Section: National Security

Tymchenko Nickolay
PhD, Scientific Researcher
Institute of Engineering Thermophysics of
National Academy of Sciences of Ukraine
Kyiv, Ukraine

Fialko Nataliia
Doctor of Technical Sciences, Professor,
Corresponding Member of NAS of Ukraine,
Honored Worker of Science and Technology of Ukraine,
Department Head
Institute of Engineering Thermophysics of
National Academy of Sciences of Ukraine
Kyiv, Ukraine

TWO MAIN THREATS TO THE NATIONAL ENERGY SECURITY

There is no unanimously internationally recognized definition of not only energy security (ES), but also national security (NS). The cause of this terminological uncertainty may be the variability of approaches to the principles, targets, and scales of ensuring safety and protection of the energy supply systems. NS (as was ES) is needed a complex, complicated and multidisciplinary concept with a large economic content and meaning. In this concept should be, firstly, embodied several levels of threats – international, regional, group, state, subregional, personal. Secondly, the concept of security is multidimensional. Thirdly, security threats can be short-term or long-term. Fourthly, the threats can manifest themselves with varying degrees of intensity and controllability. There is a tendency to transform the concepts of the NS into a special inter-disciplinary

scientific subject at the interface between general risk theory and management theory. It is clear the foundation of NS is economic security. In turn, a cornerstone of economic security is energy security (ES). Equally important are aspects of food, environmental, physical, political, medical, in-formational, etc. security. State security guarantees the stability of the functioning of the economies, as well as security from violations of public order, from manifestations of crime, from attempts to suppress or limit civil rights and freedoms. The issue of ES is devoted a huge number of studies. Most often ES is determined by the level of energy sources accessibility. The definition of the IEA essentially has the same meaning: "the uninterrupted availability of energy sources" [1].

Two global nature threats to the ES will be further considered. These threats directly concern not only of Ukraine energy security, but the world as a whole. The first threat is the depletion of geological reserves of traditional primary energy resources, the second one is the factor of global warming. Although both threats are being studied already for decades, it has been only recently become clear that even one of these two evils could call into question the survival of the mankind and the civilization. At the same time, it should be hoped that both of these threats are the driving forces for search of energy transition (Energiewende) paths.

1. **Limited natural reserves of fossil traditional primary energy sources (TPES).** The main bulk of TPES consists of three types of organic (Carbon based) fuels – coal, oil, natural gas, and two types of inorganic mineral fuels – uranium and thorium. The reserves of these types of fossil fuels are finite. In according to the Hubbert's theory [2-3], which was created in the mid-1950s to calculate the dynamics of oil production, the consumption of fossil non-renewable energy sources (non-RES) follows a logistic (on Verhulst) curve, or S-curve.

The initial stage has approximately exponential (geometric) growth of production oil function, middle stage has characterised with its linear growth

and finally in the third stage the growth stops. The time of the so-called "oil peak" is related to the peak values of resource extraction. After reaching an "oil peak" a production of oil is falling steadily to zero.

Planetary fossil primary energy resources are exhaustible. Therefore, it is important to calculate the time and pace of their complete depletion. Prospects for the timing of the TPES use are determined by, firstly, estimates of their geological reserves, and secondly, assessments of the intensity of their consumption. Both types of estimates are varied and fluctuated, albeit in broad but still finite and foreseeable future. The range of their duration does not exceed one or two hundred years. Hubbert's attempt (during the oil crisis of 1979) to predict the all world's (non-US) oil peak consumption by the year 2000 turned out to be false. But his approach was further developed. Recently the Hubbard's theory was updated and generalized in the form of the MIFI model [4, 5]. New model was modified for application not only at the regional but also at global level, and was extended to all four types of the abovementioned fossil non-renewable fuels. In the MIFI model it is assumed that for the given type of resource, the time line of its production is known. The table consists of the results of the authors of the [4, 5] calculations. Both the peak of oil (as well as natural gas, coal, uranium) production G_{max} and term of their geological reserve's depletion can be reached fairly quickly. It is not clear whether the authors of [4, 5] had been took into account the geological shale oil reserves.

