Opportunty for the development of renewable energy in Azerbaijan

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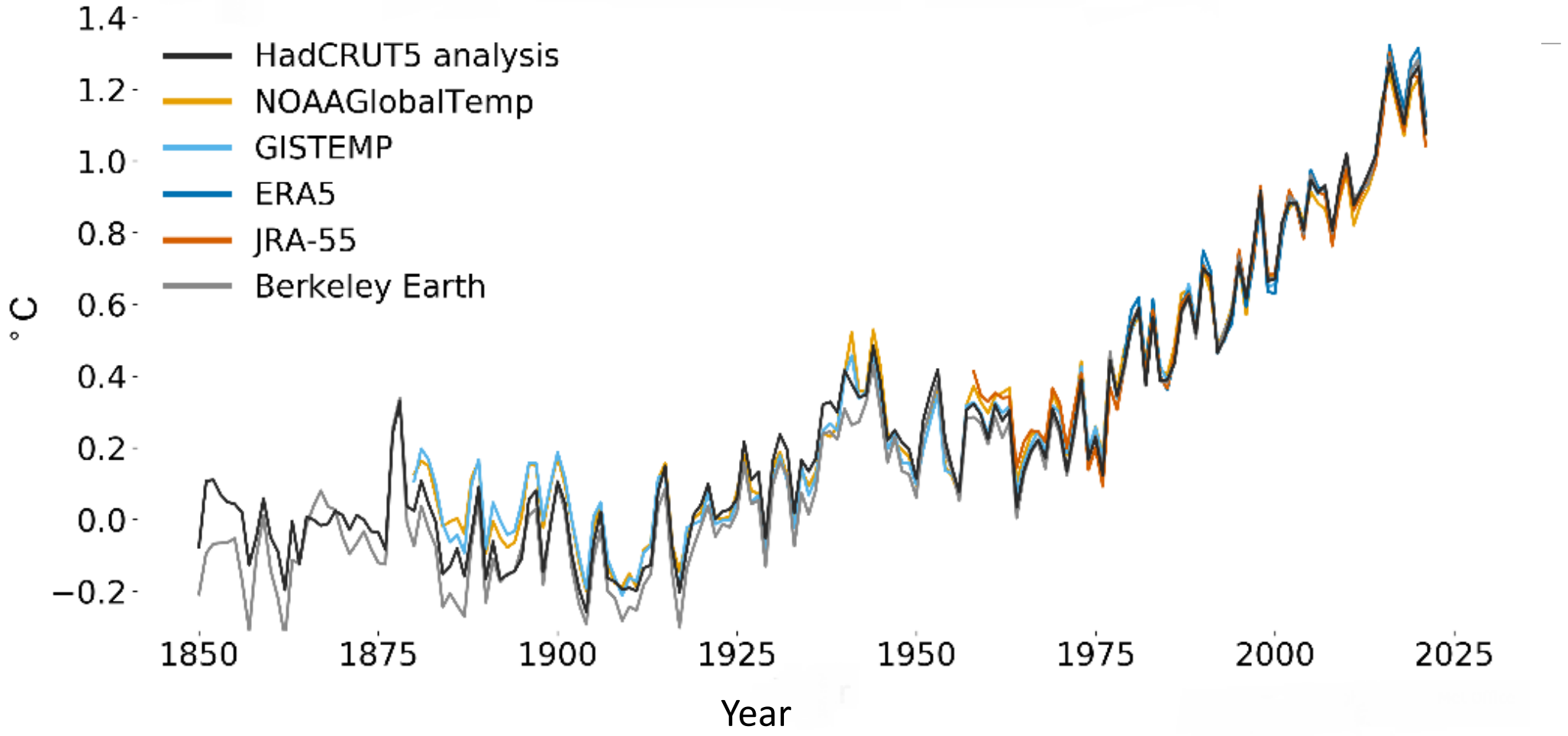
The solution to the problem of global warming is seen in the transition from the use of fossil fuels (coal, oil, gas), which currently constitute the main source of energy, to renewable energy sources such as wind, solar, hydropower and hydrogen energy.

Introduction

- Recent studies have shown that the increase in temperature and climate change on the planet depends on amount of greenhouse gases emitted into atmosphere and this is an important problem for mankind.
- According to expert estimates, by 2030 the air temperature may increase by 1-2°C.
- According to research by the Institute of Geography of the National Academy of Sciences of Azerbaijan, the temperature is also predicted to rise to 1.5 °C by 2030 on the territory of the Republic.
- Global warming will significantly worsen the conditions and quality of human life.
- The solution to the problem of global warming is seen in the transition from the use of fossil fuels (coal, oil, gas), which currently constitute the main source of energy, to renewable energy sources such as wind, solar, hydropower and hydrogen energy.

