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**The alternative energy development as a priority of accelerating
the modernization and the structural changes of Uzbekistan
economy**

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Dissertation

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CONTENTS

INTRODUCTION.....	3
....	
CHAPTER I. THE ESSENCE AND INSIGHT OF THE DEVELOPMENT OF THE ALTERNATIVE ENERGY RESOURCES IN THE NATIONAL ECONOMY	
1.1 Generation of the needs for alternative energy and the factors of the development.....	9
1.2 Literature review on alternative energy.....	16
1.3 Climate change and alternative energy developments.....	21
Summary of chapter I.....	27
CHAPTER II. INTERNATIONAL EXPERIENCE OF ALTERNATIVE ENERGY DEVELOPMENT AND PRIORITIES	
2.1 World fuel crisis and transfer to green economy.....	29
2.2 Alternative energy models development	41
2.3 Financing models of alternative energy development.....	45
Summary of chapter II.....	49
CHAPTER III. ALTERNATIVE ENERGY DEVELOPMENT IN THE REPUBLIC OF UZBEKISTAN	
3.1 Legal framework for alternative energy development in the Republic of the Uzbekistan.....	51
3.2 Challenges of alternative energy in structural reforms implementation and modernization of the economy of Uzbekistan..	55
3.3 Priority directions for alternative energy development	64
Summary of chapter III.....	75
CONCLUSION.....	77
....	
REFERENCES.....	80
.....	

INTRODUCTION

Topicality of the theme of master dissertation. In condition of globalization of the world economy, demand for electricity is rising extremely. Currently, oil, natural gas, coal and uranium are the world's major sources of energy. Due to the continuing use of limited natural resources, environment to reserves are depleting from year to year and it made an impact. According to economists, if the world's natural resources are used in this way, the world's oil reserves could provide us from 45 up to 50 years, coal 165-170 years, natural gas 70-75 years, brown coal 450-500 years¹.

Because of the world energy resources are unevenly allocated among the countries and the protection of the environment in the energy sector, demand of unlimited and renewable energy sources is growing sharply. Renewable energy is a source of energy which takes from the environment's energy flow. Sun, wind, geothermal, biogas which takes from agricultural waste, and other sources, an example can be seafood. Alternative energy is becoming one of the priorities of the development of the world economy.

As noted by the President of the Republic of Uzbekistan Sh.M.Mirziyoyev in his appeal to the Oliy Majlis, "In order to improve the efficiency of energy resources, we need to reform our country's energy system and develop a clear strategy on it. First of all, it is necessary to privatize the enterprises that are ineffective and damaged and to terminate the monopoly. Also it is important to create a competitive environment for energy supply and encourage the use of alternative energy sources. For this purpose it is necessary to switch to the market mechanism of financing production, with the involvement of the private sector"².

The further deepening of economic reforms in country, reduction of energy consumption in GDP, implementation of saving energy high technologies and

¹ http://uzbekistonovozi.uz/uz/articles/index.php?ELEMENT_ID=9947

² Ўзбекистон Республикаси Президенти Шавкат Мирзиёевнинг Олий Мажлисга Мурожаатномаси. – Тошкент: “Ўзбекистон” НМИУ, 2018. Б-49.

systems in economy and social sphere, going towards innovative development by government, to organizing technical measures in elaborating and implementing targeted government programs for energy saving-all together highlight the topicality of given scientific research work.

Object and subject of research. The object of research work is the process of introducing alternative energy into national economy. The subject of the research work is a set of economic relations occurring in the process of development and implementation of alternative energy development in national economy.

Objective and tasks of the research work. The objective of the research is developing and rooking scientific conclusions and practical recommendations ensuring sustainable economic growth of the national economy, modernization and deepening structural transformations on the bases of alternative energy development.

The tasks of the research work are:

- analyzing the factors of formation and development of alternative energy sources;
- studying of the evolution of development of scientific views on alternative energy;
- identifying prior areas for accelerated development of climate change and alternative energy;
- analyzing the necessity and factors of rapid development of alternative energy in connection with the global crisis;
- determining the mechanism and trends of development of the world alternative energy market;
- studying the directions of financing practice of alternative energy development international financial institution;
- studying the directions of the legal-institutional bases of alternative energy development in Uzbekistan;

-finding tendencies and problems of the role of alternative energy in the modernization of economy and deepening structural transformations of the National economy;

- working out the long-term strategy of developing alternative energy and development of prior directions of transition of the national economy.

Scientific novelty of research. The following are scientific novelties of the research:

- the scientific views on alternative energy have been described, evaluated, grouped and summarized;

- the factors of development of the global crisis of fuel and alternative energy have been analyzed, grouped and developed scientific conclusions and practical recommendations;

- structures of alternative energy, trends of development, its problems and scientific proposal of solving them have been developed;

- the practice of financing international investment projects for alternative energy development projects have been analyzed and scientific recommendations and practical recommendations for its improvement elaborated;

- the status, development tendencies, problems of alternative energy in Uzbekistan have been and systemic scientific conclusions and recommendations have been developed to deepen structural transformations in the national economy.

Main agenda and assumptions of the research work. To make a systematic scientific proposal and practical recommendations, to develop an alternative energy development strategy in Uzbekistan and to strengthen its position in the modernization of the national economy and structural transformations are mentioned in the assumption of the research work.

Literature review. As a result of problems in the energy supply system of the countries, by the end of the 20th century alternative sources of energy have been searched from existing sources of energy. In 1985 the term "alternative

energy" was used for the first time. The reason of using this term was the first solar power plant in the USSR that year. Theoretical and Practical aspects of Alternative Energy was mentioned in the scientific works of scientists such as: R.P Mukund, S.Gibilisko, G. Scheer, V.M. Kargiev, V.I. Vissarionov, V.M.Polonsky, G.Titov, A.V.Polonsky, Yu.D. Sibikin, M. Yu.Sibikin³ and others.

Peculiarities of renewable energy in economy and introducing Green economy to National economy in conditions of Uzbekistan is being studied by local scientists like A.V.Vahabov, Sh.X.Xadjibakiev.⁴

While writing the dissertation, the materials and annual reports of State Statistical Committee of the Republic of Uzbekistan, the World Bank Group, UNDP, Asian Development Bank, International Energy Council, International Revenue Agency, the International Renewable Energy Agency were used.

Methods of the research. Methods like grouping, analysis and synthesis, quantitative and qualitative analysis, historical, logical, comparative analysis, economic statistics, systematization, monographic observation, mathematical modeling were used in preparing master's dissertation.

Theoretical and practical significance of the research The research materials can be used as a natural for research, dedicated to deep, independent, comprehensive studying of alternative energy. Scientific results of the research and the developed practical proposals can be used to planning government's long-term alternative energy programs.

³ Mukund R. Patel. Wind and solar power systems: design, analysis and operation. - England: CRC Press, 2005, 472 p; Гибилиско С. Альтернативная энергетика без тайн.-Москва:Эксмо-Пресс, 2010, 368 с; Herman Scheer. The solar economy renewable energy for a sustainable global future.- England, 2004, 368 p; Каргиев В.М. Ветроэнергетика.Руководство по применению ветроустановок малой и средней мощности.-Москва:Интерсопарцентр, 2001, 62 с; Виссарионов В.И. Методы расчета возобновляемых источников энергии.-Москва, 2010, 144 с; Полонский В.М., Титов Г.И., Полонский А.В. Атономное теплонабжение.- Москва, 2009, 152 с; Сибикин Ю.Д, Сибикин М.Ю.Технология энергосбережения.-Санкт Петербург, 352с.
⁴ Вахабов А.В., Хажибакиев Ш.Х. Барқарор иқтисодий ривожла-нишни таъминлашда “яшил” иқтисодиётнинг ўрни//“Жаҳонда барқарор иқтисодий ривожланиш концепцияларини амалга ошириш механизми ва дастаклари” мавзусидаги республика илмий-амалий конференцияси материаллари тўплами. - Тошкент.: “Universitet”. 2018. 239 б.;Вахабов А.В., Ходжикулова С.Н. “Яшил иқтисодиёт”ни халқаро кредитлаш манбалари, таркиби ва тенденциялари//“Жаҳонда барқарор иқтисодий ривожланиш концепцияларини амалга ошириш механизми ва дастаклари” мавзусидаги республика илмий-амалий конференцияси материаллари тўплами. - Тошкент.: “Universitet”. 2018. 239 б.

The practical significance of the research work is that the materials of dissertation can be used to enhance higher education institutions' study programs such as "National Economy", "Industrial Economics", "Innovation Management", "Strategy for Economy modernization and diversification", "Real sector economy", "Investment and innovative activity in the real sector".

Brief description of the dissertation content. The research paper consists of introduction, three chapters, summary and list of used literature.

The topic of the master dissertation, actuality of the work, the object and the subject, main idea and objectives, the analysis of used literature, a brief description of the methods used in research work, the theoretical and practical relevance, scientific novelty and practical significance of the research work are reviewed in the introduction part of the dissertation.

In the chapter of the research work, the factors of the formation and development of alternative energy sources, the evolution of scientific concepts of alternative energy, the direction of dynamic development of climate change and alternative energy have been studied.

The global crisis of fuel and alternative energy, alternative energy structure and development trends, and ways to improve financing practices for international financial institutions and alternative energy development is pointed out in the second chapter of the work.

The third chapter of the study examines the legal and institutional basis of the development of alternative energy in Uzbekistan, the role of alternative energy in deepening the modernization and transformation of the Uzbek economy, the development of alternative energy in the long term, and the development of national economies.

In the summary section, comparative analysis and evaluation of the investment projects implemented with the support of international financial institutions in the use of alternative energy in countries, identified problems and developed scientific recommendations.

The dissertation consists of an introduction, three chapters, containing nine paragraphs, conclusion, a list of references. The research is described in 85 pages of typewritten text and contains 5 tables, 7 pictures, 3 diagrams and 57 list of used literature.

CHAPTER I. THE ESSENCE AND INSIGHT OF THE DEVELOPMENT OF THE ALTERNATIVE ENERGY RESOURCES IN THE NATIONAL ECONOMY

1.1 Generation of the needs for alternative energy and the factors of the development

For thousands of years we have relied on burning fossil fuels to generate energy, but in today's world using oil, gas and coal for our energy needs is becoming a problem. Climate change is one of the greatest environmental challenges that we have ever faced, and the main cause behind it is our dependence on fossil fuels. Burning coal, petroleum and other fossil fuels is the primary means by which we produce electricity, but it also leads to heavy concentrations of pollutants in our air and water.

Another problem with using fossil fuels to generate energy is that there is not a limitless amount available. For the past couple of centuries, we have come to rely more and more on the world's supply of fossil fuels, and that supply is fast running out. As the demand for fossil fuels has increased, the cost of using them has also increased and each year we find ourselves with larger and larger energy bills.

The answer to all of these problems is renewable energy. Energy such as solar energy, wind energy and water power is generated from natural energy sources and unlike fossil fuels, these sources of energy never run out. With a much lower impact on the environment, using renewable energy helps to protect our planet by significantly reducing the amount of carbon emissions that we produce. By using renewable energy sources, we also reduce our dependence on fossil fuel gas and oil reserves, which means that we can avoid the rising cost of energy bills and improve our energy security.

In order to preserve our planet, our finance and our energy sources we all need to be involved in switching to renewable energy sources and making our homes more energy efficient.

Renewable technologies use natural energy to make electricity. Fuel sources include wind, wave, marine, hydro, biomass and solar. It is also made using sources of natural energy that are quickly replaced, such as biomass.

Renewables produce more than 20% of the UK's electricity, and EU targets means that this is likely to increase to 30% by 2020. From 2020, renewable energy will continue to be an important part of the strategy to reduce carbon emissions. To achieve this, a range of technologies will need to be used, such as onshore and offshore wind farms, biomass power stations or hydropower systems.

In the UK there are several schemes that provide financial support for renewable energy. These schemes encourage technological development and wider adoption of renewables which in turn lead to economies of scale and lower costs.

- The Renewable Obligation (RO) is intended to encourage renewable electricity generation for large scale installations. It requires suppliers to source an ever increasing amount of the electricity from renewable sources. The RO rewards renewable output over the lifetime of a project.

- The Feed-in Tariff (FiT) is designed to support small scale renewable installations up to 5MW. Through FiTs, generators are paid a tariff for every unit of electricity they produce. Any electricity not used on site can also be sold back into the Grid, and generators are paid extra to do this. Find out more about the FiT scheme at Department of Business, Energy and Industrial Strategy.

- A new scheme to support renewables and other low carbon technologies is currently being developed through Electricity Market Reform. The scheme will be called a Feed in Tariff with a Contract for Difference (CfD).

The UK is well placed to take advantage of wind power, with some of the best conditions in Europe and high average wind speeds. Both onshore and offshore wind farms are an important part of where the UK sources its energy. The UK has invested significantly in offshore wind and has installed as much capacity as the rest of the world combined.

Biomass can be sourced from any living substance as well as from material such as biodegradable waste, food waste and animal manure. Biomass can be burnt in thermal power and heat generation. It can also be used in the anaerobic digestion process, making a bio-gas that can be burnt in electricity or heat generation. This gas can also be refined to become methane and injected into the gas grid.

The UK Government has committed to reducing UK greenhouse gas emissions by 80% by 2050. To achieve this, elements of the UK energy system must deliver negative emissions – that is to say, they must remove from the atmosphere more carbon than they emit. Biomass production and consumption, especially when combined with Carbon Capture and Storage, offer a credible route for the UK to deliver negative emissions. Low-cost routes to 80% reductions in greenhouse gas emissions foresee around 130 TWh per year of energy being delivered from bioenergy sources. This equates to approximately 10% of total UK energy demand in 2050.⁵

Hydroelectric power is a well-established technology in the UK. The flow of water is used to turn turbines to generate electricity. There are different types of hydro power including those using the natural flow of the river or dam storage schemes.

Marine and wave technologies use the energy in the ocean to produce electricity. The marine and wave industries in the UK are at an early stage, but are growing due to several innovative designs. Marine technologies are expected to make a significant contribution to renewable power generation after 2020.

Solar photovoltaics are panels that convert the rays of the sun into energy. Current installed capacity exceeds 8.7GW and is increasing rapidly, with year-on-year growth exceeding 80% in 2015.

Renewable energy technologies increase their hold across developing and emerging economies throughout the year. The year 2016 saw several developments and ongoing trends that all have a bearing on renewable energy,

⁵ <https://www.energy-uk.org.uk/energy-industry/renewable-generation.html>

including the continuation of comparatively low global fossil fuel prices; dramatic price declines of several renewable energy technologies; and a continued increase in attention to energy storage.

For the third consecutive year, global energy-related carbon dioxide emissions from fossil fuels and industry were nearly flat in 2016, due largely to declining coal use worldwide but also due to improvements in energy efficiency and to increasing use of renewable energy.

As of 2015, renewable energy provided an estimated 19.3% of global final energy consumption, and growth in capacity and production continued in 2016. The power sector experienced the greatest increases in renewable energy capacity in 2016, whereas the growth of renewables in the heating and cooling and transport sectors was comparatively slow.

Most new renewable energy capacity is installed in developing countries, and largely in China, the single largest developer of renewable power and heat over the past eight years. In 2016, renewable energy spread to a growing number of developing and emerging economies, some of which have become important markets. For the more than 1 billion people without access to electricity, distributed renewable energy projects, especially those in rural areas far from the centralized grid, offer important and often cost-effective options to provide such access.

The renewable energy sector employed 9.8 million people in 2016, an increase of 1.1% over 2015. By technology, solar PV and biofuels provided the largest numbers of jobs. Employment shifted further towards Asia, which accounted for 62% of all renewable energy jobs (not including large-scale hydropower), led by China⁶.

The development of community renewable energy projects continued in 2016, but the pace of growth in some countries is in decline. In a new trend, such projects have begun to expand into energy retailing (supply), storage and demand-side management.

⁶ Renewables 2017. Global status report. P-19

Government policy at all levels remained important for renewable energy developments. The 2015 Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) formally entered into force at the 22nd Conference of the Parties (COP22) in November 2016. However, renewable energy markets were affected only indirectly during the year. A number of governments implemented new renewable energy targets, and several cities established new commitments to 100% renewable energy. Despite the importance of the heat and transport sectors to energy demand and global emissions, policy makers focused predominantly on the power sector.

1.1-table.

Renewable energy indicators 2016.⁷

		2015	2016
INVESTMENT			
New investment (annual) in renewable power and fuels ¹	billion USD	312.2	241.6
POWER			
Renewable power capacity (total, not including hydro)	GW	785	921
Renewable power capacity (total, including hydro)	GW	1,856	2,017
 Hydropower capacity ²	GW	1,071	1,096
 Bio-power capacity	GW	106	112
 Bio-power generation (annual)	TWh	464	504
 Geothermal power capacity	GW	13	13.5
 Solar PV capacity	GW	228	303
 Concentrating solar thermal power capacity	GW	4.7	4.8
 Wind power capacity	GW	433	487

Record numbers reached for newly installed renewable power generating capacity. Renewable power generating capacity saw its largest annual increase ever in 2016, with an estimated 161 gigawatts (GW) of capacity added. Total global capacity was up nearly 9% compared to 2015, to almost 2,017 GW at year's end. The world continued to add more renewable power capacity annually than it added (net) capacity from all fossil fuels combined. In 2016, renewables

⁷ Renewables 2017. Global status report. P-21

accounted for an estimated nearly 62% of net additions to global power generating capacity⁸.

