IRSTI 06.56.31

S.K. Kondybayeva*[1], R. Kabylkairatkyzy[1]

Al-Farabi Kazakh national university,
Almaty, Kazakhstan
*E-mail: saltanat.kondybaeva@kaznu.kz

GLOBAL ENERGY CONSUMPTION AND IMPORTANCE OF RENEWABLE RESOURCES

Energy is inevitable for human life and a secure and accessible supply of energy is crucial for the sustainability of modern societies. Achieving solutions to environmental problems that we face today requires long-term potential actions for sustainable development. Economic growth, along with accompanying structural changes, strongly influences world energy consumption. As countries develop and living standards improve, energy demand grows rapidly. Increased demand for appliances and transportation equipment, and growing capacity to produce goods and services for both domestic and foreign markets, also lead to higher energy consumption. From this perspective, renewable energy resources are in all likelihood the one of the most efficient and effective solutions. That is why there is an intimate connection between renewable energy and sustainable development. This article presents current energy resources data and human activity on it. As energy consumption and economic growth of world is directly depends on each other, here the issue about efficiency of energy saving. Active and passive measures which can be taken by us, can solve some issues relating to energy consumption problems.

Key words: Energy resources, fossil fuels, renewable resources, nuclear fuel, energy consumption.

С.К. Кондыбаева, Р. Қабылқайратқызы

Энергияның ғаламдық тұтынылуы және қайта жаңғыртылатын ресурстардың маңыздылығы

Энергия көзі қоғамның өмір сүруіне қажет, сонымен қатар қауіпсіз және қолжетімді энергиямен жабдықтау қазіргі заманғы қоғамның тұрақтылығы үшін маңызды болып табылады. Қазіргі таңдағы экологиялық мәселелерді шешуге жету мүмкіндігі тұрақты даму аясында ұзақ мерзімді әлеуетті әрекеттерді талап етеді. Осыған байланысты, қайта жаңғыртылатын энергия ресурстар көзі осы мәселені шешудің ең тиімді және жүзеге асатын амал ретінде қарастырылады. Сондықтан, қайта жаңғыртылатын энергия ресурстар көзін пайдалану мен тұрақты даму арасында тығыз байланыс бар. Мақалада ағымдағы энергия ресурстары туралы мәліметтер мен адам әрекеті туралы мағлұматтар берілген. Энергияның тұтынылуы мен экономиканың өсуі бір-біріне тікелей байланысты болғандықтан, энергияны үнемдеу мәселесі туындайды. Мақалада орындалып жатқан активті және енжар шаралар осыған байланысты кейбір сұрақтарды шеше алу мүмкіндігі келтірілген.

Түйін сөздер: энергия ресурстары, табиғи отын көздері, қайта жаңғыртылатын ресурстар, ядролық отын, энергияның тұтынылуы.

С.К. Кондыбаева, Р. Кабылкайраткызы

Глобальное энергопотребление и значимость возобновляемых ресурсов

Энергия является важной в человеческой жизни, и поэтому безопасный и доступный запас энергии имеет решающее значение для обеспечения устойчивости современных обществ. Достижение решений экологических проблем, с которыми мы сталкиваемся сегодня, требует долгосрочных потенциальных действий в интересах устойчивого развития. В связи с этим, возобновляемые источники энергии представляются одним из самых действенных и эффективных решений. Именно поэтому существует тесная связь между использованием возобновляемых источников энергии

и устойчивым развитием. Статья рассматривает текущие данные об энергетических ресурсах и деятельностью человека по ним. Поскольку потребление энергии и экономический рост мира непосредственно зависят друг от друга, в статье рассматривается вопрос об эффективности энергосбережения. Представлены активные и пассивные меры, которые могут быть применимы нами, могут решить некоторые вопросы, связанные с проблемами потребления энергии.

Ключевые слова: энергетические ресурсы, ископаемые виды топлива, возобновляемые ресурсы, ядерное топливо, потребление энергии.

