

## **The Study of Alternative Energy in the Curriculum of the Subject: "Ecology and Sustainable Development"**

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**Abstract:** An individually developed research work of a student on a topic: "Ecological approach to the rational use of energy in Kyzylorda region". The work includes a number of stages: the preliminary and experimental. During the preliminary stage, the literature sources are studied, the major data is highlighted. During the experimental stage, the resources and production methods of electrical power, promising in ecological characteristics, are analyzed. It is the use of solar and wind energy in Kyzylorda region. Further work consists of the study of production materials for revealing: the population quantity, area of the investigated region; data on the PCC performance index and consumption based on the types of economic activity, for the last 2 years. The obtained data is analyzed. Energy saving ways based on loss factor in lines of general use are revealed by means of the inquiry of Kyzylorda citizens and the investigation of state and operation of street and entrance lighting in private sector and multi-storey houses. At the end of this stage, the first conclusions are made. The final stage of the work included the study of prospects for implementation of alternative solar and wind energy. The result of individual research work is the conclusion. Kyzylorda region has a great potential for the development of solar and wind energy.

**Key words:** Hydropower Plant (HPP) • Thermal Power Plant (TPP) • Atomic Power Plant (APP)  
• Consumption level of electric power • Resources of electric power production • Alternative kinds of energy

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### **INTRODUCTION**

In conditions of economic globalization, the electric power becomes more and more important factor for economic prosperity. Reliable and available electric power supply is a necessary condition for the competitiveness of world industrial markets and an integral part of daily life of modern society. At the same time, ecological consequences of energy usage is one of the most complex world legislative problems [1]. The main energy source in the modern world is the fossil fuel [2]. Taking into consideration the fact, that the world modern economy is based on consumption of mineral resources, at present extraction rates the reserves can be depleted during the several decades, resulting in the full economic breakdown [3]. The base of the traditional energy sector is the following: Thermal Power Plant (TPP), Hydropower Plant (HPP), Atomic Power Plant (APP) [4]. From all energy sources, only hydropower engineering is said to be an

ecologically clean method of energy production. However, the fact, that during hydropower plants construction, it is necessary to flood vast populated areas or the natural ecosystems, disquiets. Besides, large hydropower constructions have a risk of large-scale disasters [2]. Gybilisko (2010) in the book "Alternative Energy Without Mysteries" answers to the main question of modernity: "What technologies can prevent the energetic catastrophe?" [5]. Mukund R. Patel (2005), Palts (2011), Beknazov and others (1996) in their works discuss the alternative energies of the sun and the wind, geothermal waters, waves and wastes, which should replace modern technologies. A magazine "Home Power" is very popular in the world; it propagates the alternative energy sources in its pages (2011). Petrova and others (2011) consider main ways to improve the efficiency of energy resources use [6-13]. It is not a secret, that among the global problems, which govern the existence of the humankind, the most urgent are the ecological ones.

Due to abovementioned, ecological education is one of the main tasks of the high school, that is why a subject "Ecology and Sustainable Development" is included to almost all specializations. Methodic preparation for this subject is carried out by means of lectures, practice, the student's individual work under the teacher's guidance (SIWT). However, the opportunities of the training process (45 hours in total are dedicated: 20 lectures, 10 practical trainings, 15 SIWT) do not fully provide the formation of the particular practical knowledge. In the program of the curriculum: "Ecology and Sustainable Development" insufficient attention is paid to the independent research works of the student. Meanwhile, a long experience of our work shows that at properly selected topics the studies of such kind give a significant educational effect. To attract students' attention to the problems of environment protection, we practice implementation of topics of practical content, which students execute individually. Special attention in terms of environmental education in the curriculum: "Ecology and Sustainable Development" is paid to the problems of sustainable development. For instance, the topic "Biosphere" includes such obligatory task, as the individual research work on a topic: "Ecological Approach to Rational Energy Use". As a matter of experience, a reference list is offered to the students in advance. An obligatory oral analysis follows the study of the literary sources: the degree of topic exploration and main concepts in SIWT class. From the considered literary materials the most important information is highlighted:

- Electric power is now produced by HPP, TPP and APP. All types of power stations have a negative impact on the environment;
- Electric power consumption level principally depends on the following:
  - Climatic conditions;
  - Life culture;
  - Energy-saving technologies;
  - Implementation of new methods of electric power transmission;
- Electric power production resources involve the following:
  - Energy saving;
  - Oil;
  - Natural gas;
  - Coal;
  - Uranium;
  - Nuclear fusion;

- Ecological ways of electric power production involve the following:
  - Rivers;
  - Geothermal heat;
  - Floods;
  - Waves;
  - Sun;
  - Wind etc.

A group is mainly consists of 20 people. That is why a student can choose any point of the globe for the individual investigation.

As an example, let us consider an individual research work on a topic: "Ecological Approach to Rational Use of Power Energy in Kyzylorda Region".

The student's work on this topic starts with the analysis of electric power production resources in Kyzylorda region. The results of the analysis, based on the collected data, provide an opportunity to select the electric power production methods, promising in ecological characteristics for Kyzylorda region. First of all, it is the use of sun and wind energy.