Solar PV saw record additions and, for the first time, accounted for more additional capacity, net of decommissioning, than did any other power generating technology. Solar PV represented about 47% of newly installed renewable power capacity in 2016, and wind and hydropower accounted for most of the remainder, contributing 34% and 15.5%, respectively⁹.

The ongoing growth and geographical expansion of renewable power capacity was driven by the continued decline in prices for renewable energy technologies; by rising power demand in some countries; and by targeted renewable energy support mechanisms. Some well-established renewable energy technologies, such as hydropower and geothermal energy, have long since become cost-competitive with fossil fuels where resources are plentiful. Solar PV and wind power are now joining in, challenging fossil fuels in a growing number of locations. Plants owned by utilities or large investors dominated renewable electricity production in 2016, and the scale of renewable energy plants continued to grow. Major corporations and institutions around the world continued to make large commitments to purchase renewable electricity.

Modest improvements achieved, but renewable heating and cooling still constrained by low fossil fuel prices and lack of policy support. Modern renewable energy supplies approximately 9% of total global heat demand. In 2016, the vast majority of renewable heat continued to be supplied by biomass, with smaller contributions from solar thermal and geothermal energy. While additional capacities of modern bio-heat and solar thermal were installed in 2016, growth in both markets has slowed.

District heating systems are incorporating solar thermal energy for larger installations. Interest is expanding in the use of district heating as a way to provide flexibility to power systems, by storing energy from the electric power

⁸ Renewables 2017. Global status report. P-21

⁹ Same source

grid as heat, which reflects a more general increased interest in the electrification of the heating sector.

Continued improvements of materials, systems and industrial processes in the heating and cooling sector facilitated increases in renewable energy use. In general, however, deployment of renewable technologies in this market continued to be constrained by a number of factors including comparatively low fossil fuel prices and a relative lack of policy support.

Liquid biofuels remain the primary renewable energy in the transport sector, but electrification continues to expand. Liquid biofuels continued to represent the vast majority of the renewable energy contribution to the transport sector. In 2016, they provided around 4% of world road transport fuels, which account for the majority of transport energy use.

Biogas use in transport grew substantially in the United States and continued to gain shares of the transport fuel mix in Europe. Although other regions have established natural gas infrastructure into which biogas could be incorporated, deployment has remained limited.

Electrification of the transport sector expanded during the year. Direct links between renewable energy and electric vehicles (EVs) were few, but the share of renewables in electrified transport is rising as the share of renewables in grid power increases. Further electrification of the transport sector has the potential to create a new market for renewable energy and to facilitate the integration of variable renewable energy.

Policy support for renewable energy in the transport sector lags behind such support in the power sector. While there was increased attention to the decarbonization of transport at the international level in 2016, direct links with renewable energy were limited in this arena as well.

1.2 Literature review on alternative energy

Much research in recent years has focused on renewable energy industry. Summarizing the current researches results is vital for having a whole understanding on the research of renewable energy industry.

The most famous research on financing efficiency is by France Modigliani and Merton Miller (1958), published in the *American Economic Review* on the Modigliani–Miller (MM) theorem¹⁰. The theorem says that without considering income tax, the company's financing structure can affect the allocation of "cake", but will not affect the size of the "cake"; the total value of the company to contact the company's financing structure does not exist. This theory has become the pioneer of modern capital structure in the world. After that, the factor of income tax has been considered, and the theory has been revised. The revised MM theory creates a starting point for the study of capital structure theory and provides a useful analytical framework. More recently, researchers have employed the DEA (data envelopment analysis) to analyze investment efficiency in different industries/sectors. For instance, Li and Liu et al. (2017) have proposed a new framework based on the combination of the dynamic DEA¹¹, meta-frontier analysis theory, and truncated regression model, and then focus on the efficiency evaluation of regional high-tech industries in China. Lu and Yan Bai (2012) have made some conclusion based on the research on teaching quality evaluating theory and DEA method; by using the original data of class-teaching, where they evaluate many teachers' comparative efficiency and analyze the final conclusion¹². Wu and Li (2017) analyze the financial support efficiency from the aspect of capital raise based on a data envelopment

¹⁰ Modigliani, F.; Miller, M.H. The Cost of Capital, Corporation Finance, and the Theory of Investment. *Am. Econ.Rev.* 1958, 48, 125–143

¹¹ Li, L.B.; Liu, B.L.; Liu, W.L.; Chiu, Y.H. Efficiency evaluation of the regional high-tech industry in China: A new framework based on meta-frontier dynamic DEA analysis. *Soc. Econ. Plan. Sci.* 2017, 60, 24–33.

¹² Lu, T.; Yan, B.W. The Study of the DEA Method Model for University Teaching Quality Assessment and Benefit Analysis. *Phys. Proc.* 2012, 5, 1187–1191.

analysis (DEA) model, and find that helpful financial support plays an essential role in the process of its development¹³.

Recent researches have focused on the financing methods of renewable energy industries. For instance, Ng and Tao (2016) have explored the cause of the financing gap in Asia and proposes the use of bond financing to address the financing gap, find that three fixed income instruments, namely local currency denominated (LCY) corporate bonds, asset-backed project bonds and financial green bonds will be assessed and suggest that whilst the potential for these three instruments to mobilize large flows of private sector financing is great, key supportive policies aimed at reducing the capital market bias for conventional power generation technologies and supportive renewable energy (RE) policies are required, and another key aspect would be the necessary deepening of local and regional fixed income markets before such capital market instruments are able to play a big role¹⁴. Mazzucato and Semieniuk (2018) have analyzed the asset portfolios of different RE technologies financed by different financial actors according to their size, skew and level of risk and use entropy-based indices to measure skew, and construct a heuristic index of risk that varies with the technology, time, and country of investment to measure risk. And then they disaggregate further along 11 different financial actors (e.g., private banks, public banks, and utilities) and 11 types of renewable energy (RE) technologies (e.g., different kinds of power generation from solar radiation, wind or biomass). Krupa and Harvey (2017) have discussed a range of existing and emerging options for financing renewable electricity and uses the United States as a reference case study to contextualize the discussion¹⁵. Jiang and Duan (2016) put forward the corresponding mode of financing, which includes the government and financial institutions and establishes a financial support system

¹³ Wu, L.; Li, H. Analysis of the development of the wind power industry in China—From the perspective of the financial support. *Energy Sustain. Soc.* 2017, 7, 37.

¹⁴ Ng, T.H.; Tao, J.Y. Bond financing for renewable energy in Asia. *Energy Policy* 2016, 95, 509–517

¹⁵ Krupa, J.; Harvey, L.D.D. Renewable electricity finance in the United States: A state-of-the-art review. *Energy* 2017, 135, 913–929

to meet the financing needs of new energy enterprises¹⁶. Jiang et al. (2010) find that the higher listing requirements restrict the stock financing scale of new energy enterprises and the hesitant attitude of venture capitalists lead to the lack of venture capital. Finally, this article puts forward that project financing has not only expanded the financing channels of new energy projects, but also improved the economic efficiency of the new energy industry by introducing private capital¹⁷.

Some research has focused on the financing efficiency of new energy industry. For instance, Kabir and Kumar et al. (2018) find that the development of novel solar power technologies is considered to be one of many key solutions toward fulfilling a worldwide increasing demand for energy. Rapid growth within the field of solar technologies is nonetheless facing economic hindrances (e.g., high upfront costs and a lack of financing mechanisms)¹⁸. Zeng and Jiang et al. (2017) evaluate the investment efficiency of the new energy industry in China and investigate factors that explain variations in investment efficiency across firms and over time by applying a four-stage semiparametric DEA analysis framework, and find that overall investment efficiency of the new energy industry is relatively low, and new energy firms' investment efficiency is affected by both macroeconomic conditions and firm-specific characteristics¹⁹. Huijuan Deng (2015) figures out the macroscopic and microscopic influences of enterprise financing efficiency (FE) based on the foregoing study, calculates the financing efficiency value by using the basic DEA model according to the analysis of these influence factors and conducts the second-stage research on the relationship between the influences factors and the FE value with a multiple

¹⁶ Jiang, X.L.; Duan, Y.C. Research on financial support system for new energy enterprises based on life cycle theory. *Mod. Manag. Sci.* 2016, 10, 24–26.

¹⁷ Jiang, X.L.; Wang, Y.; Lyu, D.K. Financial support path analysis in the development of new energy industry. *Econ. Asp.* 2010, 8, 50–53.

¹⁸ Kabir, E.; Kumar, P.; Adelodun, A.A.; Kim, K.H. Solar energy: Potential and future prospects. *Renew. Sustain. Energy Rev.* 2018, 82, 894–900.

¹⁹ Zeng, S.; Jiang, C.; Ma, C.; Su, B. Investment efficiency of the new energy industry in China. *Energy Econ.* 2017

regression model²⁰. Zhao (2016) finds that equity financing can exacerbate the insider control problem of the new energy listed company and the new energy enterprise internal low financing costs can improvement capital utilization efficiency²¹. Zheng (2015) analyzes new energy efficiency of financing of listed companies in China, and finds that the traditional financing channels are not sufficient, which exist less money, long time delay and low efficiency²².

Most scholars have studied the financing efficiency of the new energy industry only with qualitative analysis or from the perspective of enterprises. Few studies have concerned on the financing efficiency of different approaches from the perspective of industry. The renewable energy industry has different financing methods and it cannot highlight the financing efficiency of different ways from the perspective of “unification”²³. Therefore, the financing efficiency of different financing methods should be analyzed. This paper uses Bloomberg New Energy Finance (BNEF) data to study the financing efficiency of different renewable energy industries and financing channels, and will help the government make reasonable policies and promote the implementation of the policy.

Historians of economies have examined the key transitions to alternative energies and regard the transitions as pivotal in bringing about significant economic change. Prior to the shift to an alternative energy, supplies of the dominant energy type became erratic, accompanied by rapid increases in energy prices.

In the late medieval period, coal was the new alternative fuel to save the society from overuse of the dominant fuel, wood. The deforestation had resulted in shortage of wood, at that time soft coal appeared as a savior. Historian Norman F. Cantor describes how:

²⁰ Deng, H. Research on Financing Efficiency of New Energy Industry in China. Master’s Thesis, South China University of Technology, Guangzhou, China, 2015.

²¹ Zhao, B. The impact of financing method and enterprise nature on financing efficiency—Based on empirical research on China’s new energy industry. *J. Commer. Econ.* 2016, 17, 180–182.

²² Zheng, D. Research on Financing Efficiency of Listed Companies in China’s New Energy Industry. Master’s Thesis, South China University of Technology, Guangzhou, China, 2015.

²³ Zhu, Y.; Zhou, S.; Feng, Y.; Hu, Z.; Yuan, L. Influences of solar energy on the energy efficiency design index for new building ships. *Int. J. Hydrogen Energy* 2017, 42, 19389–19394.

Europeans had lived in the midst of vast forests throughout the earlier medieval centuries. After 1250 they became so skilled at deforestation that by 1500 AD they were running short of wood for heating and cooking... By 1500 Europe was on the edge of a fuel and nutritional disaster, [from] which it was saved in the sixteenth century only by the burning of soft coal and the cultivation of potatoes and maize.

Whale oil was the dominant form of lubrication and fuel for lamps in the early 19th century, but the depletion of the whale stocks by mid century caused whale oil prices to skyrocket setting the stage for the adoption of petroleum which was first commercialized in Pennsylvania in 1859.

In 1917, Alexander Graham Bell advocated ethanol from corn, wheat and other foods as an alternative to coal and oil, stating that the world was in measurable distance of depleting these fuels. For Bell, the problem requiring an alternative was lack of renewability of orthodox energy sources. Since the 1970s, Brazil has had an ethanol fuel program which has allowed the country to become the world's second largest producer of ethanol (after the United States) and the world's largest exporter. Brazil's ethanol fuel program uses modern equipment and cheap sugar cane as feedstock, and the residual cane-waste (bagasse) is used to process heat and power. There are no longer light vehicles in Brazil running on pure gasoline. By the end of 2008 there were 35,000 filling stations throughout Brazil with at least one ethanol pump.

Cellulosic ethanol can be produced from a diverse array of feedstock's, and involves the use of the whole crop. This new approach should increase yields and reduce the carbon footprint because the amount of energy-intensive fertilizers and fungicides will remain the same, for a higher output of usable material. As of 2008, there are nine commercial cellulosic ethanol plants which are either operating, or under construction, in the United States.

Second-generation biofuels technologies are able to manufacture biofuels from inedible biomass and could hence prevent conversion of food into fuel."As

of July 2010, there is one commercial second-generation (2G) ethanol plant Inbicon Biomass Refinery, which is operating in Denmark.

In the 1970s, President Jimmy Carter's administration advocated coal gasification as an alternative to expensive imported oil. The program, including the Synthetic Fuels Corporation was scrapped when petroleum prices plummeted in the 1980s. The carbon footprint and environmental impact of coal gasification are both very high.

There are numerous organizations within the academic, federal, and commercial sectors conducting large scale advanced research in the field of alternative energy. This research spans several areas of focus across the alternative energy spectrum. Most of the research is targeted at improving efficiency and increasing overall energy yields.

In the US, multiple federally supported research organizations have focused on alternative energy in recent years. Two of the most prominent of these labs are Sandia National Laboratories and the National Renewable Energy Laboratory (NREL), both of which are funded by the United States Department of Energy and supported by various corporate partners. Sandia has a total budget of \$2.4 billion while NREL has a budget of \$375 million.

With the increasing consumption levels of energy, it is projected that the levels would increase by 21% in 2030. The cost of the renewables was relatively cheaper at \$2.5m/MW as compared to the non-renewables & 2.7m/MW. Evidently, the use of renewable energy is a cost effective method of obtaining energy. Additionally, their use also dispenses with the trade-off that has existed between environmental conservation and economic growth.

1.3 Climate change and alternative energy developments

Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average

conditions. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have been identified as primary causes of ongoing climate change, often referred to as global warming.²⁴

Scientists actively work to understand past and future climate by using observations and theoretical models. A climate record—extending deep into the Earth's past—has been assembled, and continues to be built up, based on geological evidence from borehole temperature profiles, cores removed from deep accumulations of ice, floral and faunal records, glacial and periglacial processes, stable-isotope and other analyses of sediment layers, and records of past sea levels. More recent data are provided by the instrumental record. General circulation models, based on the physical sciences, are often used in theoretical approaches to match past climate data, make future projections, and link causes and effects in climate change.

The most general definition of climate change is a change in the statistical properties (principally its mean and spread)²⁵ of the climate system when considered over long periods of time, regardless of cause²⁶. Accordingly, fluctuations over periods shorter than a few decades, do not represent climate change.

The term "climate change" is often used to refer specifically to anthropogenic climate change (also known as global warming). Anthropogenic climate change is caused by human activity, as opposed to changes in climate that may have resulted as part of Earth's natural processes²⁷. In this sense, especially in the context of environmental policy, the term climate change has

²⁴ America's Climate Choices: Panel on Advancing the Science of Climate Change; National Research Council (2010). *Advancing the Science of Climate Change*. Washington, D.C.: The National Academies Press. ISBN 0-309-14588-0. Archived from the original on 29 May 2014.

²⁵ Solomon, S.; Qin, D.; Manning, M.; Chen, Z.; Marquis, M.; Averyt, K. B.; Tignor, M.; Miller, H. L., eds. (2007). "Understanding and Attributing Climate Change". *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*. Intergovernmental Panel on Climate Change (IPCC).

²⁶ "Glossary – Climate Change". Education Center – Arctic Climatology and Meteorology. NSIDC National Snow and Ice Data Center.; Glossary, in IPCC TAR WG1 2001.

²⁷ "The United Nations Framework Convention on Climate Change". 21 March 1994. Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

become synonymous with anthropogenic global warming. Within scientific journals, global warming refers to surface temperature increases while climate change includes global warming and everything else that increasing greenhouse gas levels affect.

A related term, "climatic change", was proposed by the World Meteorological Organization (WMO) in 1966 to encompass all forms of climatic variability on time-scales longer than 10 years, but regardless of cause. During the 1970s, the term climate change replaced climatic change to focus on anthropogenic causes, as it became clear that human activities had a potential to drastically alter the climate²⁸. Climate change was incorporated in the title of the Intergovernmental Panel on Climate Change (IPCC) and the UN Framework Convention on Climate Change (UNFCCC). Climate change is now used as both a technical description of the process, as well as a noun used to describe the problem²⁹.

The world is fast becoming a global village due to the increasing daily requirement of energy by all population across the world while the earth in its form cannot change. The need for energy and its related services to satisfy human social and economic development, welfare and health is increasing. All societies call for the services of energy to meet basic human needs such as: health, lighting, cooking, space comfort, mobility and communication and serve as generative processes³⁰. Securing energy supply and curbing energy contribution to climate change are the two-over-riding challenges of energy sector on the road to a sustainable future³¹. It is overwhelming to know in today's world that 1.4 billion people lack access to electricity, while 85% of them live in rural areas. As a result of this, the number of rural communities

²⁸ "What's in a Name? Global Warming vs. Climate Change". NASA. Retrieved 23 July 2011.

²⁹ Hulme, Mike (2016). Concept of Climate Change, in: The International Encyclopedia of Geography. Wiley-Blackwell/Association of American Geographers (AAG). Retrieved 16 May 2016.

³⁰Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P.,Kadner, S., von Stechow, C. (2011). Renewable Energy Sources and Climate Change Mitigation. Cambridge: Cambridge University Press.10.1017/CBO9781139151153

³¹ Abbasi, T., & Abbasi, S. (2010). Renewable energy sources: Their impact on global warming and pollution. PHI Learning

relying on the traditional use of biomass is projected to rise from 2.7 billion today to 2.8 billion in 2030³².