Introduction

World energy resources are the estimated maximum capacity for energy production given all available resources on the Earth. They can be divided by type into fossil fuel, nuclear fuel and renewable resources: Fossil fuels are fuels formed by natural processes such as anaerobic decomposition of buried dead organisms, containing energy originating in ancient photoproductin [1]. Coal, oil, and natural gas provided 79.6% of primary energy production during 2002 (in million tons of oil equivalent (mtoe). A 2015 report studied 20 fossil fuel companies and found that, while highly profitable, the hidden economic cost to society was also large [2]. The report spans the period 2008–2012 and notes that: "For all companies and all years, the economic cost to society of their CO2 emissions was greater than their after□tax profit, with the single exception of ExxonMobil in 2008." [3]. Nuclear fuel is a substance that is used in nuclear power stations to produce heat to power turbo. Heat is created when nuclear fuel undergoes nuclear fission. Most nuclear fuels are consisted of heavy fissile elements that are capable of nuclear fission, such as uranium-235 or plutonium-239. When the unstable nuclei of these atoms are hit by a slow-moving neutron, they split, creating two daughter nuclei and two or three more neutrons. These neutrons then go on to split more nuclei. This creates a self-sustaining chain reaction that is controlled in a nuclear reactor, or uncontrolled in a nuclear weapon. The processes involved in mining, refining, purifying, using, and disposing of nuclear fuel are collectively known as the nuclear fuel circle [4].

A renewable resource is a natural resource which replenishes to overcome resource depletion caused by usage and consumption, either through a biological process or other naturally recurring processes in a finite amount of time in a human timescale. Renewable resources are a part of Earth's natural environment and the largest components of its ecosphere. A positive life cycle assessment is a key indicator of a resource's sustainability [5].

Materials and methods of research. Some renewable resources, species and organisms face a very high risk of extinction, caused by population growth and excessive consumption. It has been estimated that more than 40% of all living species on Earth are threatened with extinction [6]. As human activity grows, more and more energy it needs. The U.S. Energy Information Administration's recently released International Energy Outlook 2016 (IEO2016) projects that world energy consumption will grow by 48% between 2012 and 2040. Most of this growth will come from countries that are not in the Organization for Economic Cooperation and Development (OECD), including countries where demand is driven by strong economic growth, particularly in Asia. Non-OECD Asia, including China and India, accounts for more than half of the world's total increase in energy consumption over the projection period. Concerns about energy security, effects of fossil fuel emissions on the environment, and sustained, long-term high world oil prices support expanded use of no fossil renewable energy sources and nuclear power. Renewables and nuclear power are the world's fastest-growing energy sources over the projection period. Renewable energy increases by an average 2.6% per year through 2040; nuclear power increases by 2.3% per year [7].

Our reliance on fossil fuels for energy is one of the most hotly debated issues of our generation. Because energy that is harnessed to do work is usually released as heat, sound, light, or other irretrievable forms, we must constantly replenish our energy source to keep our machines running. The period of unprecedented growth starting with the industrial revolution was only made possible by tapping the planet's vast stores of energy. This system is inherently unsustainable because we consume fuels far faster than the planet can replenish them, yet only in the past decade or so has there been any serious talk of reaching peak production of these energy sources. Since the extraction of these fuels itself requires fuel, the returns have to be greater than the amount of energy invested. As oil wells reach their peak, oil no longer freely spouts out of the ground. It becomes increasingly difficult and expensive to pull to the surface. This is also where energy ties into economic growth. By its very nature, our economy is based off of exponential

growth. It is under constant pressure by many factors such as debt and population growth to continually and infinitely expand. What many policy makers and, by extension, people, do not understand is that continued economic growth in our current system is completely reliant on a continuing increase in the availability of fossil fuels to perform work. The status quo itself exploits unsustainable quantities of the earth's resources, making infinite growth impossible. In a physical world there are physical limits to the amount of energy available at any given time to exploit.

