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## **WORLD ENERGY RESOURCES: CURRENT STATE AND DEVELOPMENT PROSPECTS**

**Chychyna O.A. World energy resources: current state and development prospects.** The research considers a current state of energy market. The study deals with the analysis of the main factors of energy markets. Author focuses on three main development drivers of the world energy market in the nearest future: regional development, technological order and decarbonisation.

**Keywords:** energy market, GDP growth, energy intensity, fuel, renewable energy, environmental protection, technological wave.

**Чичина О.А. Світові енергетичні ресурси: сучасний стан та перспективи розвитку.** Статтю присвячено аналізу основних факторів розвитку енергетичних ринків. Розглянуто сучасний стан світового енергетичного ринку. Автор зосереджує увагу на драйверах розвитку в найближчому часі: регіональному розвитку, технологічному укладі, декарбонізації.

**Ключові слова:** енергетичний ринок, зростання ВВП, енергоємність, паливо, поновлювані джерела енергії, охорона навколишнього середовища, технологічний уклад.

**Чичина О.А. Мировые энергетические ресурсы: современное состояние и перспективы развития.** Статья посвящена анализу основных факторов развития энергетических рынков. Рассмотрено современное состояние мирового энергетического рынка. Автор сосредоточивает внимание на драйверах развития в ближайшем времени: региональном развитии, технологическом укладе, декарбонизации.

**Ключевые слова:** энергетический рынок, рост ВВП, энергоёмность, топливо, возобновляемые источники энергии, охрана окружающей среды, технологический уклад.

**The statement of the problem.** In the period of globalization, changes in the energy market have a significant impact on the world economic conjuncture. Industry of energy resources is living through a period of profound change. But that is nothing new: the past 65 years have seen huge changes to the global energy landscape.

We should mention that issue of energy policy became the more important in every country and all over the world. As countries prepare for the critically important UN climate summit in Paris (also known as COP21) and its legacy, it is more important than ever for policy-makers, industry and other stakeholders to have a clear understanding of the state of the energy sector today, to see which changes are transient or cyclical, which are here to stay, what risks and opportunities might lie ahead – and what can be done to put the energy system on a more secure and sustainable footing [5].

One of the main topic of the world agenda is to continue to invest in energy, in all its forms, to meet future needs.

**An analysis of recent research and publications.** The patterns of energy policies, systems and security have been studied by numerous researchers from all over the world such as Bob Dudley, Spencer Dale, Andry Darvil. For further in-depth analysis of the problem we used reports British Petroleum, U. S. Energy Information Administration, International Energy Agency and the Organization of the Petroleum Exporting Coun-

tries. Among Ukrainian researchers energy issues has been reflected in A. Golikov, O. Dovgal, Z. Varnaliy, V. Lipkan publications.

**Setting the objectives.** Our goal is to identify changes and trends in the world energy market in recent years and the impact of energy resources on the world economy to be able to form the country's energy policy.

**Summary of the main material research.** The gradual transition towards slower growth in energy demand was again compounded by cyclical weakness last year.

Global economic growth (3%) remained lacklustre, with much of this weakness concentrated in the more energy-intensive industrial sectors. One manifestation of this weakness in industrial production was that power generation grew less rapidly than total energy for only the second time in 30 years [4].

The combination of this gradual transition underway in energy demand compounded by cyclical weakness meant global energy demand grew by just 1.0% in 2015, similar to the rate of growth seen in 2014 (1.1%), but almost half the average rate seen over the past 10 years (1.9%) [4].

The sluggish growth in energy demand meant that energy intensity – the average amount of energy needed to produce a unit of GDP – declined by 2% (Figure 1). Although broadly similar to the rate of decline seen for much of the past 10 years (except immediately after the financial crisis), it's striking that in a year when energy prices fell sharply, energy intensity still declined as much as it did [6].

The graph shows us the dependence of GDP growth and energy consumption in the world. Thus, we can confirm that energy demand depends on the country: its economic level and energy policy. At the same time, industrial capacity and development of the country depends on a number of factors in the energy market (price, infrastructure, etc.) [1].

Thus, in the global energy market research is necessary to pay attention to the main stakeholders. We should describe the map of world energy market and distinguish the main actors.

The weakness in energy demand was concentrated within developing economies: energy consumption outside the OECD increased by just 1.6% in 2015, less than a half of its average growth over the past 10 years (Figure 2). The main driver was China, where growth in energy consumption slowed to just 1.5%, its weakest rate of growth since the late 1990s prior to its period of rapid industrialization. Even so, China remained the world's largest growth market for energy [2].

First, on China: the recent slowing in global energy demand has been driven to a large extent by developments in China. Not so much by the slowdown in economic growth, but rather by the rapid declines in energy intensity as China's pattern of growth has adjusted [4].

Indeed, if China's energy intensity hadn't declined over the past 5 years, global energy demand would have been almost 5% higher – roughly equivalent to the entire energy consumption of France, Germany and Belgium combined – even with the slowdown in Chinese GDP growth. Future trends in China's energy intensity matter as much, if not more so, for energy demand as its economic growth.