Two years after agreeing to limit global warming to well below 2°C, and to pursue efforts to even aim for a 1.5°C limit, we still see a huge ambition gap³³ in the countries' greenhouse gas reduction targets and their progress regarding a sufficient implementation of the Paris agreement in national legislation.

Nonetheless, there are encouraging signs that a global energy transition is underway. Numbers show that, in 2014, 2015 and 2016, global energy-related carbon dioxide emissions did not grow further - the first time since industrial revolution in years without a big economic crisis. Also, according to the recent UNEP "Emission Gap Report" all global greenhouse gas emissions declined in 2016 for the first time since the early 1980s.³⁴ However, preliminary data published by the Global Carbon Project indicates that the emission in 2017 increased again by 2%.³⁵

The decarbonization of energy systems plays a key role in limiting emissions and in reducing them in the future. In addition, it is an encouraging sign for ongoing decarbonization that global energy related emissions have not grown, while primary energy demand has grown by an annual average of around 1.8% since 2011.³⁶

Investments in renewable energies continue to dominate the new investments in the energy system worldwide. At the same time coal use is declining. Last year the world consumption of coal was 1.7% less than in 2015. Even though coal prices have fallen, coal production already peaked in 2013 globally³⁷ and among the world's largest emitters, China, the USA, as well as in the EU. In 2015, almost all countries included in the index maintained double-digit growth rates in renewable energy and we see solar and wind technologies

³² Energy for sustainable development: A case of developing countries. Renewable and Sustainable Energy Reviews, 16,1116–1126.10.1016/j.rser.2011.11.013

³³ UNEP (2017)

³⁴ UNEP (2017)

³⁵ <http://www.globalcarbonproject.org/>

³⁶ REN21 (2017)

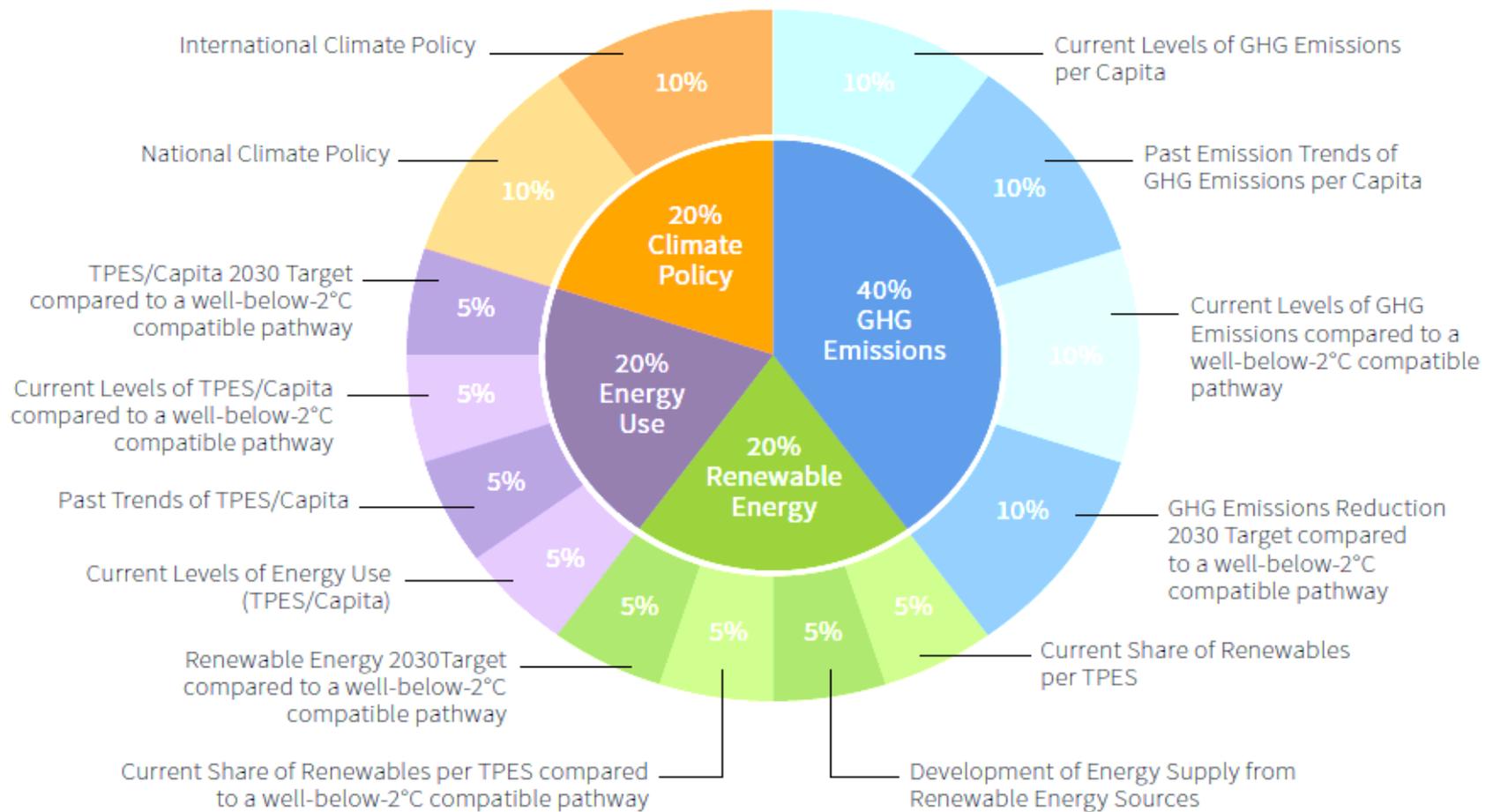
³⁷ BP (2017)

being more competitive from year to year. While growth rates of renewables have been particularly strong in industrialized countries in the past, emerging economies are playing an increasingly crucial role in the global energy transition. China is leading the upsurge in renewable energy, but Middle Eastern, North African and Central and South American countries are also expected to increase their installed capacity drastically by 2018. 51% of global capacity in wind energy and 53% in solar³⁸ energy is already installed in emerging economies, indicating the potential of leapfrogging a fossil-fuel-based industrialization.

Shrinking costs for renewable energies (wind and solar) is also an opportunity to more rapidly phasing out fossil fuels in the order of magnitude that is necessary to meet the well-below-2°C threshold of global warming. Prices for oil, gas and coal are dropping, which sets an incentive to use them also in the longer term. To maintain the positive developments in renewables, the need to set more ambitious renewable energy targets and appropriate carbon regulation including prices is increasing every day.

The global reaction to Donald Trump's withdrawal of the USA from the Paris Agreement has so far made the other countries present a united front in holding on to the goals of the Agreement. It still remains to be shown whether this will hold true when it comes to the real implementation of necessary policies. Positive signs have also come from US towns, states and companies, as well as actors in the financial market. Many of them implement their own strategies and at the same time demand more ambitious climate action internationally and nationally. They ask for a reliable and stringent policy framework and investment-relevant CO₂ price signals.

³⁸ Financial Times (2017)



1.1-diagram. Components of the CCPI³⁹

³⁹ Climate Change Performance Index. Results 2018

One of the key tasks of ongoing climate negotiations is to establish an “ambition mechanism”, thus continuously raising ambition in order to close the remaining gap between the countries’ emissions reduction targets and the global limit for temperature rise. This is not only a request to raise the mitigation target, but also the level of climate financing and innovative ways of cooperation, regarding technologies as well as beyond technology.

To find new ways of cooperation, it is equally important for countries to deliver on their promises and adopt sufficient legislation domestically. As Paris has requested and G19 has promised, countries should put forward their plans for moving towards greenhouse gas neutrality until 2050.

The design of the Climate Change Performance Index (CCPI) has now been changed, taking into account the new reality after adopting the Paris Agreement. (1.1-picture) It is now suited to measure the progress of countries towards contributing to the temperature limit the global community agreed to in Paris. It is also important to note that data show none of the 56 countries or the EU on a well-below-2°C pathway in their overall performance, while there are some initial indications that this might change for a few countries during the next years. Countries have to prove consistency in implementing necessary policies to reach national mitigation targets and raise ambition in adapting their targets to what would be well-below-2°C or 1.5°C compatible.

Summary of chapter I.

With a view to eliminating the adverse effects of natural and sustainable use of natural resources, for countries in developing regions it is necessary to invest no less than \$ 70-100 billion annually to improve their ecosystems, biodiversity and climate.. However, it should be kept in mind that the investment potential of developing regions is quite low. The attracted foreign investments are directed to the strategically important sectors (production and processing of minerals) in these regions. In addition, national legislation of some developing countries does not provide for the environmental or social

responsibility of economic entities. Such an aggressive approach to the exploitation of natural resources can cause serious damage to all modern civilization.

According to UNEP research, the rational and efficient use of global natural resources is estimated at \$ 2 trillion annually by 2050 for the next generation. The dollar generates economic benefits. It is predicted that the population of the world will increase by 28% and the per capita resource utilization rate by 71%. While no rigid measures on the rational use of natural resources are developed, annual consumption of metals, biofuels, minerals and other resources is estimated at \$ 85 billion. tons per year, up to 186 tonnes. Implementation of an effective resource utilization can cover this loss, provided that investment expenditures for the prevention of climate change lead to a reduction in the share of per capita gross domestic product by 3.7%⁴⁰.

⁴⁰ <http://web.unep.org/newscentre/smarter-use-resources-can-add-2-trillion-annually-global-economy>

CHAPTER II. INTERNATIONAL EXPERIENCE OF ALTERNATIVE ENERGY DEVELOPMENT AND PRIORITIES

2.1. World fuel crisis and transfer to green economy

The energy crisis is the concern that the world's demands on the limited natural resources that are used to power industrial society are diminishing as the demand rises. These natural resources are in limited supply. While they do occur naturally, it can take hundreds of thousands of years to replenish the stores. Governments and concerned individuals are working to make the use of renewable resources a priority, and to lessen the irresponsible use of natural supplies through increased conservation.

The energy crisis is a broad and complex topic. Most people don't feel connected to its reality unless the price of gas at the pump goes up or there are lines at the gas station. The energy crisis is something that is ongoing and getting worse, despite many efforts. The reason for this is that there is not a broad understanding of the complex causes and solutions for the energy crisis that will allow for an effort to happen that will resolve it.

“An energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. In popular literature though, it often refers to one of the energy sources used at a certain time and place, particularly those that supply national electricity grids or serve as fuel for vehicles”.

During election years there is a renewed debate on how “real” the energy crisis is in the world. One side will always say it is based on faulty science and politics; the other will say that the other side is basing their findings on junk science and political interests. The best way to sum up the reality of the energy crisis is that you cannot have growing demands on limited resources without eventually running out of the resource. That is just common sense. What is really at play in the discussion about how real the energy crisis is concerns the perception of responsibility for the future. There is no real energy crisis if you

are not concerned about life after your time on Earth is gone. There is a very real energy crisis if you care about the future that the next generations will inherit.

What is Being Done Today? There are many global initiatives that are working towards resolving the energy crisis. This has taken the form of increased regulation and restriction on carbon emissions, the promotion of greener manufacturing and construction projects, the funding of research into hybrid technologies and more sustainable technologies and more. Locally, more communities are seeing beyond the recycle bin and recognizing that how the community uses their local resources is important too. More community gardens, parks and farmer's markets are springing up not only as a means of introducing more elements into people's, but as an important part of educating the public about the importance of resources⁴¹.

The most important source of our modern civilization is energy. Energy is in everything. It comes in different forms — heat (thermal), light (radiant), mechanical, electrical, chemical, and nuclear energy. The use of energy has been a key in the development of the human society by helping it to control and adapt to the environment. Managing the use of energy is inevitable in any functional society. In the industrialized world the development of energy resources has become essential for agriculture, transportation, waste collection, information technology, communications that have become prerequisites of a developed society. The increasing use of energy since the Industrial Revolution has also brought with it a number of serious problems, some of which, such as global warming, present potentially grave risks to the world.

⁴¹ <https://www.conserve-energy-future.com/causes-and-solutions-to-the-global-energy-crisis.php>

<p>Causes of the Energy Crisis. It would be easy to point a finger at one practice or industry and lay the blame for the entire energy crisis at their door, but that would be a very naive and unrealistic interpretation of the cause of the crisis.</p>	<p>1. Overconsumption: The energy crisis is a result of many different strains on our natural resources, not just one. There is a strain on fossil fuels such as oil, gas and coal due to overconsumption – which then in turn can put a strain on our water and oxygen resources by causing pollution.</p>
	<p>2. Overpopulation: Another cause of the crisis has been the steady increase in the world's population and its demands for fuel and products. No matter what type of food or products you choose to use – from fair trade and organic to those made from petroleum products in a sweatshop – not one of them is made or transported without a significant drain on our energy resources.</p>
	<p>3. Poor Infrastructure: Aging infrastructure of power generating equipment is yet another reason for energy shortage. Most of the energy producing firms keep on using outdated equipment that restricts the production of energy. It is the responsibility of utilities to keep on upgrading the infrastructure and set a high standard of performance.</p>
	<p>4. Unexplored Renewable Energy Options: Renewable energy still remains unused in most of the countries. Most of the energy comes from non-renewable sources like coal. It still remains the top choice to produce energy. Unless we give renewable energy a serious thought, the problem of energy crisis cannot be solved. Renewable energy sources can reduce our dependence on fossil fuels and also helps to reduce greenhouse gas emissions.</p>
	<p>5. Delay in Commissioning of Power Plants: In few countries, there is a significant delay in commissioning of new power plants that can fill the gap between demand and supply of energy. The result is that old plants come under huge stress to meet the daily demand for power. When supply doesn't matches demand, it results in load shedding and breakdown.</p>
	<p>6. Wastage of Energy: In most parts of the world, people do not realize the importance of conserving energy. It is only limited to books, internet, newspaper ads, lip service and seminars. Unless we give it a serious thought, things are not going to change anytime sooner. Simple things like switching off fans and lights when not in use, using maximum daylight, walking instead of driving for short distances, using CFL instead of traditional bulbs, proper insulation for leakage of energy can go a long way in saving energy. Read here about 151 ways of saving energy.</p>
	<p>7. Poor Distribution System: Frequent tripping and breakdown are result of a poor distribution system.</p>
	<p>8. Major Accidents and Natural Calamities: Major accidents like pipeline burst and natural calamities like eruption of volcanoes, floods, earthquakes can also cause interruptions to energy supplies. The huge gap between supply and demand of energy can raise the price of essential items which can give rise to inflation.</p>
	<p>9. Wars and Attacks: Wars between countries can also hamper supply of energy specially if it happens in Middle East countries like Saudi Arabia, Iraq, Iran, Kuwait, UAE or Qatar. That's what happened during 1990 Gulf war when price of oil reached its peak causing global shortages and created major problem for energy consumers.</p>
	<p>10. Miscellaneous Factors: Tax hikes, strikes, military coup, political events, severe hot summers or cold winters can cause sudden increase in demand of energy and can choke supply. A strike by unions in an oil producing firm can definitely cause an energy crisis.</p>

2.1-picture. Causes of the Energy⁴²

⁴² The table was created by the author

Possible Solutions of the Energy Crisis. Many of the possible solutions are already in place today, but they have not been widely adopted.

1. Move Towards Renewable Resources: The best possible solution is to reduce the world's dependence on non-renewable resources and to improve overall conservation efforts. Much of the industrial age was created using fossil fuels, but there is also known technology that uses other types of renewable energies – such as steam, solar and wind. The major concern isn't so much that we will run out of gas or oil, but that the use of coal is going to continue to pollute the atmosphere and destroy other natural resources in the process of mining the coal that it has to be replaced as an energy source. This isn't easy as many of the leading industries use coal, not gas or oil, as their primary source of power for manufacturing.

2. Buy Energy Efficient products: Replace traditional bulbs with CFL's and LED's. They use less watts of electricity and last longer. If millions of people across the globe use LED's and CFL's for residential and commercial purposes, the demand for energy can go down and an energy crisis can be averted.

3. Lighting Controls: There are a number of new technologies out there that make lighting controls that much more interesting and they help to save a lot of energy and cash in the long run. Preset lighting controls, slide lighting, touch dimmers, integrated lighting controls are few of the lighting controls that can help to conserve energy and reduce overall lighting costs.

4. Easier Grid Access: People who use different options to generate power must be given permission to plug into the grid and getting credit for power you feed into it. The hassles of getting credit of supplying surplus power back into the grid should be removed. Apart from that, subsidy on solar panels should be given to encourage more people to explore renewable options.

5. Energy Simulation: Energy simulation software can be used by big corporates and corporations to redesign building unit and reduce running business energy cost. Engineers, architects and designers could use this design to come with most energy efficient building and reduce carbon footprint.

6. Perform Energy Audit: Energy audit is a process that helps you to identify the areas where your home or office is losing energy and what steps you can take to improve energy efficiency. Energy audit when done by a professional can help you to reduce your carbon footprint, save energy and money and avoid energy crisis.

7. Common Stand on Climate Change: Both developed and developing countries should adopt a common stand on climate change. They should focus on reducing greenhouse gas emissions through an effective cross border mechanism. With current population growth and over consumption of resources, the consequences of global warming and climate change cannot be ruled out. Both developed and developing countries must focus on emissions cuts to cut their emission levels to half from current levels by 2050.