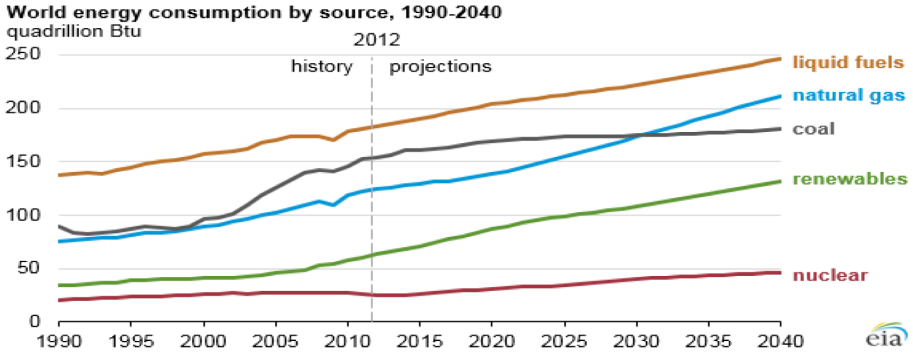

Figure 1 – World energy consumption by 1990-2040 [8]

Much of the analysis conducted for the IEO2016 was done before the release of the U.S. Environmental Protection Agency's final Clean Power Plan (CPP). For this reason, the IEO2016 Reference case does not include the potential effects of the CPP regulations in the United States, analysis that shows the potential for significant reductions in U.S. coal consumption and increases in U.S. renewable consumption compared with the Reference case projection. Key tables and figures throughout the report provide results that also include the effects of the CPP where they differ significantly from the IEO2016 Reference case results, based on EIA's analysis of the preliminary CPP rule [7]. Anyway, as we can see from figure 1, energy consumption demand is going up.

Globally, buildings account for about 40% of total annual energy consumption. Most of this energy is for lighting, heating, cooling and air conditioning. Raising awareness of the environmental impacts of CO2 and NOx and chlorofluorocarbon emissions has generated renewed interest in environmentally friendly cooling and heating technologies. In accordance with the 1997 Montreal Protocol, governments agreed to waive the use of chemicals used as refrigerants that could destroy the ozone layer of the stratosphere. Therefore, it was considered desirable to reduce energy consumption and reduce the rate of depletion of global energy reserves and environmental pollution. One way to reduce the energy consumption of a building is to design buildings , which are more economical in using energy for heating, lighting, cooling, ventilation and hot water supply. Passive measures, in particular natural or hybrid ventilation, rather than air conditioning, can significantly reduce primary energy consumption. However, the use of renewable energy sources in buildings and agricultural greenhouses can also significantly reduce the dependence on fossil fuels. Therefore, the promotion of innovative renewable applications and the strengthening of the renewable energy market will help to conserve the ecosystem by reducing emissions at the local and global levels. It will also help improve environmental conditions by replacing traditional fuels with renewable energy sources that do not produce air pollution or greenhouse gases. The provision of good indoor environmental quality (IEQ) while achieving energy and cost efficient operation of the heating, ventilating, and air-conditioning plants in buildings represents a multivariate problem. The comfort of the occupants of a building depends on many environmental parameters, including air speed, temperature, relative humidity and quality in addition to lighting and noise. The overall goal is to provide a high level of building performance, which can be defined as IEQ, Energy Efficiency (EE) and Economic Efficiency (CE). IEQ is a perceived comfort condition experienced by the residents of a building because of the physical and psychological conditions that they undergo in the environment. The main physical

parameters affecting IEQ are air speed, temperature, relative humidity and quality. EE is related to the provision of the desired environmental conditions while consuming the minimal quantity of energy. CE is the financial expenditure on energy relative to the level of environmental comfort and productivity that the building occupants attained.