For the further substantiation of the study, the student gathered the following required materials:

- The area and population size of Kyzylorda region;
- Performance indices of the PCC based on electric power for the last two years;
- Electric power consumption based on the types of economic activity in Kyzylorda region for the last two years;
- Experimental part.

The area of Kyzylorda region is 226,0 thous.sq.km. The population size of the region is more than 703 thous. people. The study of the PCC performance indices based on electric power from 2011 to 2012 showed the increase of electric power production. Electric power consumption based on the types of economic activity showed the following:

- The major part of electric power was consumed by mining industry and excavation: 1025,6 and 1148,8 kWh;
- Production of crude and natural gas: 845,8 and 951,6 kWh;
- Electric power average consumption was recorded accordingly based on the index of power supply, gas steam supply, air conditioning, electric power production and distribution: 87,3 and 90,5 kWh.

- The least electric power consumption was recorded accordingly based on the index of clothes production: 1,8 kWh.

Analyzing the data, the student concludes, that electric power consumption can be reduced only based on the index of loss consumption in lines of general use. Based on the other items, it is necessary to implement the alternative energy sources, as year by year we increase the electric power production. This fact can have a negative impact on environment.

During the next stage, the student revealed the main ways of electric power saving based on the index of consumption losses in lines of general use. He made an inquiry of population of Kyzylorda city.

The results of the investigation showed, that at average, each citizen of Kyzylorda spends on electric power usage from 1,500 to 3000 tenge per month. Electric power cost increases gradually from September to March and then starts to reduce up to September. It was noted, that people aged 50 and older have the skills of rational economic attitude to electric power spending. The following stable regularity was revealed: the presence of seniors in the family usually leads to the reduction of payment (by 25 - 55% at average) as compared to the families of young or very young people [14-16].

Then the student studied the state and operation of street and entrance lighting in private sector and multi-storey houses. The following data was obtained:

- From 100% of random houses of private sector more than 80% have the lighting in the yard, moreover 40% of houses use the lighting sets, consuming a lot of electric power, nearly 5% does not turn off the light even by day;
- From 100% of random multi-storey houses, 40% have the lighting at the entrance, electric bulb of 40W is mainly used; 10-15% does not turn off the light by day. The student makes first conclusions based on the work done. In Kyzylorda region the following work is required:
  - Ecological propaganda of energy saving;
  - Motivation of people who save energy;
  - Propaganda of different types of dimmers.

The next stage of the student's work included the study of possibilities for implementation of alternative solar energy in the territory of Kyzylorda region. The following data was studied:

- Annual average sunshine duration in Kyzylorda region equals to 3062 hours. There is no cloudage in warm season.
- The amount of total radiation is 155 J/m<sup>2</sup> per year;
- Total radiation is distributed unequally per the seasons: in July it equals to 15 - 18 J/ m<sup>2</sup>, in January it is 4 times less.

Based on the presented data the student makes the following conclusion: "Kyzylorda region has a great potential for development of solar energetics".

The student offers his version to solve this problem:

- Kyzylorda region belongs to poor developed territories, so population density is 2,7 man/km<sup>2</sup>, versus 5,8 man/km<sup>2</sup> for the whole of the republic and 12,4 man/km<sup>2</sup> countrywide. From 1 m<sup>2</sup> of sunlit surface 160W is produced; to generate 100 thous. kW it is necessary to take the energy from the area of 1,6 km<sup>2</sup>. Kyzylorda region occupies 226000 km<sup>2</sup>, at a relatively poor developed territory 1,6 km<sup>2</sup> is not a significant figure. Total length of Kyzylorda city is 4014 km, here are a lot of multi-storey houses; solar energy can be obtained if the solar batteries are placed on building roofs. In Kyzylorda region it is prospective to implement the solar plants at small-meterage ships, boats, motor boats, catamarans and other water vessels.

The second type of alternative energy, which can be used in Kyzylorda region, is the wind.

Wind regime in Kyzylorda region is mainly influenced by circulation conditions:

- Frequent and strong winds, mainly of north-east direction, are typical;
- Average quantity of days with strong wind ( $\geq 15$  m/sec) is 39, the most is 70;
- Once a year the wind speed, equal to 22 m/sec, is possible, once the 10 years - 30m/sec.
- In all months of the year dust storms are observed. In average, there can be 37 dust storms a year. In summer the quantity of storms can reach 7. Their length is from 1,5 up to 10,5 hours. In winter dust storms can continue for more than 20 hours [17, 18].

The student also offers his version to solve this problem:

In dull days the wind energy can be the most replaceable alternative of solar energy. Kyzylorda region has the following conditions:

- Wind speed of 5 m/s corresponds to the requirements of world practice based on the indices of commercial reasonability of wind devices implementation. At that, in the territory, appropriate for WDPP implementation in Kyzylorda region, the average wind speed exceeds 5 m/s. If the right place for wind power unit installation is chosen, the average wind speed can reach higher values;
- The region has the conditions for obtaining 3 bln.kWh. For this 8000 of wind power units with capacity from 100 to 500 kW are required.

The result of the executed research work of the student is the following conclusion:

- Kyzylorda region has a great potential for the development of solar and wind energy.

As we can see, as a result of individual investigations, at the right approach, the student of the 1st course begins to accumulate factual material, which will promote understanding of numerous phenomena, existing in nature.

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