2.2-picture. Possible Solutions of the Energy Crisis⁴³

⁴³ The table was created by the author

In society and in the context of humanities, the word energy is used as a synonym of energy resources, and most often refers to substances like fuels, petroleum products and electricity in general. These are sources of usable energy, in that they can be easily transformed to other kinds of energy sources that can serve a particular useful purpose. All forms of energy are stored in different ways, in the energy sources that we use every day. These sources are divided into two groups — renewable (an energy source that can be replenished in a short period of time) and nonrenewable (an energy source that we are using up and cannot recreate in a short period of time). Renewable and nonrenewable energy sources can be used to produce secondary energy sources including electricity and hydrogen.

Renewable energy sources include solar energy, which comes from the sun and can be turned into electricity and heat. Wind, geothermal energy from inside the earth, biomass from plants, and hydropower and ocean energy from water are also renewable energy sources. However, we get most of our energy from nonrenewable energy sources, which include the fossil fuels — oil, natural gas, and coal. They're called fossil fuels because they were formed over millions and millions of years by the action of heat from the Earth's core and pressure from rock and soil on the remains (or "fossils") of dead plants and animals. Another nonrenewable energy source is the element uranium, whose atoms we split (through a process called nuclear fission) to create heat and ultimately electricity.

We use all these energy sources to generate the electricity we need for our homes, businesses, schools, and factories. Electricity "energizes" our computers, lights, refrigerators, washing machines, and air conditioners, to name only a few uses. Oil is one of the most important of all these energy sources. Oil that we use these days comes from a material called Crude oil. Crude oil is a smelly, yellow-to-black liquid and is usually found in underground areas called reservoirs. Scientists and engineers explore a chosen area by studying rock samples from the earth. The amount of crude oil produced has been getting smaller each year.

However, the use of products made from crude oil has been growing, making it necessary to bring more oil from other countries.

As the supply of these crude oil is decreasing with the increasing demand we call it a Energy crisis. More precisely an energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. It usually refers to the shortage of oil and additionally to electricity or other natural resources. An energy crisis may be referred to as an oil crisis, petroleum crisis, energy shortage, electricity shortage or electricity crisis. As we live in the age of oil, but it is drawing to a close. The worlds' most widely-respected geologists, physicists, bankers, and investors in the world are absolutely terrified by a phenomenon known as global "Peak Oil."

Peak oil is the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline. The concept is based on the observed production rates of individual oil wells, and the combined production rate of a field of related oil wells. The aggregate production rate from an oil field over time appears to grow exponentially until the rate peaks and then declines, sometimes rapidly, until the field is depleted. It has been shown to be applicable to the sum of a nation's domestic production rate, and is similarly applied to the global rate of petroleum production. It is important to note that peak oil is not about running out of oil, but the peaking and subsequent decline of the production rate of oil.

If 2005 was the year of global Peak Oil, worldwide oil production in the year 2030 will be the same as it was in 1980. However, the world's population in 2030 will be both much larger (approximately twice) and much more industrialized (oil-dependent) than it was in 1980. Consequently, worldwide demand for oil will outpace worldwide production of oil by a significant margin. As a result, the price will skyrocket, oil dependent economies will crumble, and resource wars will explode.

The United Nations Economic Commission for Europe (UNECE) covers a large and diverse region comprising 56 member states. The present report covers

17 of the 56 United Nations Economic Commission for Europe (UNECE) countries – grouped because of their specific needs to establish a data baseline and to track progress made in renewable energy and energy efficiency development. The UNECE has been contributing actively to fulfilling the 17 countries’ aspirations in renewable energy by providing a platform for them to collaborate with other UNECE member countries. In 2014, a UNECE Group of Experts on Renewable Energy was established to step up these efforts. Its mandate is to carry out action-oriented, practical activities to greatly increase the uptake of renewable energy, helping to meet the objectives of the Sustainable Energy for All (SEforALL) initiative. *The UNECE Renewable Energy Status Report 2017* strives to present analysis of up-to-date data and information on the status of renewable energy and energy efficiency in the selected countries. This report is the second edition, providing the latest developments since December 2015.

Most of the 17 countries continue to progress in increasing renewable energy use and improving energy efficiency. This progress includes creating the necessary regulatory frameworks and adopting targets, policies and regulations. Governments in the region share a variety of energy challenges, which could become drivers for renewable energy deployment as the countries embrace a more active approach through renewable energy policies.

Energy import dependency dominates, as 11 of the 17 countries are net energy importers. Energy subsidies for fossil fuels are still present across the region. Energy intensity in the countries is high in the global context, with continuing improvements. The quality of energy access – mainly access to heat and to some extent to electricity – is an issue in several countries with regard to reliability, affordability and sustainability. Awareness and understanding of renewable energy is an additional obstacle to further development of renewables in the region. The REN21 Hard Talks – policy debates with participation of local stakeholders, held in December 2016 in Georgia and Ukraine in the context of preparing this report – confirmed that local debate on renewable

energy can benefit from external support. Overall, it remains a challenge to build sustainable and resilient energy systems that offer reliable and affordable energy to fuel the region's future economic growth.

The share of renewable energy in total final energy consumption (TFEC) varies widely across the 17 countries, with the average share at 18.2% of TFEC in 2014. Armenia, Bosnia and Herzegovina, Georgia, Montenegro and Tajikistan have achieved high shares of renewable energy (above 30% of TFEC), whereas Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan have low shares (less than 3%). The Russian Federation, the region's largest energy system, had a 3.5% share of renewable energy in TFEC in 2014.

The regional co-operation landscape is changing with the end of the European Union's INOGATE program. The new EU4Energy initiative brings together the Energy Community, the Energy Charter and the International Energy Agency to set up collaboration activities, including on renewable energy. The Energy Community established a Renewable Energy Coordination Group in 2016 to discuss and exchange experience on the legal transposition and implementation of EU directives in EU member countries. UNECE and the International Renewable Energy Agency (IRENA) are ramping up their activities to increase the renewable energy uptake by exploiting untapped potential in these countries. The revamped Covenant of Mayors for Climate and Energy is mobilizing activity at the local level. Other donors and development banks also are implementing projects relevant to renewable energy (e.g., CASA-1000 on electricity trade in Central Asia).

The issue is not one of "running out" so much as it is not having enough to keep our economy running. In this regard, the ramifications of Peak Oil for our civilization are similar to the ramifications of dehydration for the human body. An oil based economy such as ours doesn't need to deplete its entire reserve of oil before it begins to collapse. A shortfall between demand and supply as little as 10 to 15 percent is enough to wholly shatter an oil-dependent economy and reduce its citizenry to poverty. The effects of even a small drop in

production can be devastating. For instance, during the 1970s oil shocks, shortfalls in production as small as 5% caused the price of oil to nearly quadruple. The same thing happened in California a few years ago with natural gas: a production drop of less than 5% caused prices to skyrocket by 400%. Fortunately, those price shocks were only temporary.⁴⁴

The coming oil shocks won't be so short lived. They represent the onset of a new, permanent condition. Once the decline gets under way, production will drop (conservatively) by 3% per year, every year. War, terrorism, extreme weather and other "above ground" geopolitical factors will likely push the effective decline rate past 10% per year, thus cutting the total supply by 50% in 7 years. These estimate comes from numerous sources, many of which believe global oil production will peak and go into terminal decline within the next five years, if it hasn't already. Many industry insiders think the decline rate will far higher. Andrew Gould, CEO of the giant oil services firm Schlumberger, for instance, recently stated that "An accurate average decline rate of 8% is not an unreasonable assumption." Some industry analysts are anticipating decline rates as high as 13% per year. Source A 13% yearly decline rate would cause global production to drop by 75% in less than 11 years. If a 5% drop in production caused prices to triple in the 1970s, what do you think a 50% or 75% drop is going to do? Estimates coming out of the oil industry indicate that this drop in production has already begun. The consequences of this are almost unimaginable. People tend to think of "alternatives to oil" as somehow independent from oil. In reality, the alternatives to oil are more accurately described as "derivatives of oil." It takes massive amounts of oil and other scarce resources to locate and mine the raw materials (silver, copper, platinum, uranium, etc.) necessary to build solar panels, windmills, and nuclear power plants. It takes more oil to construct these alternatives and even more oil to distribute them, maintain them, and adapt current infrastructure to run on them.⁴⁵

⁴⁴ Information the International Renewable Energy Agency

⁴⁵ Same source.

If oil production remains constant, there is enough to last 42 years. That figure is 61 years for natural gas and 133 years for coal. Oil and gas wells produce less as they become depleted which is just one reason production will not stay constant. Everyone realizes oil and gas will become scarce and expensive within the life times of living humans. Inevitably, there will be a transition to sustainable energy sources. The transition may be willy-nilly or planned—the choice is ours. Because of our numbers and our technology, we humans greatly influence the ecology of Earth. Yet Earth does not come with an operating manual and we need to look to science to create one. The new era of limited and expensive energy will be very difficult for everyone on Earth but it will be even more difficult if it is not anticipated. It is of utmost importance that the public and especially policymakers understand the global energy crisis and the underlying science⁴⁶.

The term ‘energy crisis’ is used quite loosely so it pays to be clear about what’s under discussion. Broadly speaking the term poses three distinct questions:

Will we run out of energy? We rely on coal, oil and gas (the fossil fuels) for over 80% of our current energy needs – a situation which shows little sign of changing over the medium-term without drastic policy changes. On top of this energy demand is expected to grow by almost half over the next two decades. Understandably this is causing some fear that our energy resources are starting to run out, with devastating consequences for the global economy and global quality of life.

The potential for crisis if we run out of energy is very real but there is still time before that occurs. In the past two decades proven gas reserves have increased by 70% and proven oil reserves by 40%. At expected rates of demand growth we have enough for thirty years supply. Moreover, better technology means that new oil and gas fields are being discovered all the time while enhanced recovery techniques are opening up a potentially huge array of

⁴⁶ <http://english-text.ru/energy-crisis-global-warning/>

unconventional sources, including tar sands, shale gas and ultra-deep water. Ultimately, the near-unlimited supply potential of renewable energy sources should ensure that the world does not fall short of its energy needs.

How secure is our access to energy? The security of global energy supplies continues to be problematic. Today, oil and gas reserves are in the hands of a small group of nations, several of which are considered political unstable or have testy relationships with large consuming countries. Eighty per cent of the world's proven oil reserves are located in just three regions: Africa; Russia and the Caspian Basin; and the Persian Gulf. And more than half of the world's remaining proven gas reserves exist in just three countries: Russia, Iran, and Qatar. Concerns over energy security prompt policymakers to seek independence from foreign sources of energy. In Europe, new coal-fired power stations are back on the political agenda, partly because Russia is no longer seen as a reliable supplier of gas. In the US, home-grown biofuels have been promoted by successive administrations as an alternative to Middle Eastern oil imports, despite being more expensive. These reactions are a natural consequence. The more governments can extract themselves from the dependence on foreign energy resources, the more secure they feel.

How does climate change affect the energy we use? Emissions of carbon dioxide into the Earth's atmosphere – primarily as a result of burning fossil fuels for energy – are thought to be the cause of rising global temperatures. The scientific evidence to support this assertion has become increasingly compelling in recent years, suggesting a need for urgent and concerted action by all nations to prevent ecological degradation on a massive scale.

For the first time in history we face an energy crisis not because we might run out of energy, but because we are using it in the wrong way. Up to now the energy industry was judged by two metrics: its contribution to energy security and the cost of energy delivered to the consumer. To this we must now add a third: its success in reducing the emission of greenhouse gases, chiefly carbon dioxide, into the atmosphere.

Fortunately, finding solutions to these differing energy crises demands a broadly similar response:

First solution is reduce growing energy demand through improved energy efficiency and conservation.

The first step to reducing global emissions is to arrest the growth in energy demand with an aim to eventually setting it on a downward trend. The key for continued economic progress is to learn how to create more wealth with less energy. This has additional benefits in improving energy security, preserving precious natural resources and saving money for businesses and the ordinary consumer.

However, unlocking the potential savings from improved energy efficiency will be very difficult without government coordination to change consumer behavior. This will involve stricter product regulations as well as public education programs to encourage people to think differently about energy. Governments should also address the issue of financing, providing cheap loans to households and small businesses with which they can carry out the necessary improvement works.

Second solution is research, develop and deploy a broad range of energy sources, both domestic and international, to work with properly functioning global markets to help meet future energy demands.

We need to look at both the short-term and long-term. In the short-term we can push existing technologies to help reduce carbon emissions. Fortunately we already have many technologies at our disposal: from wind, wave, solar and biomass for heat and power, to liquid biofuels, biogas and electric motors for transport. In the long-term, evolutionary technologies need to be further developed and research into revolutionary ones pursued.

A crucially important technology will be carbon capture and storage (CCS) which allows for the continued use of fossil fuels in the future energy mix. Coal is widely used to generate electricity in many of the world's largest economies (especially the USA, China and India) and without CCS technology there is little

chance that their energy demands can be met whilst at the same time reducing greenhouse gas emissions.

Third solution is the so-called ‘developed countries’ along with large developing countries such as China, India, Russia and Brazil, should agree and adopt a common position on climate change, focused on reducing greenhouse gas emissions through an effective cross-border market and technology transfer mechanism.

Put simply, we cannot hope to avoid the dangerous consequences of climate change unless global emissions are halved from current levels by 2050. At current rates of population growth and with current technologies this will be impossible without a global agreement to limit and disperse the negative consequences. Developed countries must shoulder the initial burden with an agreement for immediate emissions cuts. In return, the largest developing countries must agree to cut their own emissions in the future, but only after having achieved some recognizable level of economic development.

All countries must agree to, and participate in, a carbon market framework with the aim of reducing emissions where it is most efficient and least costly. Whatever its design, the carbon market must create and defend a long-term price for carbon which is stable enough for businesses to factor it in to their forward planning. Where the flow of finance through the carbon market is insufficient to make the necessary reductions in emissions, additional funds should be made available. These should be used to allow non-OECD countries to develop alternative energy sources and help their citizens adapt to global warming. The OECD nations should seek to create a \$100bn fund for this purpose⁴⁷.

2.2 Alternative energy models development

The global deployment of Renewable Energy has been expanding rapidly. For instance, the RE electricity sector grew by 26% between 2005 and 2010

⁴⁷<http://www.global-economic-symposium.org/knowledgebase/the-global-environment/the-energy-crisis-and-climate-change/proposals/the-energy-crisis-and-climate-change>

globally and currently provides about 20% of the world's total power (including hydro-power). Rural areas attract a large part of investment related to renewable energy deployment, tending to be sparsely populated but with abundant sources of RE. The case studies have found that RE deployment can provide hosting communities with some benefits, including:

- New revenue sources. RE increases the tax base for improving service provision in rural communities. It can also generating extra income for land owners and land-based activities. For example, farmers and forest owners who integrating renewable energy production into their activities have diversified, increased, and stabilized their income sources.

- New job and business opportunities, especially when a large number of actors is involved and when the RE activity is embedded in the local economy. Although RE tends to have a limited impact on local labor markets, it can create some valuable job opportunities for people in regions where there are otherwise limited employment opportunities. RE can create direct jobs, such as in operating and maintaining equipment. However, most long-term jobs are indirect, arising along the renewable energy supply-chain (manufacturing, specialized services), and by adapting existing expertise to the needs of renewable energy.

- Innovations in products, practices and policies in rural areas. In hosting RE, rural areas are the places where new technologies are tested, challenges first appear, and new policy approaches are trialed. Some form of innovation related to renewable energy has been observed in all the case studies. The presence of a large number of actors in the RE industry enriches the “learning fabric” of the region. Small and medium-sized enterprises are active in finding business niches as well as clients and valuable suppliers. Even when the basic technology is imported from outside the region, local actors often adapt it to local needs and potentials.

- Capacity building and community empowerment. As actors become more specialized and accumulate skills in the new industry, their capacity to learn and

innovate is enhanced. Several rural regions have developed specific institutions, organisms, and authorities to deal with RE deployment in reaction to large investment and top-down national policies. This dynamic has been observed both in regions where local communities fully support RE and in regions where the population is against potentially harmful developments.

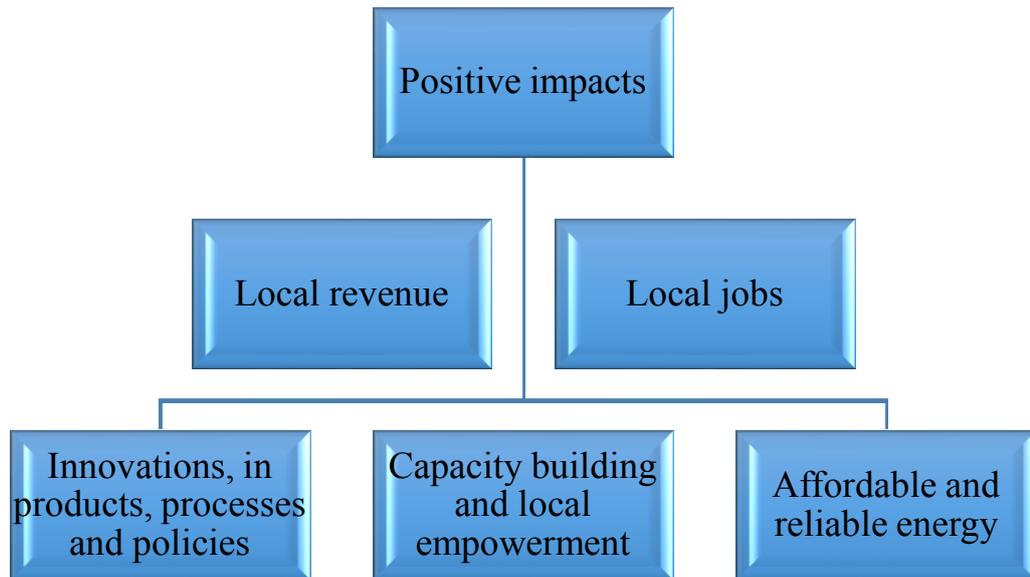
- Affordable energy. RE provides remote rural regions with the opportunity to produce their own energy (electricity and heat in particular), rather than importing conventional energy from outside. Being able to generate reliable and cheap energy can trigger economic development.