Table 1

Calculated data on the time to reach the peak values of extraction geological fossil fuel reserves and time of their full depletion (according to data [4-5])

Achievement of production peak values of	Depletion of geological reserves of
- oil after 7 years in 2024	- oil after 50 years in 2067
- natural gas after 12 years in 2029	- natural gas after 53 years in 2070
- Uranium after 35 years in 2052	- Uranium after 84 years in 2101
- coal after 42 years in 2059	- coal after 153 years in 2170

From the point of view of the energy supply with fossil TPES, the most alarming situation is related to oil and gas reserves. To create new energetics on the basis of renewable energy it remained a short time – up to two people generations.

2. **Global warming as the main challenge to energy security**. Worldwide, until recently, TPES (most often coal, petroleum products, natural gas) were used to meet the energy needs of all three major sectors of the economies – industry (together with agrarian and other branches), transport and household (together with utilities, social-budget and service segments). But over time, there utilisation to meet the energy needs has become on global scale the base source (up to 80%) of artificial (not of natural origin) greenhouse gases and many other harmful emissions. Anthropogenic pollution of the atmosphere with CO_2 is believed to be the main cause of global warming. The global warming is characterized by steadily climb of anomalous temperature difference Δt_{anom}, which defined as $\Delta t_{anom} = t_{current} - t_b^{1951\text{-}1980}$, where $t_{current}$ is average annual global temperature of *i*-th year $t_{current} \in [1880; 2018]$; $t_b^{1951\text{-}1980}$ – base average annual global temperature during 1951-1980 years.

On the base on the empirically measured growth of the rate Δt_{anom} over the past 40 years it was estimated the time which remains until realization of the specified climatic threat. If the humankind does not accept extraordinary measures of decarbonising energy production, then in 2035 humanity can face the problem of the consequences of catastrophic aridisation of temperate latitudes and the melting of glaciers in the polar "caps" of the planet.

Thus, in return for the old threat of the depletion of fossil TPES reserves (see previous point), which for a long time was considered to be the largest restraining factor in the sustainable functioning of energy in the medium-term (over 50-100 years) perspective, today there was a new threat to the energy security of mankind. This is global warming due to an increase in the Earth's atmosphere of greenhouse gases share of anthropogenic origin, mainly CO_2 pro-

duced by combustion. Moreover, restrictions on the use of traditional carbon-based fuels, as well as their prohibition, may appear in the near-short perspective (30-50 years). Already in the first decades of the 21st century, political decisions and corresponding energy packages for decarbonization of the energy supply mix were adopted in the EU. Time only confirms the relevance of these initiatives.

According to the Intergovernmental Panel on Climate Change (IPCC) as the most authoritative organization in the field of climatological assessments (see [6]), by 2050, RES-generation should provide 50-67% of primary energy resources. The share of coal should fall to 1-7%. Under the 1.5DS scenario in 2050, CO_2 emissions need to be reduced by 75-90% compared to 2010, in contrast to 50-80% in the case of the 2DS scenario. The latest IPCC report (October 2018), in fact, is the peculiar "SOS call" to stop man-made Earth climate overheat. The UN Secretary General Antoniou Guterres literally stated: "This report by the world's leading climate scientists is an ear-splitting wake-up call to the world. It confirms that climate change is running faster than we are – and we are running out of time" [7].

Conclusion

1. Energy policy in the field of energy security has radically changed in the last two decades towards the concept of energy transition and energy decarbonization.

2. The main reason for changing the paradigm of energy security is not limited geological reserves of fossil TPES (medium term perspective), but global warming due to increase concentration of anthropogenic (technogenic) greenhouse gases, mainly CO2 in the Earth's atmosphere composition over combustion of Carbon-based fossil fuels. Therefore, in order to prevent irreversible changes in the biosphere if temperatures rise 1.5 -2 K over 1951-1980 years levels, it is necessary strongly to limit emissions of CO2 and rapidly move this task into the category of the short-term perspectives.

3. Efforts to implement RES generation primarily are expediently focused on housing and communal services as the most energy-consuming and not energy effective sector of the economies.

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