The environmental impact of the energy industry is diverse. Energy has been harnessed by human beings for millennia. Initially it was with the use of fire for light, heat, cooking and for safety, and its use can be traced back at least 1.9 million years [9]. In recent years, there has been a trend towards the increased commercialization of various renewable energy sources. Consumption of fossil fuel resources leads to global warming and climate change. In most parts of the world little change is being made to slow these changes. If the peak oil theory proves true, and more explorations of viable alternative energy sources are made, our impact could be less hostile to our environment.

Rapidly developing technologies can ensure the transition of energy production, water and waste management, and food production to more advanced methods of nature management and energy use using methods of systemic ecology and industrial ecology [10].

Rapid deployment of renewable energy and energy efficiency is resulting in significant energy security, mitigation of climate change, and economic benefits In international opinion polls, there is strong support for the promotion of renewable sources such as solar energy and wind energy [11]. At the national level, at least 30 countries already have renewable energy sources that provide more than 20 percent of the energy supply. According to forecasts, national renewable energy markets will continue to develop actively in the coming decade and beyond. [12]. The following table shows increasing faceplate rating, and has utilization factor that range from 11% for solar, to 40% for hydropower [13].

Table 1 – Renewable energy global indicators

Selected renewable energy global indicators	2008	2009	2010	2011	2012	2013	2014	2015
Investment in new renewable capacity (annual) (10^9 USD) [14]	182	178	237	279	256	232	270	285
Renewables power capacity (existing) (GWe)	1,140	1,230	1,320	1,360	1,470	1,578	1,712	1,849
Hydropower capacity (existing) (GWe)	885	915	945	970	990	1,018	1,055	1,064
Wind power capacity (existing) (GWe)	121	159	198	238	283	319	370	433
Solar PV capacity (grid-connected) (GWe)	16	23	40	70	100	138	177	227
Solar hot water capacity (existing) (GWth)	130	160	185	232	255	373	406	435
Ethanol production (annual) (10^9 liters)	67	76	86	86	83	87	94	98
Biodiesel production (annual) (10^9 liters)	12	17.8	18.5	21.4	22.5	26	29.7	30
Countries with policy targets for renewable energy use	79	89	98	118	138	144	164	173
Source: The Renewable Energy Policy Network for the 21st Century (REN21)–Global Status Report [15,16]								

Conclusion

Today, searching for new sources of energy is vital, as world resources are limited. Not every country can afford innovation and new ways of using consumption energy. Another reason is human being is wasteful, not everyone comprehend that each water drop from the sink is important. So, energy conservation is now one of the ways to save both money and environment. The world's dependence on fossil fuels is creating a problem that will affect generations to come. It is important that energy not only be conserved, but also that research continues to find cleaner and better solutions for future generations.

References

1 Motoaki Sato Thermochemistry of the formation of fossil fuels. The Geochemical Society, Special Publication, #2, 2015.

2 Chris Hope Measuring fossil fuel hidden costs. University of Cambridge Judge Business School. 23 July 2015. Retrieved 2016-06-27.

3 Hope, Chris; Gilding, Paul; Alvarez, Jimena (2015). Quantifying the implicit climate subsidy received by leading fossil fuel companies – Working Paper No. 02/2015 (PDF). Cambridge, UK: Cambridge Judge Business School, University of Cambridge. Retrieved 2016-06-27.

4 Wikipedia. Free Encyclopedia. https://en.wikipedia.org/wiki/Nuclear_fuel

5 "Management for a Small Planet" by Jean Garner Stead and W. Edward Stead, M.E. Sharpe 2009

6 Water for the World organization report. Retrieved 2009-03-12.

7 What are natural gas liquids and how are the used? USA Energy Information Administration site: http://www.eia.gov/todaysinenergy/detail.php?id=26212

8 EIA, International energy resources outlook 2016. USA Energy Information Administration site: http://www.eia.gov/outlooks/ieo/nat_gas.cfm

9 Bowman, D. M. J. S. (2009). "Fire in the Earth System". Science. 324 (5926): 481–4. Bibcode:2009Sci...324..481B. doi:10.1126/science.1163886

10 Rabl A.; et al. (August 2005).. Externalities of Energy: Extension of Accounting Framework and Policy Applications. European Commission. Archived from the original (PDF) on 7 March 2012.