Renewable energy is increasingly being championed as a new source of jobs in OECD countries, as well as addressing concerns with energy security and climate change. In most OECD member countries, governments have invested large amounts of public money to support renewable energy development, and have also required that significant quantities of renewable energy be sold by energy providers. With most renewable energy facilities located in rural areas, what are the economic impacts of these policies and investments? Can renewable energy really help to develop rural economies?

These are some of the questions explored by this report, which presents the results of a two-year study of the impact of renewable energy on rural development. Drawing on case studies of renewable energy in 16 rural regions across Europe and North America, the report shows that renewable energy does not automatically create employment in rural regions. For renewable energy to trigger rural economic growth requires a coherent policy framework and the right set of local conditions.

The overall impact on economic growth is generally much lower than expected. National and regional renewable energy policies have set very ambitious targets and high incentives for renewable energy production that have caused distortions. Incentives have triggered rent-seeking behaviors, and installations often compete with agriculture and tourism for the use of land or

landscape amenities. In this context, many local communities have started opposing further deployments.



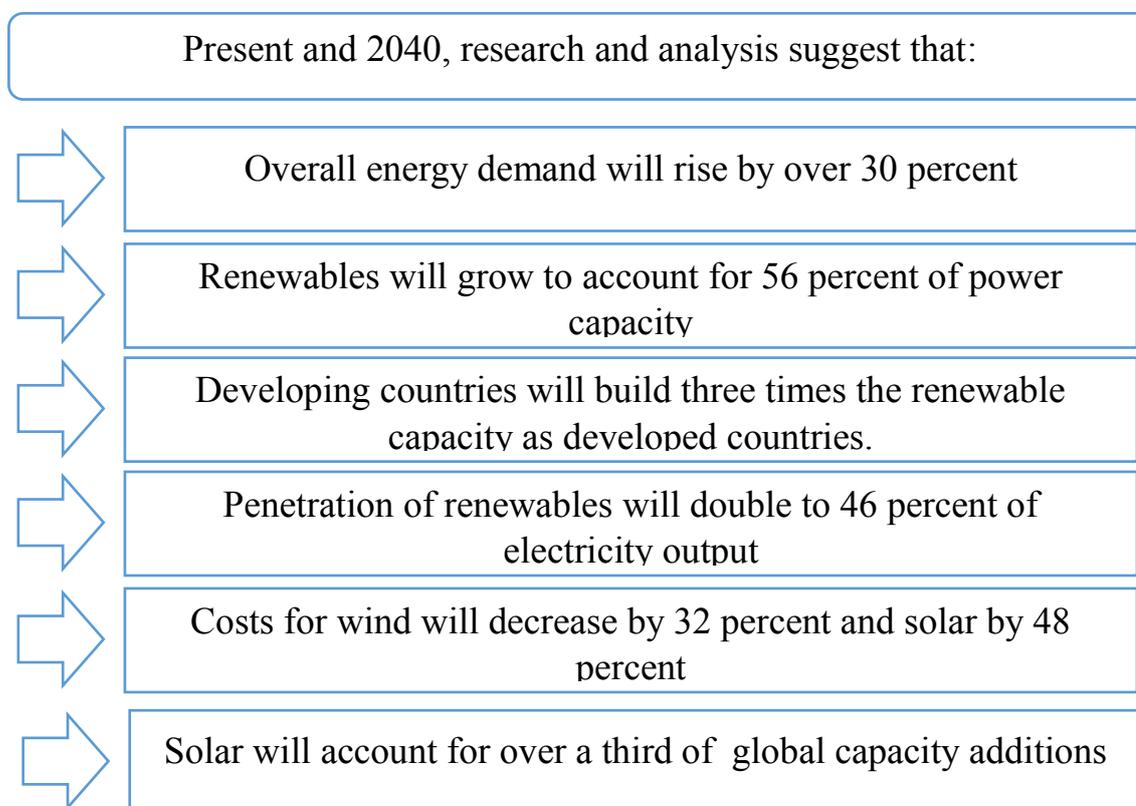
2.3-picture. Positive impacts⁴⁸

The report recommends putting renewable energy to work in rural areas. This implies a new paradigm for rural development. Reducing the use of spatially blind incentives, introducing a flexible policy framework, and taking into account the characteristics and specific needs of hosting economies could be a way to capitalize on the investment in renewable energy in terms of economic development. In particular, alternative energy should not be considered as a standalone sector within regional rural economies. Potential backward and forward linkages with rural industries such as forestry or manufacturing should be developed through an integrated approach to renewable energy deployment. Collective action should be stimulated through intermediate institutions active in rural communities and policy makers should aim at involving a larger number of stakeholders in policy interventions to stimulate sustainable development and improve local support.

⁴⁸ The table was created by the author

2.3. Financing models of alternative energy development

Over the long term, the prospects for renewable energy remain positive, marked by steady growth across all sectors.



2.4-picture. Suggestion of Research and analysis(present and 2040)⁴⁹

These long-term trends are clearly reflected in the top headlines for the industry in 2014. Renewables reached almost 11 gigawatts (GW) of installations. Developing countries almost surpassed developed countries in total investments for renewables, increasing their share of investment activity to 49 percent — a new record.⁵⁰ China alone attracted over US\$83 billion, representing almost a third of global investment and an increase of 33 percent for that country over 2013.⁵¹

The largest single initiatives for renewable energy in 2014 involved solar panel projects in China and Japan. Almost US\$75 billion was invested by the

⁴⁹ Op. cit., Bloomberg New Energy Outlook 2015; World Energy Outlook Special Report, REN 21

⁵⁰ Op. cit., REN21

⁵¹ Op. cit., Global Trends in Renewable Energy Investments 2015

two Asian countries. China dedicated almost US\$40 billion to large, utility-scale installations of more than 1 megawatt (MW). Japan invested almost US\$35 billion in smaller solar projects of less than 1 MW, supported in part by FITs to stimulate the installation of solar, wind, and other forms of renewable energy.

Wind turbine power generation represented the other major development area for renewables.

Again, China was the leader with US\$38 billion in investments, representing almost two-thirds of wind financing in developing countries. These investments were driven by national policies as well as anticipated reductions in FITs. Germany, the UK and the Netherlands invested over US\$5 billion in wind power, much of it for offshore installations. Seven projects costing US\$1 billion or more reached “final investment decision” stage during 2014. The largest project was the US\$3.8 billion financing by 12 banks, three export credit agencies, the European Investment Bank and a Danish pension fund for the 600 MW Gemini installation off the coast of the Netherlands. Globally, US\$18.6 billion worth of offshore wind projects were financed in 2014, representing an increase of 148 percent over 2013. Europe accounted for US\$16.2 billion of the world offshore wind investment, with China the remaining US\$2.4 billion.

Challenges for renewables include policy uncertainty, a trend toward auctions and away from FITs and green certificates in developed countries, retroactive changes in subsidies, and the need to expand electricity distribution systems and integrate renewable-based systems with existing power grids. In addition, the rapid drop in crude oil prices in 2015 and the continued low prices for natural gas in North America may have an impact on adoption rates for renewables, although no significant changes have been seen so far in policymaking or investments. In fact, the continued growth of renewables during a period of historically low prices for oil and gas can be explained in part by the success of policies that decouple the renewable market from the fossil fuel market.

The development of more sophisticated power storage and delivery systems will become increasingly important for renewables and require high investments. As the global middle class continues to expand, energy consumption will be marked by greater peak demand periods driven by home appliances, cooling and heating systems and transportation. However, renewables such as solar and wind are variable energy sources, dependent on whether the sun shines and the wind blows. To incorporate these renewables into their traditional energy mix, utilities will need to continue their development of battery storage systems, smart metering, demand-response solutions, and other innovations that increase energy efficiency while helping to match fluctuating supply and demand.

The following key sectors represent a number of recent industry trends:

Solar PV: Although hydropower is still the main source of renewable energy, rapidly falling costs have made solar PV the largest market for new investment. In fact, unsubsidized solar PV-generated electricity has now become cost competitive with fossil fuels in a growing number of locations around the world. The recovery that began in 2013 for solar PV continued in 2014, with an estimated 40 GW installed for a total global capacity of about 177 GW.⁵² China, Japan, and the US accounted for the vast majority of new capacity. However, significant new capacity was planned or added in Latin America, several African countries, and markets in the Middle East such as Saudi Arabia. In January 2014, Dubai Electricity & Water Authority awarded a contract to build a 200 MW, US\$330 million PV plant to a group led by Saudi Arabia's ACWA Power International.⁵³ Most EU markets declined for the third consecutive year, but the region — particularly Germany — continued to lead the world in terms of total solar PV capacity and contribution to the electricity supply.

Concentrating Solar Thermal Power (CSP): The sector maintained strong growth with total capacity increasing 27 percent to 4.4 GW.⁵⁴ Most capacity is

⁵² REN21, Technology Roadmap: Solar Photovoltaic Energy, International Energy Agency

⁵³ Op. cit., Global Trends in Renewable Energy Investments 2015

⁵⁴ REN21

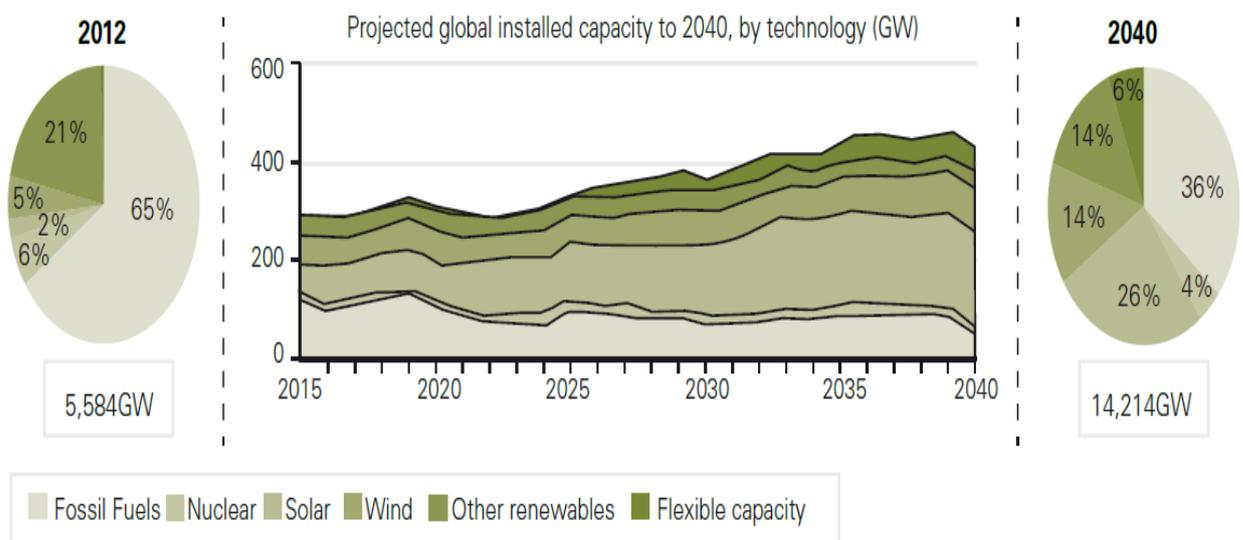
delivered through parabolic trough plants, but 2014 saw a greater diversification of technologies such as linear Fresnel and tower plants that produce energy as heat through the use of long and narrow segments of mirror that pivot to reflect sunlight onto a fixed absorber tube. Only the United States and India added CSP facilities to their grids in 2014, but South Africa and Morocco continued construction and planning for CSP. Spain remained the global leader in existing capacity, although European markets remain stagnant. However, costs are declining for CSP, particularly in the global sunbelt, and a variety of technologies are under development that can support CSP, such as thermal energy storage (TES) systems.

Solar Thermal Heating and Cooling: Solar thermal heating technologies capture the heat of the sun and transfer it to air or water to heat buildings. Solar chillers use thermal energy to produce cold air or water through absorption cooling technology. The technology is used primarily for large domestic water heating systems in hotels, schools, factories and other large complexes. In general, solar thermal technologies declined in 2014, especially in Europe and China. Cumulative capacity of water collectors reached an estimated 406 GW thermal (GWth) by the end of 2014 (with air collectors adding another 2 GWth), providing approximately 341 terawatt thermal (TWth) of heat annually. Despite overcapacity and weakening demand in 2014, China again accounted for about 80 percent of the world market for solar water collectors. Domestic sales expanded in much of Asia, parts of Africa, and Latin America.

Wind Power: Wind is still the cheapest option for new power generation, and global wind power added a record 51 GW in 2014 — the most of any renewable technology — for a total of 370 GW. An estimated 1.7 GW of grid-connected capacity was added offshore for a world total exceeding 8.5 GW. Wind energy is the least-cost option for new power generating capacity in an increasing number of locations, and new markets continued to emerge in Africa, Asia, and Latin America. Asia remained the largest market for the seventh consecutive year, led by China, and overtook Europe in total capacity. The US

was the leading country for wind power generation. After years of operating in the red, most turbine makers pulled back into the black with all the top 10 companies breaking installation records.

Hydro: Most hydro-electric projects of more than 50 MW have been in operation for decades and represent a different stage in renewable technology. However, mention should be made of several recent achievements in this sector. These are led by the final commissioning of the giant 13.9 GW Xiluodu Dam in Yunnan and Sichuan provinces, China. In addition, Andritz, an Austrian company, has been awarded a contract to supply electromechanical equipment for the 2.1 GW Lauca hydropower plant in Angola. Other financings include US\$904 million for the ICE Reventazon hydro-electric project in Costa Rica and US\$747 million for the Nam Ngiep 1 project in Laos.⁵⁵



2.1-diagram. Annual Capacity additions, 2015-2040 (GW)⁵⁶

Summary of chapter II.

According to the forecasts of the Organization for Economic Co-operation and Development (OECD), with the current production methods and consumption levels, the loss of current flora and fauna from sq.km. can be

⁵⁵ Ibid.

⁵⁶ Bloomberg New Energy Finance

irreversibly disposed of 61 to 72% in 2050, .⁵⁷ 2015 According to the Global Footprint Network project experts, the annual use of land resources, which can then be recovered, is used only for 7 months in 13 days.⁵⁸

In the current situation, the economy and the social sphere can be considered as the most optimal solution for the use of renewable energy resources. Significant potentials in the use of renewable energy (solar, wind, hydropower, and bioenergetics) sectors in almost all parts of the world. In particular, according to the International Renewable Energy Agency, Canada and the United States have created renewable energy resources 96,636 and 214,766 MW, respectively. With its significant potential and diverse climatic conditions, Russia could generate only 51,747 MW of renewable energy resources per year. Brazil and China launched 122,951 and 545,206 megawatts of renewable energy annually, respectively. Africa is a completely outsider of this issue. Because the entire African region has 38,192 MW of renewable energy resources.⁵⁹

⁵⁷ Перспективы энергетических технологий. Сценарии и стратегии до 2050 г. / ОЭСР/МЭА ; WWF России ; ред. А. Кокорина, Т. Муратовой. – М., 2007. – 586 с.

⁵⁷ <http://www.amic.ru/news/311549/>

⁵⁸ <http://www.amic.ru/news/311549/>

⁵⁹ IRENA (2017), Renewable capacity statistics 2017, International Renewable Energy Agency (IRENA), www.irena.org/Publications

CHAPTER III. ALTERNATIVE ENERGY DEVELOPMENT IN THE REPUBLIC OF UZBEKISTAN

3.1. Legal framework for alternative energy development in the Republic of the Uzbekistan

To note that in economically developed and developing countries the accelerated rates conduct developments on practical use of alternative energy sources as most important factor of sustainable development and increase in competitiveness of economies in the conditions of reduction of world reserves of carbonic raw materials.

In Uzbekistan considerable experience of conducting scientific and pilot studies in a scope of alternative energy sources, first of all solar energy on which are developed within many decades is accumulated. In the republic the scientific and experimental center Physical Solar Academy which doesn't have analogs in Central Asia which results of researches have gained world recognition is created.

Research and development on creation of low-potential installations for hot water - and heat supplies, to photo-electric and thermodynamic transformations for receiving electricity, to use of solar energy in technologies of synthesis of special materials, heat treatments of materials and designs is most actively and productively conducted.

Results of the conducted researches find broad experimental practical application in various branches and spheres of national economy. More than ten years in the republic production and experimental use of hot water supply of houses and social objects on the basis of solar water-heating installations is carried out. In the city of Tashkent, the Samarkand region and other regions solar power plants for receiving hot water are installed. Production of photo-electric installations of various power is developed. In many higher education institutions and professional colleges training of qualified personnel for this sphere is carried out.

The conditions and objective prerequisites for practical application of solar energy created in Uzbekistan form a basis for use of this region as platforms for experimental introduction of advanced technologies in this sphere not only in the republic, but in all Central Asia⁶⁰.