However, the level at which China's energy intensity will start to stabilize is uncertain.

There is considerable variation in energy intensity across developed economies, depending on their industrial structure and their levels of energy efficiency.

Perhaps more instructive is the experience of Japan and South Korea at a similar stage of development. Their falls in energy intensity happened somewhat later in their economic development than in China, but point to extended periods of quite sharp falls in energy intensity. But again here there is significant variation in the level of energy intensity at which they stabilized.

Ultimately, much will depend on the success of China in terms of its twin policy objectives of improving its level of energy efficiency and of shifting towards a more service-based (and hence less energy-intensive) pattern of growth.

We analyze the main actor of energy market, which can change demand indicators and use the profit of the rapid declines in energy intensity.

Next, we research the structure of energy demand due to kind of fuel. It is the most important issue nowadays, because problems of resource depletion, environmental protection and the development of technology becomes the main issues on the global agenda.

The story in terms of individual fuels is one of haves and have-nots (Figure 3). Despite the weakness in energy demand, 2015 saw solid growth in: oil (80 Mtoe, 1.9%), buoyed by the sharp fall in oil prices, with its share in primary energy increasing for the first time since 1999; natural gas (54 Mtoe, 1.7%) as it bounced back from the weather-induced weakness of 2014; and, as I just highlighted, renewable energy in power (48 Mtoe, 15.2%) [3].

The main casualty was coal, which saw its largest decline on record (-71 Mtoe, -1.8%), driven by large falls in the US and to a lesser extent China, with its share in primary energy falling to its lowest level for a decade [4].

Despite these differences across fuels, it's possible to identify some common features as to how these twin forces of slower demand growth and abundant supply played out across energy markets last year.

Most obviously (and predictably) is that energy prices fell sharply in response to the imbalance between demand and supply: prices of oil, natural gas, and coal were all sharply lower.

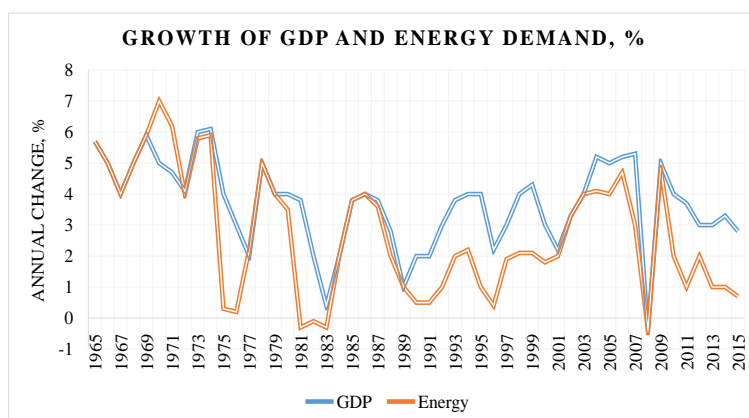


Fig. 1. Growth of GDP and energy demand, %, 1965 – 2015 [3; 4]

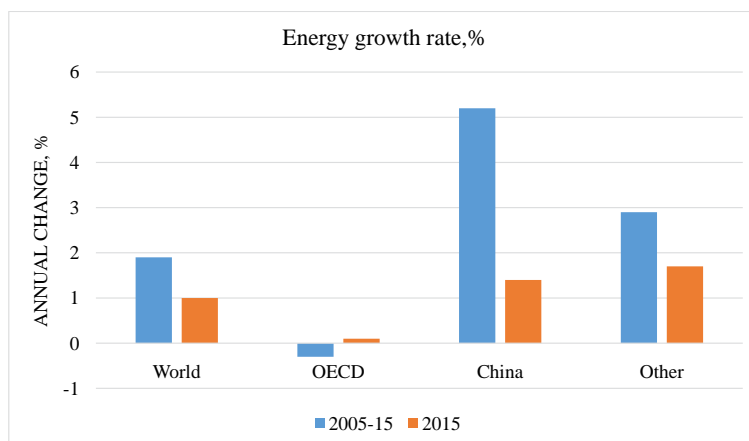
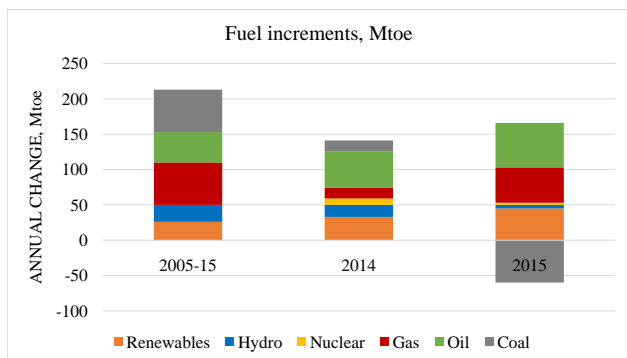
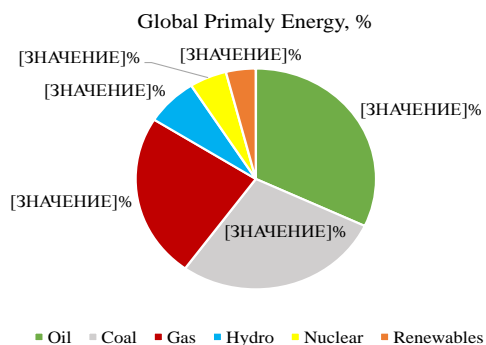