11 www.unep.org.

12 REN21 (2013). "Renewables global futures report 2013"

13 MeteoLCD Weblog. A weblog on climate, global change and climate measurement: Electricity generation: very different capacity factors. 21 September 2015. Site: https://meteolcd.wordpress.com/2015/09/21/electricity-generation-very-different-capacity-factors/

14 Renewable Energy Policy Network for the 21st Century site: http://www.ren21.net/wp-content/uploads/2015/06/GSR2015_Figure25.

15 Renewable Energy Policy Network for the 21st Century site: REN21 (2011). "Renewables 2011: Global Status Report". p. 15.

16 Renewable Energy Policy Network for the 21st Century site: REN21 (2012). Renewables Global Status Report 2012 p. 17.

Литература

1 Мотоаки Сато. Термохимия формирования ископаемого топлива // Геохимическое Общество. Специальное издание. – № 2. – 2015.

2 Крис Хоуп Измерение ископаемого топлива скрытых затрат / Кембриджский университет: Школа экономики и права. 23 июля 2015 года Источник 2016-06-27.

3 Хоуп, Крис; Гилдинг, Пол; Альварес, Химена (2015). Определение количества неявной субсидии климата для ведущих компаний ископаемого топлива - рабочий документ № 02/2015 (PDF). Кембридж, Великобритания: Школа экономики и права, Кембриджский университет. Получено 2016-06-27.

4 Википедия. Свободная энциклопедия. https://en.wikipedia.org/wiki/Nuclear_fuel

5 "Управление для маленькой планеты» Жан Гарнер стид и У. Эдвард Стид, М.Е. Шарп 2009

6 Вода для доклада Всемирная организация. Получено 2009-03-12.

7 Что такое жидкости природного газа и как его использовать? сайт США Управление по энергетической информации: http://www.eia.gov/todayinenergy/detail.php?id=26212

8 EIA, прогноз Международные энергетические ресурсы США 2016 года Управление энергетической информации, сайт: http://www.eia.gov/outlooks/ieo/nat_gas.cfm

9 Боумэн, Д. М. Джи. Эс. (2009). "Пожар в системе Земли". Наука. 324 (5926): 481-4. Bibcode: 2009Sci ... 324..481B. DOI: 10.1126 / наука.1163886

10 Рабль А; и другие. (Август 2005 г.) Экстерналии энергии: Расширение системы бухгалтерского учета и политики приложений. Европейская комиссия. Архивировано из оригинального (PDF) по 7 марта 2012 года.

11 "Глобальные тенденции в области устойчивой энергетики. Инвестиции-2007: Анализ тенденций и проблем в финансировании возобновляемых источников энергии и энергоэффективности в странах ОЭСР и развивающихся странах». www.unep.org.

12 REN21 (2013). "Возобновляемые глобальные фьючерсы, отчет 2013"

13 МетеоЛСД Вебблог. Вебблог на климат, глобальное изменение климата и измерение: Выработка электроэнергии: очень разные факторы мощности. 21 сентября 2015 года Сайт: https://meteolcd.wordpress.com/2015/09/21/electricity-generation-very-different-capacity-factors/

14 Сеть возобновляемых источников энергии политики для сайта 21-го века: http://www.ren21.net/wp-content/uploads/2015/06/GSR2015_Figure25.

15 Сеть возобновляемых источников энергии политики для сайта 21-го века: REN21 (2011). "Возобновляемые 2011: Глобальный доклад о положении дел". п. 15.

16 Сеть возобновляемых источников энергии политики для сайта 21-го века: REN21 (2012). Возобновляемые Доклад о глобальном положении 2012 С. 17.