Global temperature change



International Treaties on Mitigation of Climate Change

- In Paris, on December 12, 2015, an agreement was signed to curb global temperature growth below 2 ° C by reducing greenhouse gas emissions.
- These goals are planned to be achieved by switching electricity production to renewable sources, modernizing industrial and agricultural production.
- To reduce greenhouse emissions by 55% by 2030 (compared to 1990) and achieve carbon neutrality by 2050 by European countries, the CBAM mechanism - Carbon Border Adjustment Mechanism, i.e. the introduction of taxes on products whose production causes greenhouse gas emissions.

International Agreements of Azerbaijan

- Azerbaijan ratified the Energy Charter Treaty and Protocol on Energy Efficiency and Environmental Aspects on 2 December 1997
- The purpose of the Energy Charter is to protect and encourage investment in energy, expand trade in energy materials, equipment (based on WTO rules), freedom of energy transit through pipelines and networks, and reduce the adverse environmental impact of the energy cycle by improving energy efficiency.
- Since 2009, Azerbaijan has become a member of the International Renewable Energy Agency (IRENA).
- Its activities are aimed at improving the political conditions for the promotion of renewable energy sources by advising industrialized and developing countries to assist in increasing the use of renewable energy sources (RES).

Legislative Framework of Azerbaijan for the Introduction of Alternative Energy

- On November 20, 1996 on the initiative of the President of the Republic of Azerbaijan Heydar Aliyev

Law No. 222 "On the Use of Energy Resources" was adopted.

- The law was developed in connection with the need to introduce energy-saving technologies and develop energy on the basis of renewable energy sources in Azerbaijan.
- It is important to note article 32 "Mandatory education in the field of rational use of energy resources"
- Energy training and training programs should provide a framework for the rational use of energy resources, including renewable and other energy sources.

Legislative Framework of Azerbaijan for the Introduction of Alternative Energy

- Also article 33 "Financing programs to improve educational and professional knowledge"
- Improving the training of employees responsible for the energy supply of enterprises, institutions and organizations, the development and implementation of training programs, seminars and conferences and other activities are financed by the fund for rational energy consumption
- This law once again testifies to the vision of Heydar Aliyev as a statesman and his role in the development of Azerbaijan

Legislative Framework of Azerbaijan for the Introduction of Alternative Energy

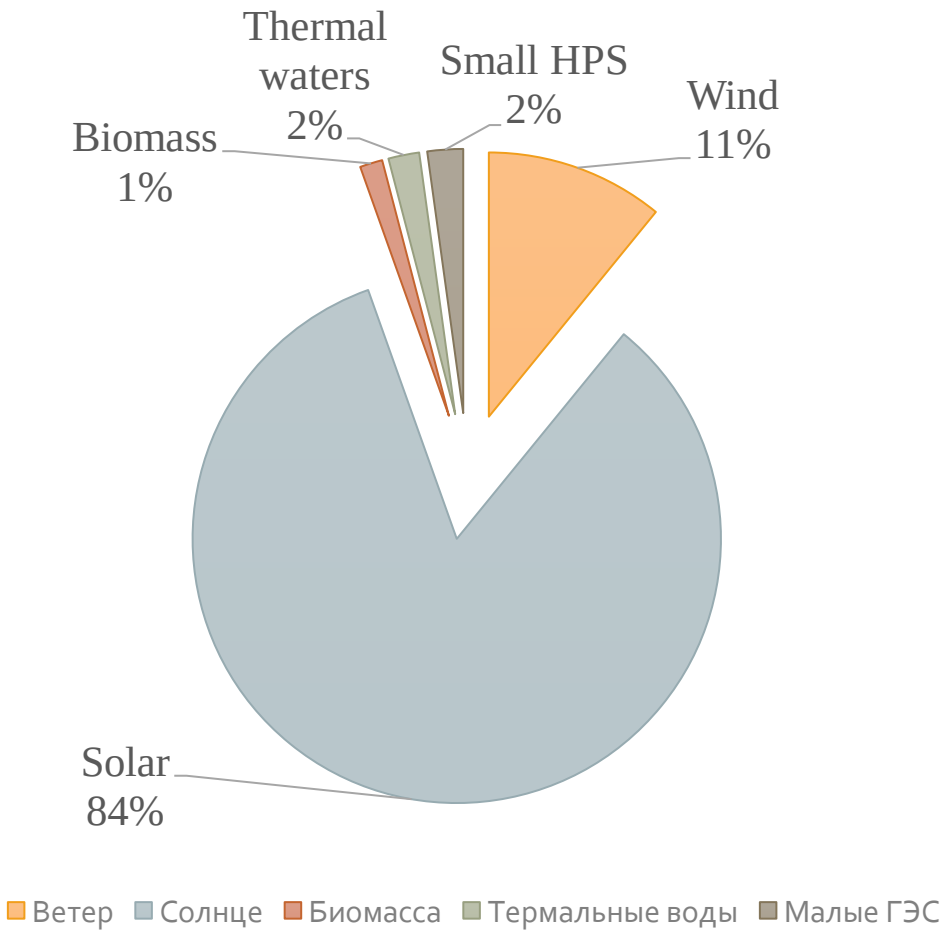
- On May 31, 2021, Law No. 339-VIQ "On the Use of Renewable Energy Sources in Electricity Production" was adopted
- The law defines the legal, economic and organizational basis for the use of energy sources in the production of electricity, as well as mechanisms for promoting the production of electricity from renewable sources.
- On June 6, 2009, the "State Agency for Alternative and Renewable Energy Sources" was established.
- The Agency's tasks are to formulate a policy to increase the volume of electricity generation from renewable energy sources and effectively manage energy resources.