For cardinal decrease in power consumption of economy taking into account the best practices of economically developed countries, ensuring rational and effective use of non-renewable carbonic resources, increase in competitiveness of products, implementation on this basis of steady providing branches of economy and the population with fuel and energy resources:

To determine by the priority directions of further reduction of power consumption, introduction of energy saving technologies and systems in branches of economy and the social sphere for 2015-2019:

- decrease in power consumption of products by the further modernization, technical and technological rearmament existing and creations of new production capacities only on the basis of modern energy efficient and energy saving technologies;

- development of organizational and technical actions for economy of fuel and energy resources and industry programs of energy saving, carrying out power audit of the enterprises according to the international practice;

- the accelerated development of renewables, including the approved technologies of use of solar energy;

- expansion of production of modern types of the energy saving equipment, devices and materials and also the automated systems of accounting of an expense of fuel and energy resources, with their universal introduction in branches of economy and the social sphere;

- ensuring energy efficiency at construction new and reconstruction of the operating residential and office buildings, industrial facilities by means of application of modern architectural and construction decisions and new energy

⁶⁰ Указ Президента Республики Узбекистан 1 марта 2013 г., № УП-4512 “О мерах по дальнейшему развитию альтернативных источников энергии”

saving types of building constructions and insulating materials⁶¹.

According to the Program of “Measures for reduction of power consumption, introduction of energy saving technologies and systems in branches of the economy and the social sphere for 2015-2019 approved by the resolution of the President of the Republic of Uzbekistan”, May 5, 2015 № PD-2343 in the republic the wide package of measures for ensuring energy saving in branches of economy and the social sphere is implemented in recent years.

Standards on power management of production and power marking of the household equipment are entered. Introduction of energy efficient technologies in the system of street lighting and energy saving lamps for residential and public buildings is carried out, realization in the territory of the republic of glow lamps with a power over 40 W is stopped.

In budgetary institutions of the Ministry of national education, the Ministry of Health and the Center of secondary vocational, professional education replacement of power-intensive coppers of heating by energy efficient is conducted. Investment projects on introduction of modern gas-turbine, steam-turbine installations in power branch are implemented.

Within the adopted Program of “Measures for further development of hydropower for 2017-2021 further development of hydro energy potential of the republic” on the basis of construction 42 new and modernizations of 32 operating hydroelectric power stations, with expansion by 2025 of capacities of environmentally friendly hydraulic power of the republic by 1,7 times is provided.

At the same time, despite the taken measures, the power consumption of domestic economy remains high, the level of diversification of fuel and energy balance due to involvement in industrial production of renewables doesn't answer global trends. In structure of primary fuel for production of electric and

⁶¹ Постановление Президента Республики Узбекистан 05.05.2015 г. N ПП-2343 “О программе мер по сокращению не энергоёмкости, внедрению энергосберегающих технологий в отраслях экономики и социальной сфере на 2015-2019 годы”

thermal energy natural gas and other traditional types of hydro carbonic fuel dominate.

By production of electric and thermal energy the available rather high potential of renewables is practically not used (solar, wind and biogas, hydraulic power of small natural and artificial water currents).

For expansion of use of renewables, reduction of power consumption of production, target introduction in practice of domestic scientific and technical developments and researches of the advanced approved international energy saving technologies, realization of the priority directions in this sphere determined by the Strategy of actions by five priority directions of development of the Republic of Uzbekistan in 2017-2021:

To determine the priority directions of further development of renewable power, increase in energy efficiency in branches of economy and the social sphere for 2017-2021: introduction of innovative technologies, scientific and technical developments in the sphere of development of renewable power and increase in energy efficiency, expansion of production and localization of the energy saving equipment and devices, including by a transfer of technologies and creation of the engineering centers; diversification of the fuel and energy balance in the part of electricity production using renewable and alternative energy sources, energy recycling of secondary energy resources, involvement of business entities in the creation of generating capacities on the basis of proven technologies for the use of solar, wind, micro and small hydroelectric power stations; reduction of the energy intensity of the produced products by creating new and modernizing, technical and technological re-equipment of existing capacities on the basis of the introduction of modern energy-efficient and energy-saving technologies.

The Academy of Sciences of the Republic of Uzbekistan, the Agency for Science and Technology, Uzbekhydroenergo JSC, the International Solar Energy Institute, the Scientific and Technical Center of JSC Uzbekenergo in two months on the basis of an analysis of domestic developments and scientific and

applied research in the field of energy use from renewable sources, including the development of solar energy, energy efficiency, as well as the possibility of transfer of proven advanced foreign technologies in this area, to develop and submit for approval in the Cabinet no Ministers plan of practical measures to increase the target implementation in the fields of economy and social sphere of renewable energy and the development of solar energy⁶².

3.2. Challenges of alternative energy in structural reforms implementation and modernization of the economy of Uzbekistan

In condition of globalization of the world economy, demand for electricity is rising extremely. Currently, oil, natural gas, coal and uranium are the world's major sources of energy. Due to the continuing usage of limited natural resources, their reserves are depleting from year to year and it causes environmental impact. According to economists, if the world's natural resources are used in this way, the world's oil reserves could provide us from 45 up to 50 years, coal 165-170 years, natural gas 70-75 years, brown coal 450-500 years⁶³.

Oil remains the world's leading fuel, accounting for 32.9% of total global energy consumption. Although emerging economies continued to dominate the growth in global energy consumption, growth in these countries (+1.6%) was well below its ten-year average of 3.8%.⁶⁴

Several structural changes are underway in the oil industry, the emergence of non-OPEC supply, the trends in energy efficiency, the diminishing role of high-Sulphur oil with the environmental pressures in the marine fuel industry and in the power generation sector, and the emergence of unconventional oil (shale oil, heavy oil, tight oil and tar sands), and increased production both from mature and frontier fields.

⁶² Постановление Президента Республики Узбекистан 26.05.2017 г. N ПП-3012. “О программе мер по дальнейшему развитию возобновляемой энергетики, повышению энергоэффективности в отраслях экономики и социальной сфере на 2017-2021 годы”

⁶³ http://uzbekistonovozi.uz/uz/articles/index.php?ELEMENT_ID=9947

⁶⁴ World energy council. World energy recourses 2016. P16

Due to the uneven distribution of energy resources between the two countries, the energy sector needs to abandon the traditional energy grid and need renewable energy sources.

3.1-table.

Global oil demand 2014-2018 (MB/D)⁶⁵

Region	2014	2015	2016	2017	2018	Change from 2014- 2018 in %
OECD Americas	24 ,1	24 ,2	24 ,3	24 ,4	24 ,5	0 ,004%
OECD Asia Ocean	8 ,1	8 ,0	7 ,9	7 ,9	7 ,9	0%
OECD Europe	13 ,4	13 ,3	13 ,3	13 ,2	13 ,1	-0 ,07%
FSU (Former Soviet Union)	4 ,8	4 ,6	4 ,7	4 ,7	4 ,8	0,021%
Other Europe	0 ,7	0 ,7	0 ,7	0 ,7	0 ,7	0%
China	10 ,4	10 ,6	10 ,9	11 ,2	11 ,5	0,026%
Other Asia	12 ,1	12 ,5	12 ,9	13 ,3	13 ,7	0,03%
Latin America	6 ,8	6 ,9	7 ,0	7 ,1	7 ,2	0,014%
Middle East	8 ,1	8 ,3	8 ,5	8 ,8	9	0,022%
Africa	3 ,9	4 ,1	4 ,2	4 ,4	4 ,5	0,22%
World	92 ,4	93 ,3	94 ,5	95 ,7	96 ,9	0,012%

Renewable energy is the source of energy from the energy source. These are examples of solar, uranium and nuclear, oil, natural gas, wind, coal, geothermal, seafood, biogas and other sources of agricultural waste. Alternative energy is becoming one of the priorities of the world economy Its contribution to global energy is growing. For example, Iceland has a vast potential to use geothermic heat as a source of energy, while Italy and Spain have a number of

⁶⁵ World energy council. World energy recourses 2016. P16

advantages over solar energy. Denmark and Germany are leading the European Union in the use of wind energy. (3.1-table)

Our country has been widely used in all sectors of the economy, especially in agriculture, from alternative sources of energy, such as biogas installations, hot water supply systems, solar photovoltaic power plants, energy efficient water pumps, small hydropower stations, wind energy.

The results of the researches are widely used in experimental practice in different sectors of the economy. For more than ten years, the country has been developing and using experiments to provide hot water to residential and social facilities based on solar water heaters. In Tashkent, Samarkand region and other regions, there are set up facilities for hot water supply. Production of photoelectric devices of different capacities is mastered. Many higher education institutions and professional colleges are trained for this field.

Experimental use of hot water for the use of hot water is being conducted by the "Sohibkor" industrial zone in the Tashkent region, "Zakovat" of Bektemir RC of Qashkadarya region and "Kelajak" farm in Akdarya district of Samarkand region.

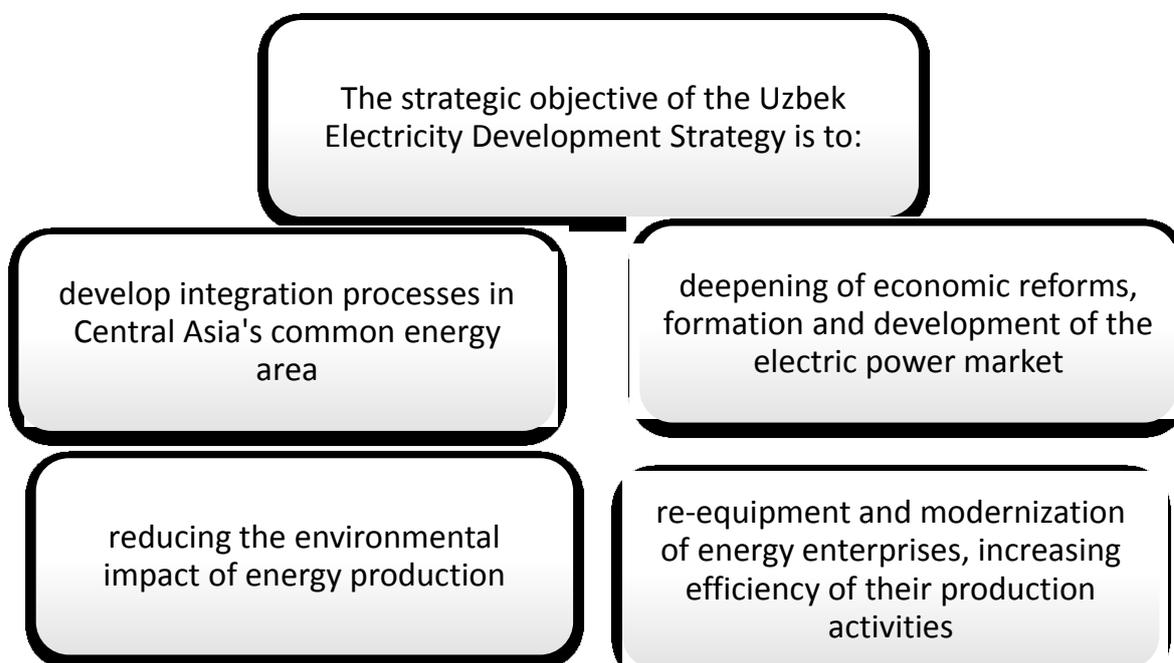
Also, researchers found that drinking water pipes could be used to generate electricity, and this experiment was conducted in Andijan region in partnership with the US company Lucid Energy. For this purpose, the width of the water pipes is 100 centimeters. 200 kW electric power is available for each installed pipe. It is planned to provide electricity to the average of 150 households by means of the 1100 megawatt energy annually⁶⁶.

One of the most effective directions of energy supply is the creation of decentralized power supply systems using small and micro hydro power stations, operating locally and with capacity.

The extensive use of micro energy by consumers in the energy supply will enable consumers to address issues of minimizing environmental damage and establish a reliable and efficient energy supply system in the shortest possible

⁶⁶ Lucid energy.com

time. Small and micro hydro power plants are environmentally friendly and cheap energy sources, and their future development will provide a great deal of coverage for the electricity needs of regions with no centralized power supply.



3.1-picture. The strategic objective of the Uzbek electricity development strategy⁶⁷

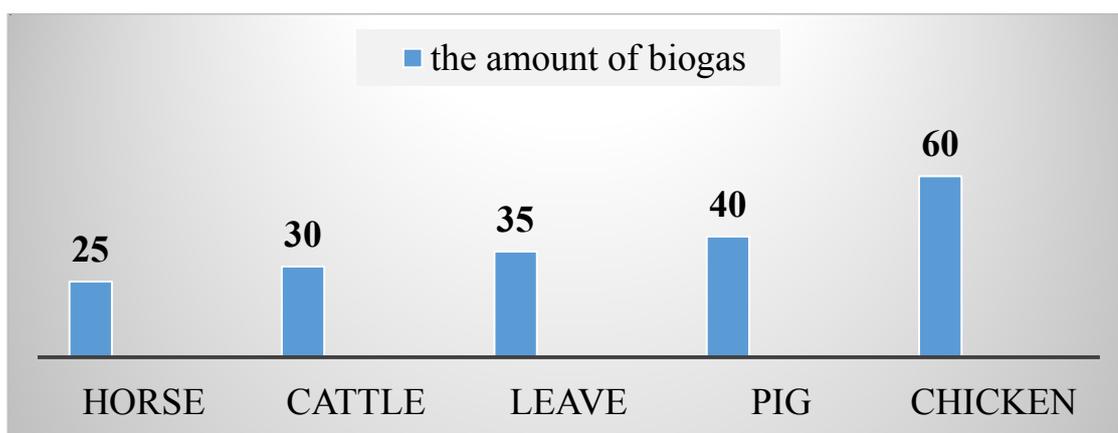
In the mountainous regions of Uzbekistan, about 80% of the average electricity consumed is spent on household consumption, homes and streets. In remote mountainous districts, there are disruptions in the supply of electricity, while using cotton, coal, fuel and fuel as the main source of energy for heating households.

There are small rivers along the large rivers in the mountainous and foothold areas of our country. Construction of micro hydroelectric power stations with capacity from 5 kW to 100 kW for small watercourses allows remote population and rural population to receive necessary electricity.

Biogas is a gaseous organic product that is formed without the participation of air in the fermentation of various organic matter.

⁶⁷ The picture was created by the author

With the announcement of the Decree of the President of the Republic of Uzbekistan of March 1, 2013 No. UP-4512 "On Measures for Further Development of Alternative Energy Sources," scientific and experimental and material-technical base for deeper development and practical application of biogas energy in the country has been created. The goal is to provide the convenience of production, while increasing the demand for renewable energy sources in daily life.



3.1-diagram. Biogas capacity of 1 ton of fertilizer (m³)

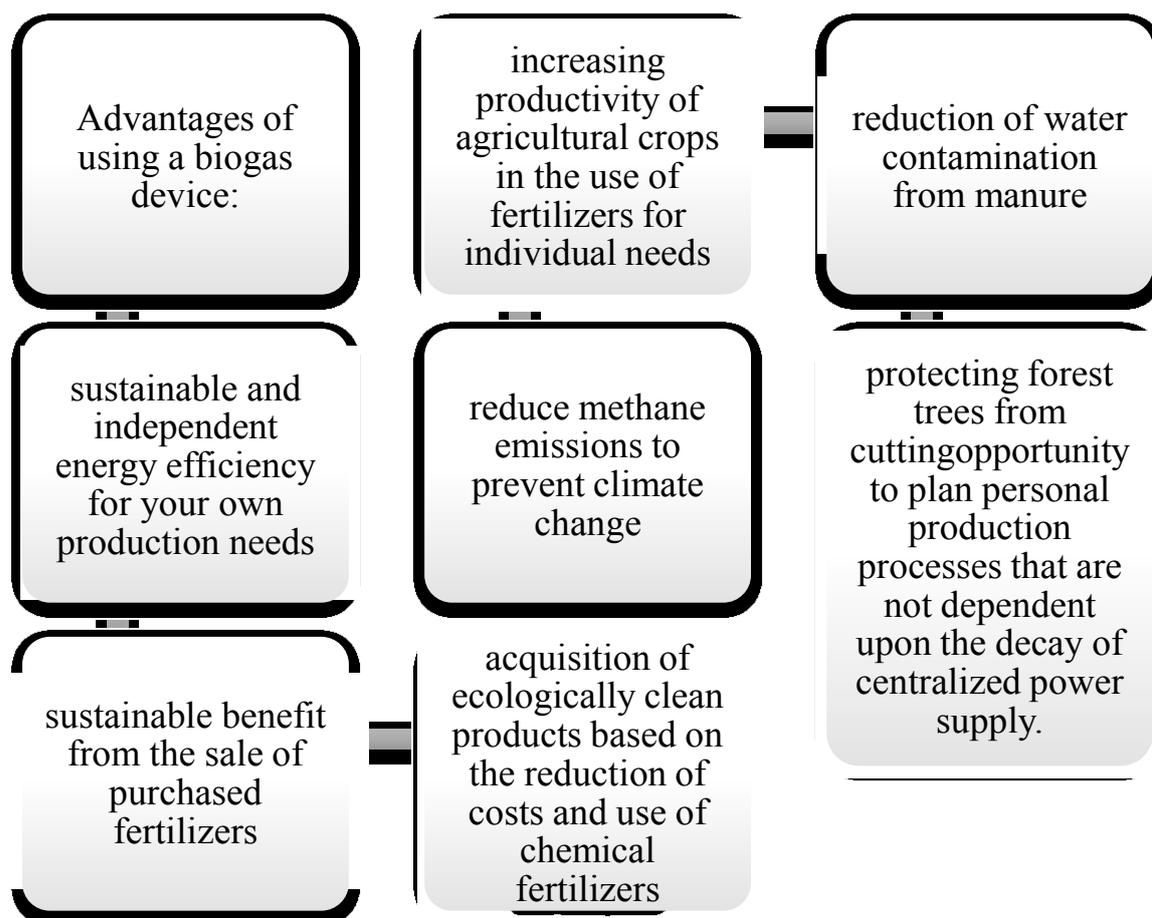
Biogas plants constructed as an experimental construction in our country are mainly built on the development of agricultural sectors. Experiments are carried out by the LLC "Milk Foods" in the Samarkand-Territory rural citizens' counseling located in Jizzakh region of Jizzakh region and "Inter Milk", LLC "Khakiqat" of Sirdaryo region.