Fig. 2. Energy growth rate, %, 2005 – 2015 [2; 4]



**Fig. 3. Fuel increments, Mtoe, 2005 – 2015 [3; 4]**



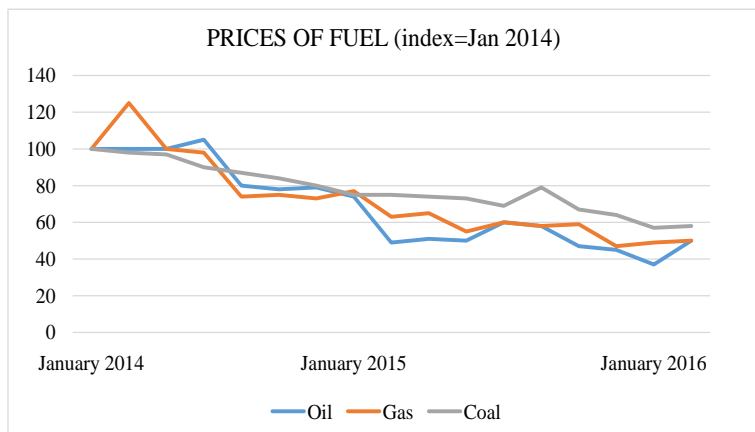
**Fig. 5. Shares of global primary energy, 2015 [3]**

The extent of the price falls partly reflects that, unlike some times in the past, key suppliers did not make off-setting adjustments to help stabilise prices. That is true of OPEC’s response to the rapid gains in US tight oil. It also appears to be the case for Russian gas exporter’s response to increasing competition from liquefied natural gas (LNG) [2].

The important point here is that ceding market share in order to support prices is less attractive when the underlying cause of the imbalance is expected to persist, rather than be relatively short-lived.

The other common feature is that in energy markets, as with other markets, prices work. There are clear signs that energy markets responded to the signal provided by lower prices: demand in some cases was boosted; supplies in the form of current activity or future investment was severely curtailed; the fuel mix adjusted (Figure 5). There is still further to go. And in some markets, notably oil, the adjustment process was offset by non-price led developments. But even so, an adjustment process does appear to be underway which bodes well for future market stability.

We see that the leading place in the structure of the energy market still holds the oil. But at the same time we see an increase of the gas consumption by reducing coal consumption.



**Fig. 4. Dynamics of fuel prices, index, 2014 – 2016 [2; 3; 4]**

We understand that the current structure of the energy market today vary due to factors such as the technological development and environmental protection. The main message of the developed countries, the transition of new technological order, but with the development of human-oriented economy [1].

So one of the key issues posed by the technological wave fostering new forms of energy is how quickly the share of renewable energy within global demand is likely to grow. The key lesson from history is that it takes considerable time for new types of energy to penetrate the global market. Starting the clock at the point at which new fuels reached 1% share of primary energy, it took more than 40 years for oil to expand to 10% of primary energy; and even after 50 years, natural gas had reached a share of only 8% [4].

Some of that slow rate of penetration reflects the time it takes for resources and funding to be devoted in scale to new energy sources. But equally important, the highly capital-intensive nature of the energy eco-system, with many long-lived assets, provides a natural brake on the pace at which new energies can gain ground.

The growth rates achieved by renewable energy over the past 8 or 9 years have been broadly comparable to those recorded by other energies at the same early stage of development. Indeed, thus far, renewable energy has followed a similar path to nuclear energy.

And as we say about human-oriented world, we should remember of the environmental protection. When we choose our national fuel we should to return to the stalling in the growth of carbon emissions.

But before we take too much comfort: the IEA 450 scenario – which is used by many as a benchmark scenario for the progress we need to make to achieve the goals agreed at Paris – suggests that the carbon intensity of GDP has to fall at an average rate of close to 5.5% p.a. on a sustained basis for the next 20 years. So almost double the rate of decline achieved last year, each year for the next 20 years [3].

It's possible to find a few isolated countries which have achieved average rates of decline of this magnitude for 10 years or so, but these tend to be countries undergoing significant economic transitions and account for only a tiny fraction of global GDP.

So certainly a step in the right direction towards meeting the goals agreed at Paris, but a relatively small step given the scale of the challenge.

Conclusions from the study. We are living through some profound changes in global energy markets, as growth in global energy demand transitions and as new energy supplies prosper. A clear and credible vision of long-term prospects on is vital to provide the right signals for investment and to allow a low-carbon, high-efficiency energy sector to be at the core of international efforts to combat climate change [5].

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