International Agreements on the Development of Electricity from Renewable Energy Sources in Azerbaijan

- The Ministry of Energy of Azerbaijan and ACWA Power (Saudi Arabia) (13 January 2022), as well as Masdar (UAE) (6 April 2021) signed an agreement on the development of electricity production from renewable sources in Azerbaijan.
- On December 6 2021, the Ministry of Education and BP Azerbaijan signed a protocol on the creation of an educational program on renewable energy
- According to the protocol, universities of Azerbaijan in partnership with universities of Great Britain will develop a new master's program in renewable energy technologies.

RENEWABLE ENERGY POTENTIAL IN AZERBAIJAN

The potential of Azerbaijani renewable energy sources is estimated at 26,940 MBT, including 3,000 MBT for wind energy, 23040 MBT for solar energy, 380 MBT for bioenergy potential, and 590 MBT for the potential of mountain rivers.



Potential of renewable energy in Azerbaijan

- It is also necessary to note the potential of wave energy, especially relevant for Azerbaijan given the length of the coastline of the Caspian Sea, constant sea currents.
- The territory of the Karabakh economic zone has significant potential in the development of renewable energy sources
- Solar
- Wind
- Hydropower (potential of mountain rivers)
- Thermal - western part of Karabakh (Kjalbajar region)