50-75% of the biogas content consists of methane, 25-45%, carbon dioxide, and 2-5% gases. From 1m³ of biogas up to 2 kWh or up to 4 kW / hr.

Characteristics of biogas devices⁶⁸

№	Capacity	Construction amount (million sum)	Disbursement period (year)	Amount of electricity to be consumed (qWh * hr. / day)
1	10 M ³	5-15	6-7	30
2	30 M ³	20-40	4-5	70-90
3	100 M ³	100-150	3-5	250-300

Using a biogas plant in livestock has a number of advantages. For example, 50 cattle can produce 1 ton of fertilizer per day. 30m³ of biogas and 1 ton of manure can be obtained as a result of manure processing. The biogas generated from this biogas will be powered by 60kWt/ hr and 120 kWh of heat.



3.2-picture. Advantages of using a biogas device⁶⁹

⁶⁸ “Эко-энергия” ИТМ маълумотлари

⁶⁹ The picture was created by the author

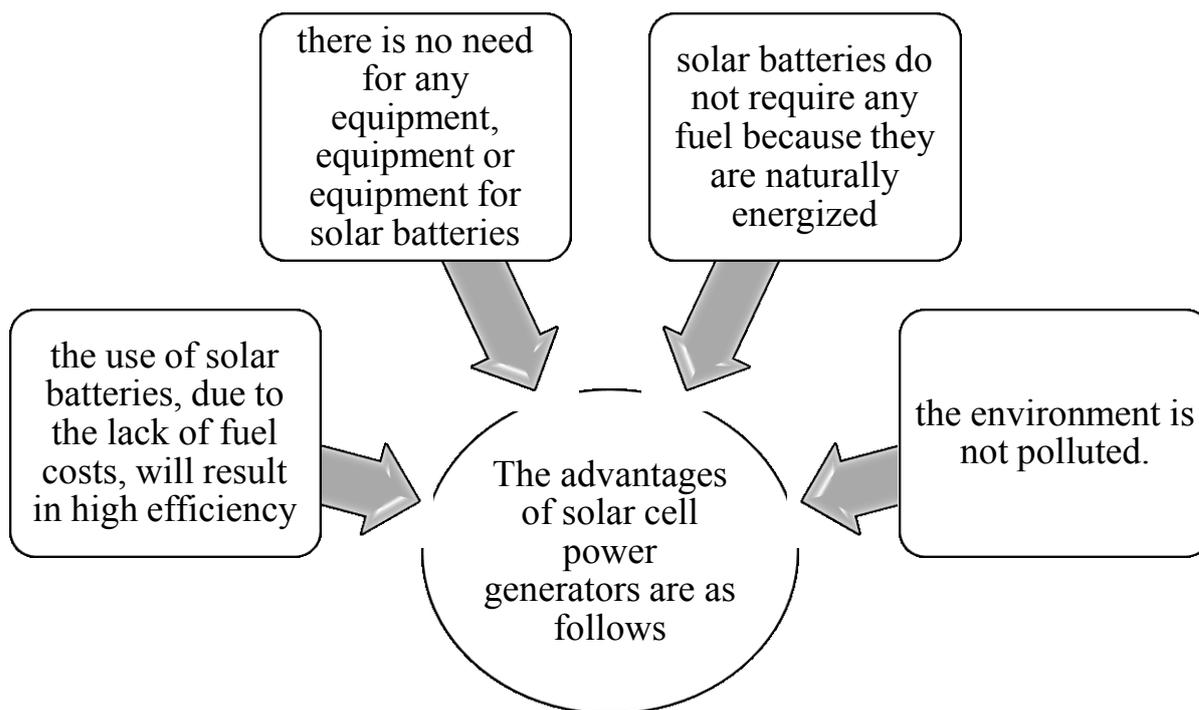
Uzbekistan has accumulated considerable experience in the field of alternative energy sources, including the use of solar energy, scientific and experimental research, which has been under development for many decades. Scientifically-experimental Center for Central Asia in the Republic - Scientific-Production Association "Fizika-Quyosh" was created at the Academy of Sciences of the Republic of Uzbekistan and the results of its research are internationally recognized⁷⁰.

Solar collector is a device for solar thermal energy collection. In contrast to the direct sunflower solar collector, the solar collector carries out heating of the heat transfer material. Solar collectors (solar collectors) are today the most efficient use of solar energy. In contrast to solar panels, which generate electricity, solar collectors produce heat. Solar photovoltaic station in practice: In the "Ak Su" farm of Kurgantepa district of Andijan region at the exhibition area on the introduction of water outflow technology with photovoltaic station (solar panel), on the exhibition ground for the introduction of water pump technology at the "Povulgan Bastoni" farm in Oltiaryk district of Fergana region on the introduction of the technology of water pump from the well, to introduce a technology for water outflow using a photoelectric station (solar panel) in Samarkand's Aminjon Nurli Zamini farm at the exhibition grounds.

According to the data, the radiating source, which distributes the heat source, produces $4 \cdot 10^{23}$ kilowatts of radiation per minute. The energy size of the sunlight coming to the Earth is 1018 kW / h per year. This means that today's limited fuel consumption exceeds 50 times the fuel, which is 35,000 times more than the world's annual energy consumption.⁷¹ If solar batteries have been produced since 2010, their cost has fallen by 80% after seven years, and this battery will last for at least 25 years.

⁷⁰ 2013 йил 1 мартдаги ПФ-4512-сон “Муқобил энергия манбаларини янада ривожлантириш чора-тадбирлари тўғрисида” Ўзбекистон Республикаси президентининг фармони

⁷¹ <https://alternativenergy.ru/>



3.3-picture. The advantages of solar cell power generators⁷²

Taking into account the above advantages, it is planned to build solar power plants with 100 MW each in Namangan, Surkhandarya, Qashkadarya and Navoiy regions.⁷³

At the same time, the masters' research was comparable to the work of solar power stations with energy resources produced by hydropower stations. The study analyzed daily energy consumption of all household appliances and was estimated to be 68.8 kilowatts maximum. Its annual consumption was 23,811.63 kW.

According to the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated November 14, 2017, № 913 "Uzbekenergo" JSC, starting from April 1, 2018, cost of 1 kW of electricity was set at 228 soums per month for household consumption.

Daily energy consumption:

$$68,8 \text{ kW} * 228 \text{ soum} 60 \text{ tiyin} = 15 \text{ 727,6 soums}$$

⁷² The picture was created by the author

⁷³ Постановлению Президента РУз от 26.05.2017 г. N ПП-3012

Annual Energy Consumption:

23811,63 kW * 228 soum 60 tiyin = 5 443 337,7 soums

We estimate the cost of building a solar power plant for the above needs (3.3-table):

3.3-table.

Mini solar station costs for a home⁷⁴

The sun is an average of 9 hours a day. For our needs, we need 117kW / 9h = 13 kWh.			
Required tools:	Quantity	Computation	Summary
panel	36	36 x 1 280 000*	46 080 000
battery	36 (100A)	36*1 286 000	46 296 000
inventor	1 (10кВт)	1*14 225 000	14 225 000
supervisor	1 (60A)	1*600 000	600 000
other expenses			5 000 000
total expenditure			112 201 000

*) An example of solar panels with 2.5 thousand watts of AllSolar firm

Construction of solar panels will cost us 112,201,000 soums.

Considering a whole range of global trends, Energy prices in the world are expensive, and they prefer alternative energy sources.

3.4-table.

Mini solar station comparison table for a home (USD)⁷⁵

Countries name	kW / hr	Daily energy consumption (kW)	Daily charge for consumed energy	Annual payment for spent energy	Payback period (years)
Ukraine	0,04	68,8	2,5	901,9	15,6
Kazakhstan	0,03	68,8	2,2	811,7	17,3
Russia	0,06	68,8	3,8	1 398,0	10,1
Belarus	0,06	68,8	4,2	1 533,3	9,2
Denmark	0,36	68,8	24,5	8 929,1	1,6
Germany	0,34	68,8	23,6	8 613,4	1,6
Uzbekistan	0,03	68,8	2,0	722,6	20,6

The higher the cost of electricity produced by the hydropower stations, the higher the demand for alternative energy sources, and the shorter the return on

⁷⁴ The table was created by the author

⁷⁵ <http://riarating.ru/countries/20170627/630066485.html>

the stock. Taking into account these aspects, it is desirable to support the activities of the country's alternative energy sources.

3.3. Priority directions for alternative energy development

The need to use alternative energy sources in Uzbekistan is largely due to the fact that most of the energy consumed in the national economy is produced using non-renewable natural resources, limited resource allocation, environmental pollution, water scarcity, environmental problems associated with Aral Sea drainage due to rapid industrial development interpreted. Sustainable development of Uzbekistan's economy and the development of a long-term strategy of structural transformations require the consideration of internal and global processes and issues. In this regard, one of the priorities of Uzbekistan's development strategy for 2017-2021 is "reducing energy and resource consumption in the economy, widespread introduction of energy-efficient technologies in production, and the use of renewable energy sources"⁷⁶. In particular, projects worth \$ 1.9 billion will be allocated for the projects in 2017-2021. It is planned to invest US dollars. For the construction of solar photoelectric stations with total capacity of 500 megawatts 1.1 billion cubic meters. \$ 700 million for the construction of 8 existing hydropower stations and 13 new small hydropower stations. US dollars will be invested⁷⁷.

Most of the energy consumed in Uzbekistan (87%) is produced at thermal power plants. At the same time, the basis of the energy consumption structure is oil and gas resources. While maintaining the current level of natural gas and oil utilization, their reserves can reach natural gas and oil for 20-30 years. Given the fact that the amount of electricity consumed by the national economy doubles up to 2030 (50 billion kW / h), natural gas and natural gas reserves can be further reduced.

⁷⁶ Ўзбекистон Республикаси Президентининг “Ўзбекистон Республикасини янада ривожлантириш бўйича ҳаракатлар стратегияси тўғрисида”ги 2017 йил 7 февраль, ПФ-4947-сон фармони <http://www.lex.uz>

⁷⁷ Махмудов Р. Нормативная энергетика. //Экономическое обозрение, №5, 2017. С. 28.

The calculations show that alternative sources of energy have great potential in Uzbekistan. Biogas energy produced by solar energy, small rivers, reservoirs and channels, organic and inorganic waste is promising in this regard. Solar energy is very high in Uzbekistan. In Uzbekistan, the number of sunny days throughout the year is more than 320 days and solar energy is 51 billion cubic meters. tons of oil equivalent. Combined use of solar power stations along with traditional sources of production of electricity generates annually 1.8 billion cubic meters. cubic meters of natural gas.

In Table 3.5 information on electricity production in Uzbekistan is presented. The highest rates are shown for Tashkent region, Sirdarya region and Navoi region. However, Namangan and Jizzakh regions do not produce electricity. The main reason for this is the uneven distribution of natural resources. Taking into account these aspects, alternative energy sources should be used in these regions.

According to European experts, Uzbekistan can produce up to 40 times more annual energy consumption per year and can reduce the energy intensity of the country's GDP by 2030 by launching a wide range of modern technologies.

In particular, the Decree of the President of the Republic of Uzbekistan № PP-2192 dated June 25, 2014, for the construction of the Solar photovoltaic station at Mirabad MFU, 0.47 hectares of land was allocated to the “Vodiy” massif of Namangan region. The main customer for the construction of this solar photovoltaic station is the Eastern Main Trunking Electric Network, which is being executed by MK-11, the general contractor for the construction works in Namangan region of "Elektrkishlokkurilish" OJSC.

In accordance with the interstate agreement South Korea's CO LTD KS COTTRELL has tested the solar FES of 130 kW, with a total sum of \$ 700,000. This work started in August 2014 and the FES was launched on December 10, 2014. The cost of the purchased FES was \$ 477,000, and currently 650 million soums have been spent. At present, construction of auxiliary buildings for the FES is underway. Various equipment and accessories have been installed in the

Korean Photoelectric Industry Association's HANWHA, JSPV, SENENGY, Solar Models and KAKO and DASS TECH developers. (3.6-table)

3.5-table.

Electricity production in Uzbekistan (million kWh).⁷⁸

	2014	2015	2016
Republic of Uzbekistan	55766	57658,1	59100,5
Republic of Karakalpakstan	3466,6	3451,3	3632,7
Regions			
Andijan	438,5	674,1	647,9
Bukhara	8,9	4,9	6,8
Jizzakh	-	-	0,01
Qashkadarya	6706,3	6310,9	7344,3
Navoiy	8811,4	8864	9259,7
Namangan	0,1	0,1	0,4
Samarkand	2,4	3,7	6,3
Surkhandarya	81,1	82,9	94,4
Sirdaryo	16155,1	16718,4	17373
Tashkent	18791,5	20049,7	19379,5
Fargona	351	312,8	321,2
Kharazm	293,3	648,8	443,8
Tashkent city	635,3	518,0	570,2

⁷⁸Ўз.Рес. Давлат статистикаси қўмитаси. Ўзбекистон ҳудудларининг йиллик статистик тўплами-2016
Ўз.Рес. Давлат статистикаси қўмитаси. Ўзбекистон ҳудудларининг йиллик статистик тўплами-2017

3.6-table.

Optical equipment and sets fitted to the solar photovoltaic station

Panel model	(Module- “HANWHA”– HSL250)	Module- “JSPV”– JSMM2501	Module - “ S – ENERGY ” – SM250PC8	Module- “TOPSUN”– TS-S- 400
Complete	198 (22 comp *9 couple =198)	198 (22 comp * 9 couple =198)	72 (12 comp * 6 couple =72)	24 (8 comp * 3 couple =24)
Power	250 W	250 W	250 W	400 W
Strength	(-)30.4 V	(-)30,6 V	(-)30,8 V	(-) 49,39 V
Current	8,23 A	8,25 A	8,14 A	8,1 A
Inventor	“KAKO” – 60kW (KAKO – 60 TL3) – № 1 connected to “KAKO” to 198 * 250 W= 49,500 W	“KAKO” – 60kW (KAKO – 60 TL3) – №2 connected to invertor “KAKO” to 198 * 250 W= 49,500 W	“DASS TECH” – 20 kW (DASS TECH – DSP3320KT) – № 3ra MJB – A the cabinet is connected “DASS TECH” 72 * 250 W= 18,000 W	“DASS TECH” – 10 kW (DASS TECH – DSP3310KT) – № 4 MJB – B the cabinet is connected “DASS TECH” 24 * 400 W= 9,600 W
Power produced so far (280 days)	54417 kW	52617 kW	22253 kW	11282 kW
Average daily	194 kW	188 kW	79,5 kW	40,3 kW
Inventor performance per day (hours)	KAKO 10-12 hours	KAKO 10-12 hours	DASS TECH 10-12 hours	DASS TECH 10-12 hours
Electricity generation	16,1 – 19,4 kW	16 – 19 kW	6,6 – 8 kW	3,4 – 4 kW
Production capacity of each panel (per hour)	81-98 W	80,1 - 96 W	91,7 - 111 W	142 – 166,7 W
Useful business coefficient	36%	35,2%	40,5%	38,6%

Renewable energy potential in Uzbekistan is as follows: solar energy from 525 to 760 billion kW / h; wind power up to 1 trillion kWh; hydroelectric power is over 21 billion kW / h.

Works on the efficient use of energy resources by 2025:

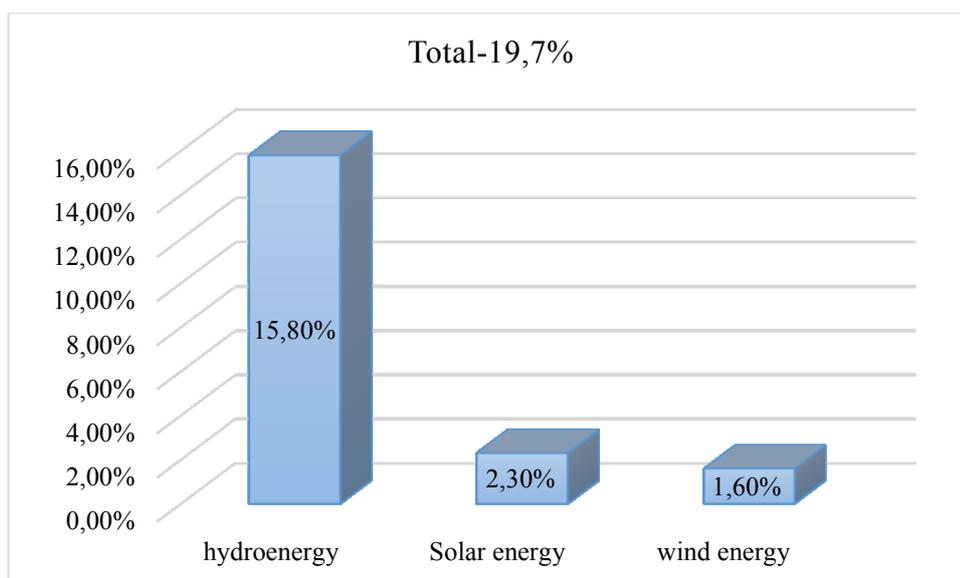
810 objects totaling \$ 5.3 billion:

- sharp reduction of production capacity (9 782.3 tons of conditional fuel or 8-10 percent per year);

- 6333 units of the Ministry of Public Education, the Ministry of Public Health and the Center for Special Vocational Education, 17,251 heating boilers for budgetary organizations and more than 56,6 million cubic meters of natural gas in budgetary organizations;

- Replacement of an electric motor with 1523 power consumptions and 878 pumps and save more than 807.3 million kWh of water in the water management organizations of the Ministry of Agriculture and Water Management.

