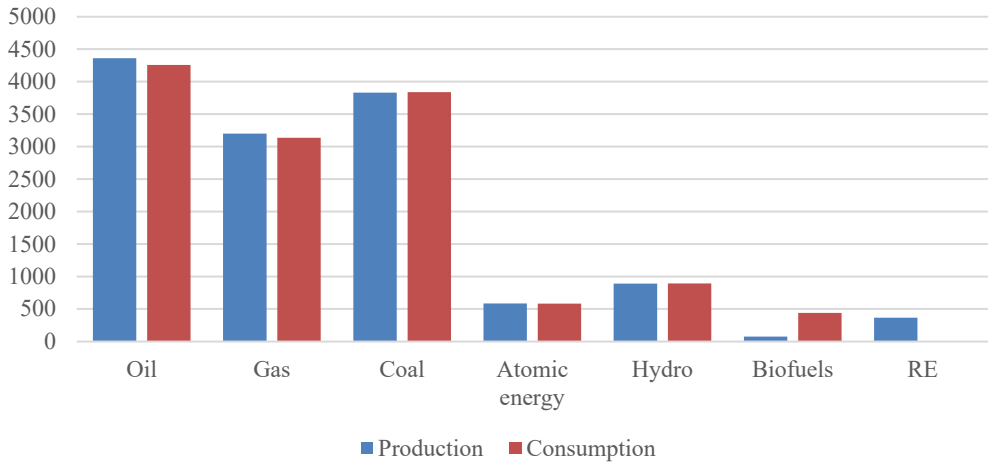

Figure 3: Energy production and consumption (data 2019) (Nuclear Energy Agency, 2000).

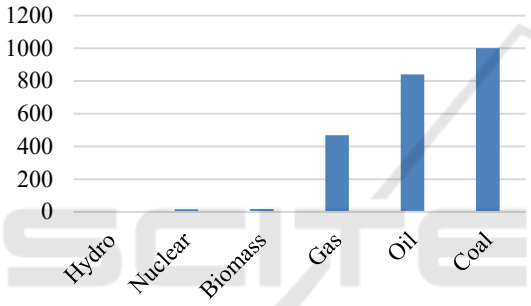

Figure 4. Specific emissions of greenhouse gases.

Organic and nuclear power generation will have synergistic effects related to the use of conventional and non-conventional hydrocarbons, methane conversion, coal gasification, etc. and the production of hydrogen from water using nuclear technologies (Velikhov et al, 2008).

In this case, the energy sector will develop as a single complex, allowing for the best use of any energy technology: oil and gas for high-value raw materials for chemistry, transportation fuels and export earnings; coal - as an energy source for electricity generation, heat for households, metallurgy and other industries; nuclear power - to replace coal, oil and gas in the production of cheap electricity, reliable supply of energy to remote areas, export of high technology, production of clean hydrogen in quantities necessary for the needs of the economy. Nuclear hydrogen technologies exist and do not require significant investments that fundamentally alter the energy mix.

4 DISCUSSION OF THE RESULTS

Considering the situation of electricity generation in the Russian Federation, this is the case. About 700 million tons of energy are currently consumed for primary energy production; almost 90 per cent of total consumption is accounted for by fossil fuels (oil, natural gas, coal).

In the long-term projections developed by the Russian Ministry of Energy, fossil energy resources continue to dominate energy supply; with a 24% increase in energy consumption by 2035, gas and coal consumption is expected to increase by 24% and 9% respectively.

The need to move no later than 2020 - 2030 to the 'Low Carbon Russia' scenarios is well founded, otherwise the opportunities and prospects for economic growth will be greatly hampered by energy scarcity and its high cost (Bashmakov, 2009; Bashmakov and Mysakak, 2014; Lugovoi et al, 2015).

Analysis of the report prepared by the International Energy Agency 'World Energy Outlook 2017' leads to the following conclusions:

- World oil demand is projected to increase by 10% by 2040, natural gas consumption by 45% (Total world gas production by 2040 will exceed 5.3 trillion cubic metres.);

- Russia will produce 718 billion cubic meters of gas by 2025 and 788 billion cubic meters by 2040 while remaining the leader in gas exports in both the medium and long term: the share of Russian gas in the world will be 37% by 2025 and 40% by 2040.

Currently, only three countries - the United States (about 50% of total gas production), Canada and China - produce oil shale gas in commercial volumes. Production transaction costs are estimated at 12 to 20 dollars per barrel, including labour costs, taxes, energy costs, field maintenance and transportation to trunk systems or other oil transport facilities; capital costs are estimated at 9.7 to 12.6 dollars per barrel (Grushevenko, 2012).

The results of the analysis of the current status and prospects of shale oil production in the projection of the development of the Russian oil and gas complex make it possible to draw the following conclusions:

- Low shale oil production costs are likely to lead to tighter price competition and lower world prices for traditional oil;
- Technological innovation in production will play a key role in shaping the future of the oil market;
- There is a need to develop Russian exploration technologies and the necessary technological basis.

In terms of technical support for exploration and oil production, the share of import security for pump-compressor equipment was 61 per cent only a few years ago; offshore equipment - 78%. Currently, the bulk of purchases in the oil industry are made by domestic goods and services (Zorina, 2016).

5 CONCLUSION

The transition of humankind to a sustainable development path is imminent and requires substantial refinement of the methodology for the study of long-term energy development, especially at the regional and global levels. Consequently, the article emphasizes that compared to 'green' energy, it is necessary to ensure a minimum of energy consumption in developing countries and to integrate the coordination of energy development not only on a global but also on a national basis, regional levels.

Only by finding an environmentally sustainable way to produce and use energy can we hope for an energy-secure future.

To talk about energy in the context of sustainable development is to address the social dimension of the problem. The production and use of energy should not only be compatible with the priorities of society with regard to the environment, but it should also be organized in such a way as to support social cohesion.

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