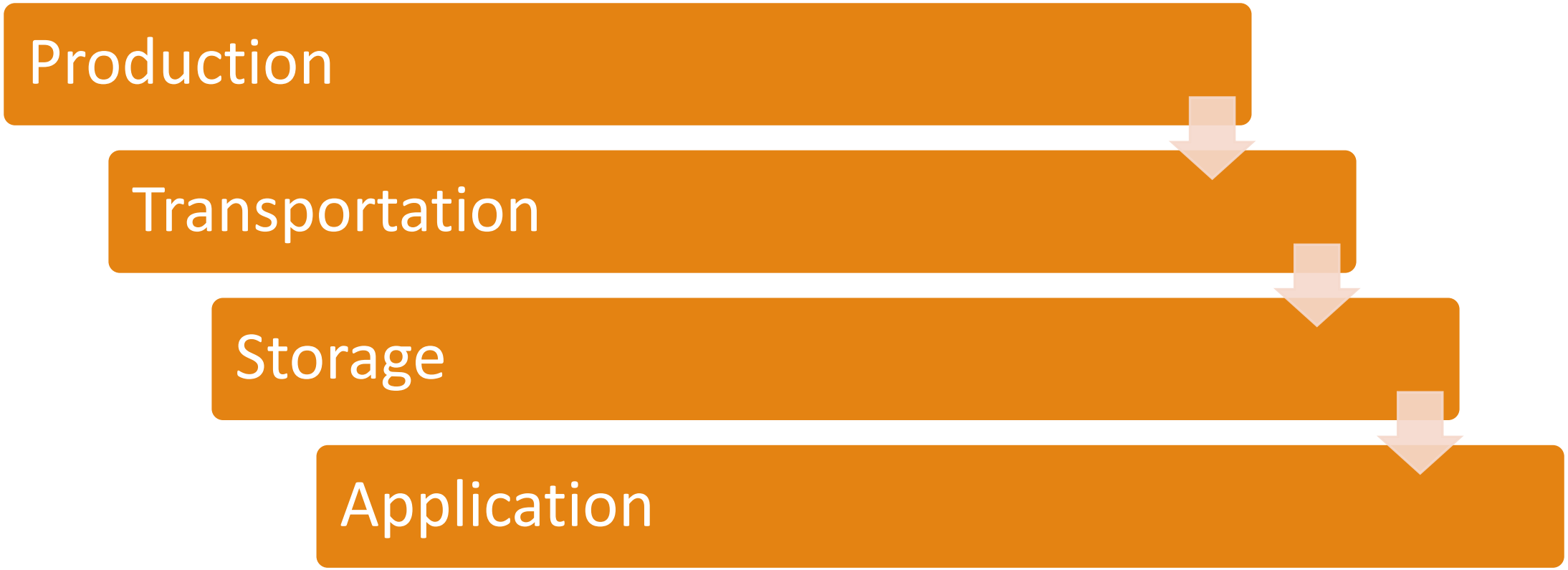
Hydrogen power engineering

- Hydrogen, as an energy source, is the most environmentally friendly and efficient in terms of generating electricity:
- Heat of hydrogen combustion is 1.175 joule/kg
- This is three times higher than oil and four times higher than gas and coal.
- The advantage of the development of hydrogen energy:
- Its high potential (the highest energy density is 33 kWh/kg)
- Availability of almost unlimited resources
- Consistency in time
- Zero environmental impact

Hydrogen power engineering

- In 2018, hydrogen consumption amounted to 74 million tons, by 2030 it is expected to increase hydrogen consumption to 100-114 million tons, and by 2050 - 370 million tons
- By 2050, the European Union plans to create a climate-neutral economy of energy production and consumption
- A significant drawback of hydrogen energy is the high cost of hydrogen generation, which reaches 2.5-6.8 dollars per 1 kg of fuel according to various sources.
- By 2030, the cost of hydrogen production is projected to fall to $1 per kg, making it absolutely competitive compared to other types of electricity
- By 2050, the cost of hydrogen generation will be 0.8 dollars per kg

Hydrogen Power Technology



Hydrogen Power Technology

Production:

- From fossil raw materials (coal)
- From natural gas (methane)
- Water electrolysis using power sources (renewable, nuclear and hydroelectric power plants)

Transportation:

- network of special pipelines
- in special tanks under high pressure
- according to the existing gas pipeline system, subject to special preparation of a gas mixture (hydrogen + methane)

Hydrogen Power Technology

Storage:

- In liquefied and adsorbed state;
- In hydrogen accumulators:
- titanium-based composite materials,
- based on cluster carbon structures.

Application:

- Power generation at power plants (industrial, domestic)
- Fuel Cell Electrical Installations
- Road, rail, aviation

Introduction of hydrogen energy technology in Azerbaijan

For the introduction of hydrogen energy in Azerbaijan, two main ways can be identified:

1. Independent development of hydrogen energy technology
2. The introduction of technologies developed by foreign companies through the acquisition of technology licenses, the creation of consortia with the involvement of various companies or some other form of cooperation

Introduction of hydrogen energy technology in Azerbaijan

Advantages of self-development:

- Azerbaijan creates its own research and production base
- Training of scientific and technical personnel in the relevant areas
- Creation of modern multidisciplinary production

Disadvantages of self-development:

- To realize the problem of introducing hydrogen technology, significant own funds will be required
- The process will take a considerable time to implement
- There are risks of constant technological lag

Introduction of hydrogen energy technology in Azerbaijan

Advantages of collaboration with leading foreign companies:

- *Solving the tasks in a shorter time frame*
- *Relatively lower costs of own funds*

Disadvantages of collaboration with leading foreign companies:

- *Dependence on foreign companies,*
- *Political and possible financial risks when borrowing from international financial institutions*
- *Partner Company Selection and Project Economic Model.*

Directions of scientific research in the Institute on hydrogen energy

- **Hydrogen production**

- Raw materials for hydrogen production

For Azerbaijan, the most acceptable is the production of hydrogen from natural gas and the method of electrolysis of water.

It is advisable to use energy of renewable sources (solar, wind, thermal) and energy of hydroelectric stations as sources of electricity at low levels of its consumption

Hybrid energy sources, i.e. a combination of renewable and traditional energy sources.

Directions of scientific research at the Institute

- *Research areas*
- *Catalyst development to improve the efficiency of the methane steam convection process,*
- *Development of carbide-nitride catalysts in order to increase the efficiency of the electrolysis process.*
- *A study in the field of "cold" steam convection, i.e. a decrease in the temperature of the process. The existing technologies require a temperature of 700-1000 ° C.*
- *Analysis of electricity consumption, determination of time intervals for the use of energy generated by hydroelectric power plants, thermal power plants, the use of excess thermal energy for the production of hydrogen from methane, etc.*
- *Carbon capture technologies and its further application.*

Directions of scientific research at the Institute

- **Hydrogen transportation**

- Study and improvement of the technology of hydrogen transportation together with natural gas through the network of gas pipelines (main and local),

The technology of construction of pipelines for the transfer of hydrogen - "hydrogen pipelines."

- Storage

- The safest way is to store hydrogen in the adsorbed state. Based on this, the task arises to develop effective hydrogen accumulators, which make it possible to carry out the hydrogen storage and extraction process with the least losses.

Thanks for attention