According to statistical data, 3.9% of legal entities in the country (1.7% in 2012) use alternative energy sources. Of these, 2.7% use biogas installations.⁷⁹



3.2-diagram. The share of renewable energy in the power generation capacities by 2025⁸⁰

A number of activities are under way in Navoiy region. Kizilkumcement and Navoiy mining metallurgy are producing 1000 kWh of electricity per hour using photovoltaic solar photovoltaic systems. The photoelectric station at the Railway Industry Department of JSC Almalyk Mining and Metallurgy Combine generates electricity of up to 120kWt and saves 29 million soums. The Republic

⁷⁹ Ўзбекистон Республикаси Статистика Қўмитаси 2018 йил 1 апрель муълумотлари

⁸⁰ Приложение N 1 к постановлению Президента РУз от 26.05.2017 г. N ПП-3012

of Uzbekistan has great potential for renewable energy and its systematic timeline has been developed.

Chronicle: Uzbekistan shifts to alternative energy⁸¹. All new buildings and structures of Uzbekistan will use alternative energy. This is stipulated by the presidential decree "On measures to ensure the rational use of energy resources." In addition, the country has taken a course towards the use of renewable energy in almost all spheres of life. Spot watches how this intention is embodied in reality.

November 13, 2017. The presidential decree "On Measures to Ensure the Rational Use of Energy Resources" was published. According to the document, from January 1, 2018, all new buildings and structures, except for individual housing construction, will necessarily be equipped with certified solar water heating installations for hot water supply. In old buildings and structures such installations will appear during the reconstruction.

In addition, now all buildings and structures will be designed, built and reconstructed taking into account the use of energy-efficient and energy-saving technologies. From January 1, 2022, all state institutions will be disconnected from the centralized supply of hot water and switch to solar water heating installations.

November 18, 2017. In Uzbekistan, there will be a wind power plant. JSC "Uzbekenergo", JSC "National Energy Saving Company" and German company Siemens Gamesa signed a memorandum on the implementation of the project on wind power with a capacity of 100 MW.

November 21, 2017. In Akhangaran, green technologies were introduced. The "Aghangaran Green City" project is implemented in cooperation with the Chinese company JONTIAGroup. It is reported that the solution will allow to cut carbon dioxide emissions into the atmosphere several times and thereby improve the ecological situation in the city. Currently, Chinese experts are preparing a technical justification for the project.

⁸¹ <https://www.spot.uz/ru/2018/05/02/alternative>

The project is planned to be implemented in two stages. The first two installations are scheduled to be built in 2018 and three more - in 2019. According to preliminary calculations, the project is estimated at 87.45 million dollars.

In the Tashkent region, the first eco-village will be built. Eco village will be located on the territory of 5 hectares, where all houses will be classified as energy efficient. The total cost of the project will be, according to plans, \$ 6 million due to direct investments.

November 28, 2017. A plant of solar energy will appear in Uzbekistan. South Korean company POSCO Daewoo will produce modules for solar panels and will build several solar photovoltaic stations with a capacity of 2 GW according to the model of public-private partnership.

It is reported that the total cost of the project will be \$ 637.5 million, of which \$ 127.5 million is foreign direct investment. It is planned to build and start the plant by 2035.

December 1, 2017. In Uzbekistan, they will start producing solar collectors for heating water. Deutsche Kabel AG Tashkent will start production on the basis of the enterprise, which has been idle for 14 years. On the site of the complex "Uzglaszaiden" and will be deployed a new production. Deutsche Kabel AG Tashkent, investing \$ 8 million over two years, will overhaul buildings and facilities, launch production of fiberglass and products from it, as well as industrial water-heating boilers and solar collectors. The facility will be located on the territory of the Almazar small industrial zone in Tashkent and will be implemented in 2018-2021.

December 6, 2017. The World Bank supports the efforts of the government of Uzbekistan aimed at increasing the share of renewable energy in the energy structure of the country from 12.7% in 2016 to 19.7% by 2025. This was reported during a seminar on the development of renewable energy policies jointly organized by the Government of Uzbekistan and the World Bank Group in partnership with the International Renewable Energy Agency (IRENA).

December 26, 2017. The lag in the use of alternative energy sources is one of the obstacles to the economic development of the country, Shavkat Mirziyoyev said in his message to the parliament. According to him, for the development of the economy, it is necessary, among other things, to stimulate the use of alternative energy sources.

April 9, 2018. The specialized IT-school, which is being built in Tashkent, will use solar energy. The school will be designed for 1470 pupils, which will be selected annually on a competitive basis.

April 9, 2018. Owners of houses that have completely switched to alternative energy will receive tax benefits. Owners of houses using alternative energy sources in residential premises with complete disconnection from existing energy networks are exempted from taxing property of individuals and land tax from individuals for a period of three years starting from the month in which sources of alternative energy are installed.

May 1, 2018. SkyPower Global is implementing solar energy projects in Uzbekistan for 1.3 billion dollars. Land plots will be allocated in Tashkent, Samarkand, Navoi, Jizzakh, Surkhandarya and Qashkadarya regions. In addition, the World Bank's leadership will consider the allocation of a loan for the introduction of energy-saving technologies in Uzbekistan.

It became known that the bank had already given permission to prepare additional financing in the amount of \$ 200 million for the implementation of the project to increase the energy efficiency of industrial enterprises of the republic.

The project to increase the energy efficiency of industrial enterprises in Uzbekistan is implemented with the participation of the International Association of Aazvitiya (IDA). According to expert estimates, Uzbekistan will consume 71.8 billion kilowatt-hours of electricity by 2020.

SkyPower Global, based in Canada, will invest \$ 1.3 billion in projects to develop solar energy in Uzbekistan, said the Justice Ministry. SkyPower Global

will invest \$ 1.3 billion in projects for the production, financing, design, construction, ownership and operation of photovoltaic solar energy facilities.

According to the Ministry, this amount of investments is stipulated by the decree of the President of Uzbekistan Shavkat Mirziyev "On additional measures to implement investment projects in the field of renewable energy sources."

In accordance with the resolution, the leadership of six oblasts of Uzbekistan was instructed in the established order to allocate land for the implementation of projects involving SkyPower Global. Other details of the document are not provided.

Earlier, JSC "Uzbekenergo" planned to build by 2020 three heliostations with total capacity of 300 MW near Samarkand, in Surkhandarya and Namangan regions.

At the end of 2016, the Chinese Zhuhai Singyes Green Building Technology Co., Ltd. won a tender for the construction of a solar power station in the Samarkand region with a capacity of 100 MW with an \$ 110 million loan from the Asian Development Bank. However, later the results of the tender were canceled.

At the end of 2016, the Chinese Zhuhai Singyes Green Building Technology Co., Ltd. won a tender for the construction of a solar power station in the Samarkand region with a capacity of 100 MW with an \$ 110 million loan from the Asian Development Bank. However, later the results of the tender were canceled.

Representatives of Uzbekenergo then reported that for the construction of solar power plants in the country, foreign investors will be attracted on the terms of public-private partnership. In particular, upon completion of the construction, the foreign company will participate in the management of the power station and the sale of electricity.

3.7-table.

Target parameters program of measures for further development renewable energy (MW)⁸²

№	The name of indicators	Generator-providing power in 2016 (fact)	Forecast of input of generating capacities						Share of in the structure generating capacities, %		Growth rate in 2025 by 2016 (to year input), % *
			2017	2018	2019	2020	2021	2025	2016	2025	
	total	14 164,0	415,0	587,7	1 159,7	2 991,5	5 222,5	7 401,9	100,0	100,0	135,5
	Including										
1.	traditional energy	12 370,0	370,0	427,0	802,0	2 409,0	4 218,6	5 406,0	87,3	80,3	124,6
2.	Renewable energy sources	1 794,0	45,0	160,7	357,7	582,5	1 003,9	1 995,9	12,7	19,7	211,3
2.1	hydropower engineering	1 793,9	45,0	60,7	157,7	382,5	601,9	1 243,9	12,7	15,8	169,3
2.2	Solar energy	0,13		100,0	200,0	200,0	300,0	450,0	0,001	2,3	3462,5 p.
2.3	Wind energy						102,0	302,0		1,6	3,0p

*) Taking into account the estimated forecast of the output of obsolete facilities, 2 369.0 MW.

⁸² Приложение N 1 к постановлению Президента РУз от 26.05.2017 г. N ПП-3012

3.8-table.

Investment projects on the development of renewable energy(million dollars)⁸³

Name of projects	The project power	Timing of implementation	General information value project *	Including by sources of financing:			
				Own facilities	Recourses of budget	Credits commercial banks	foreign investment credits
Total (810 projects)			5 338,9	2 634,1	389,0	139,0	2 176,8
new construction (778 projects)			4 260,1	2 222,5	389,0	139,0	1 509,7
modernization (32 projects)			1 078,8	411,7			667,2
Projects for the creation of new and modernization of existing generating capacities for renewable energy sources			5 220,7	2 593,7	389,0	67,2	2 170,8
New construction			4 141,9	2 182,1	389,0	67,2	1 503,7
JSC "Uzbekenergo"			879,3	110,1	389,0	67,2	313,0
Construction of a solar photovoltaic power plant with a capacity of 100 MW in the Samarkand region	100 MBТ	2017- 2018	233,1	13,1	110,0		110,0
Construction of solar photovoltaic power station with a capacity of 100 MW in Navoi region	100 MW	2017- 2019	233,1	35,0	114,0	9,1	75,0
Construction of a solar photovoltaic power plant with a capacity of 100 MW in Sherabadsky district Surkhandarya region	100 MW	2019- 2021	233,1	35,0	114,0	9,1	75,0
Construction of a wind power station 102 MW in Navoi region	102 MW	2018- 2021	180,0	27,0	51,0	49,0	53,0

⁸³ Приложение N 2 к постановлению Президента РУз от 26.05.2017 г. N ПП-3012

At present 97% of the fuel and energy resources of Uzbekistan are occupied by oil and gas, 2.3% by coal, and 0.7% by hydropower. At the same time, the renewable energy potential of Uzbekistan is about 51 billion tons of oil equivalent. The potential of solar energy in the republic, where there are 300 sunny days a year, is about 50.973 billion tons of oil equivalent.⁸⁴

Future indicators of further development of renewable energy are developed and production capacity of energy sources is projected in table -3.7. Production capacity of energy sources is estimated according to Table -3.7. It is projected that the total production capacity will be increased from 415 MW to 7401.9 MW. In 2016, traditional energy will be 87.3%, with the reduction of this indicator by 80.3% by 2025 (12.7% in 2016 and 19.7% in 2025) with the main power of the country.

Table -3.8 lists investment projects for the development of renewable energy and has sum up to \$ 5338.9 million of 810 projects. Total cost Projects on creation of new and modernization of operating generating capacities on renewable energy sources 5220,7 million dollars. 2017-2018, the solar photovoltaic power station with a capacity of 100 MW in the Samarkand region will be sold and the total cost of the project is \$ 233.1 million. 2017-2019, the solar photovoltaic power plant with a capacity of 100 MW will be sold in Navoi region and the total cost of the project is \$ 233.1 million. 2019-2021 realizes a solar photovoltaic power plant with a capacity of 100 MW in the Sherabad region of the Surkhandarya region and the total cost of the project is \$ 233.1 million. 2018-2021 will be sold to a 102 MW wind farm in Navoi region and the total cost of the project is \$ 180 million.

Summary of chapter III.

World Bank experts say that Uzbekistan is one of the world's energy-rich countries. For example, the energy intensity of the country's GDP is 35% higher than in Kazakhstan and 3 times higher than in Germany. Approximately 40% of

⁸⁴ <https://www.eprussia.ru/news/base/2018/5326926.htm>

the country's energy consumption is accounted for by enterprises using old technologies. The Government of Uzbekistan plans to reduce the energy intensity of the national economy by 50% by 2030. World Bank to allocate \$ 200 mln to improve energy efficiency of industrial enterprises in Uzbekistan It has allocated \$ 1 million.⁸⁵

In particular, projects worth \$ 1.9 billion will be allocated for the projects in 2017-2021. It is planned to invest US dollars. For the construction of solar photoelectric stations with total capacity of 500 megawatts 1.1 billion cubic meters. \$ 700 million for the construction of 8 existing hydropower stations and 13 new small hydropower stations. US dollars will be invested.

In Uzbekistan, the number of sunny days throughout the year is more than 320 days and solar energy is 51 billion cubic meters. tons of oil equivalent. Combined use of solar power stations along with traditional sources of production of electricity generates annually 1.8 billion cubic meters. cubic meters of natural gas.

⁸⁵ <https://nbu.uz/wp-content/uploads/Novosti-TSAMRIT-5-02-2018.pdf>

CONCLUSION

With a view to eliminating the adverse effects of natural and sustainable use of natural resources, for countries in developing regions it is necessary to invest no less than \$ 70-100 billion annually to improve their ecosystems, biodiversity and climate.. However, it should be kept in mind that the investment potential of developing regions is quite low. The attracted foreign investments are directed to the strategically important sectors (production and processing of minerals) in these regions. In addition, national legislation of some developing countries does not provide for the environmental or social responsibility of economic entities. Such an aggressive approach to the exploitation of natural resources can cause serious damage to all modern civilization.

According to UNEP research, the rational and efficient use of global natural resources is estimated at \$ 2 trillion annually by 2050 for the next generation. The dollar generates economic benefits. It is predicted that the population of the world will increase by 28% and the per capita resource utilization rate by 71%. While no rigid measures on the rational use of natural resources are developed, annual consumption of metals, biofuels, minerals and other resources is estimated at \$ 85 billion. tons per year, up to 186 tonnes. Implementation of an effective resource utilization can cover this loss, provided that investment expenditures for the prevention of climate change lead to a reduction in the share of per capita gross domestic product by 3.7%⁸⁶.

According to the forecasts of the Organization for Economic Co-operation and Development (OECD), with the current production methods and consumption levels, the loss of current flora and fauna from sq.km. can be irreversibly disposed of 61 to 72% in 2050, .⁸⁷ 2015 According to the Global

⁸⁶ <http://web.unep.org/newscentre/smarter-use-resources-can-add-2-trillion-annually-global-economy>

⁸⁷ Перспективы энергетических технологий. Сценарии и стратегии до 2050 г. / ОЭСР/МЭА ; WWF России ; ред. А. Кокорина, Т. Муратовой. – М., 2007. – 586 с.

⁸⁷ <http://www.amic.ru/news/311549/>

Footprint Network project experts, the annual use of land resources, which can then be recovered, is used only for 7 months in 13 days.⁸⁸

In the current situation, the economy and the social sphere can be considered as the most optimal solution for the use of renewable energy resources. Significant potentials in the use of renewable energy (solar, wind, hydropower, and bioenergetics) sectors in almost all parts of the world. In particular, according to the International Renewable Energy Agency, Canada and the United States have created renewable energy resources 96,636 and 214,766 MW, respectively. With its significant potential and diverse climatic conditions, Russia could generate only 51,747 MW of renewable energy resources per year. Brazil and China launched 122,951 and 545,206 megawatts of renewable energy annually, respectively. Africa is a completely outsider of this issue. Because the entire African region has 38,192 MW of renewable energy resources.⁸⁹

World Bank experts say that Uzbekistan is one of the world's energy-rich countries. For example, the energy intensity of the country's GDP is 35% higher than in Kazakhstan and 3 times higher than in Germany. Approximately 40% of the country's energy consumption is accounted for by enterprises using old technologies. The Government of Uzbekistan plans to reduce the energy intensity of the national economy by 50% by 2030. World Bank to allocate \$ 200 mln to improve energy efficiency of industrial enterprises in Uzbekistan It has allocated \$ 1 million.⁹⁰

Scientific - theoretical conclusion. A number of scientific conclusions have been made in the process of studying the priorities of the modernization of the economy of Uzbekistan and the acceleration of structural transformations by development of alternative energy:

⁸⁸ <http://www.amic.ru/news/311549/>

⁸⁹ IRENA (2017), Renewable capacity statistics 2017, International Renewable Energy Agency (IRENA), www.irena.org/Publications

⁹⁰ <https://nbu.uz/wp-content/uploads/Novosti-TSAMRIT-5-02-2018.pdf>

- expanding renewable energy sources and ecologic clear energy into energy balance gives the opportunity to reduce environmental impacts. This will save hydrocarbon resources not for the production of electricity, but for the use as raw materials in the petrochemical industry;

- alternative energy sources serves as a convenient and reliable source of energy for people living in remote, hard-to-reach areas;

- facilities of alternative energy production need larger assets, but later on, it economically justify itself. As a result of increased cost of primary energy carriers (geological exploration, mining, supply) and renewable energy technologies helps to increase alternative;

- rational use of energy resources and by means of the modernization of production technologies should decrease the development of effective measures;

Practical suggestions and recommendations. As a result of the research, the following suggestions and recommendations have been developed:

- Formation and improvement of the legal framework for state support and incentives for renewable energy sources, as well as support for the activities of firms producing renewable energy sources in the country, should be widely used by the manufactured technical facilities;

- Scientific research should be supported by the state and grant them scholarships. It is possible to produce new alternative sources of energy on the territory of the country;

- Due to the use of alternative energy sources, it is necessary to abandon oil fuel and implementation of environmentally friendly fuels.

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