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Synthetic Management of Energy and Ecology in Georgia

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Abstract: The interests of the public and ecological issues of developing the energy complex are closely inter-connected. The public is interested in both its energy provision and living in the clean environment. Therefore, ensuring the energy and ecological balance is the essential pre-condition of ensuring the energy and ecology balance of any energy project. The aim of the scientific work is find the essential rational balance between energy and ecology. The environmental issues in the energy sphere of Georgia as well as the energy complex development tendencies are analyzed and it is assessed taking into consideration ecological requirements. Among the fields of material production/manufacturing, the energy complex is the most contaminating one. Attention is focused on ecological problems of the land, including, the cultivable ones, water, climate and other spheres. The Georgian experience of meeting those challenges is given. At the end opinions are given regarding the improvement of the situation in future: objectives necessary for implementing the energy ecology security policy are set and key issues of full scale envisaging of the requirements of ecology are given.

Keywords: Energy, Energy Resources, Environment Protection, Ecology, Electric Power Station

1. Introduction: Synthetic Interconnection Between Energy and Ecology

Interests of the community and ecological issues of developing the energy complex are closely interconnected. The community is interested in both its energy provision and living in clean environment. Therefore, providing energy and ecological balance is a significant pre-condition for implementing any energy project. Without solving these issues any project is destined to fail. This was clearly proven the events unfolded in Georgia: in the 90ies of the previous century the construction of Khudoni HEPS was terminated due to the critical protest of the society towards issues threatening the ecology [1].

Energy plays a significant role in nature contamination. It spends a large amount of mining raw materials, pristine water, atmospheric oxygen, changes the landscape, contaminates air and water basins with organic fuel combustion products and remains of technological processes, emits a large amount of low potential thermal energy. Frequently, layers of the soil become partially or fully useless during mining and manufacturing any one type of product, the hydro-geological regime gets deteriorated, etc.

Energy, and, first of foremost, electric energy are significant water users. Also, for years thermal electric stations existing in the country utilize approximately one billion cubic meters of water, including, more than three million without getting it back. This means that for every one thousand kwt/hour electric energy generation use 82 cubic meters of water, including 0, 22 cubic meters without getting back [2].

In energy, as well as in other fields, gradual solving of the problems of ecology is done at the government level. The parliament approved the document of basic directions of the state policy in the energy field of Georgia on June 24, 2015 which clearly envisages the environmental components. Namely, taking into consideration best international practice while implementing energy projects of significant impact. It envisages assessment of social and environmental impact, organizing consolations with local communities, publicity of respective information and ensuring availability [7, 10, 12, 15].

In order to implement the mentioned policy, it is envisaged to use the methods with ecologically high efficiency and production and use of ecologically clean energy resources in respect with activities and production of the energy complex; economic stimulation of using technologies with little or no waste and establishing the system of compensation remuneration in case of violating them; strengthening such compensations with the rule of the principle of the organization and giving it the nature of economic remuneration (including, insurance funds of preventive measures); rationalization of monetary payments for using natural resources, their management and legislative regulation of ecological insurance [8].

Environmental problems are especially critical in developing countries which include Georgia as well. Provided that the energy complex is one of the main sources of polluting the environment, energy functioning and development in the recent period encounters most acute and ecological problems. Besides, based on the naturally monopolistic nature of companies of the energy sector, it is regulated by the independent regulatory company and energy production as well as its transmission and distribution are subject to licensing [20, 21].

2. Energy Complex in Georgia

Based on the data of recent years, water harvesting and utilization in the energy complex of Georgia equaled 691.8 and 664.3 million cubic meters, respectively. This was commensurate with respective 64.2 and 57.3 percent of our industry and 18.1 and 21.3% of total economy. 1.3% of contaminated waters in the country accounts for the share of the complex whereas the indicator is much higher in respect with the industry - 5.2% [3].

Out of all types of energy sources the majority is represented in Georgia. The country has hydro resources, coal, peat, oil, natural gas, thermal waters, the prospects for using wind, sun, biomass and thermal waters energies are great.

Hydro-energy resources represent invaluable wealth. The country's technical hydro-energy resources amount to 80 billon kw/hour whereas economic resources equal 40 billion kw/hour [3, 9]. As of today, only 12% of technical resources had been utilized and they are, obviously, still being used.

Analysis shows that electric energy generated at hydro-electric power stations is ecologically cleaner than at the thermal electric power stations operating with coal, heavy fuel oil or even natural gas. We consider that in hydro-energy sphere putting ecological issues to the front was conditioned by mainly construction of HEPSs with water protection mechanisms. It also needs to be taken into consideration that the hydro-electric power station with water protection generates the most costly peak energy. It ensures water holding during floods and flooding and minimization of damage caused to nature and electric energy users as a result of these processes. Besides, it is possible to increase the efficiency of multilateral use of water, using it for both energy generation and irrigation and water supply [3].

Georgia has the history of almost 1.5 century of building and exploiting HEPSs. Their impact on the environment used to change periodically [4, 13, 16]. As of 2016, HEPSs of large and medium capacity are put into operation in Georgia as well as those of small capacity in the amount of 67 to 50 (less than 13 megawatts). The period of functioning of the significant part of electric transmission infrastructure exceeds 40 years and requires technical re-equipment [5, 14].

Besides, the Baku-Tbilisi-Geican pipeline flows over the territory of the country as well as the Erzerum gas pipeline; oil products and natural gas flow in large number. Overall, there is a growing tendency of transporting and utilizing energy resources in the country (see the table 1). Respectively, the "ecological burden" gradually increases.

Table 1. *Manufacturing and transporting energy resources in Georgia (Thousand tons of oil equivalent).*

Name of energy resources	Type of activity	2014	2015	2016	2016, % comparison with 2014
Coal	Manufacturing	121.5	124.2	120.4	99.1
	Export	1.0	0.7	0.6	60.0
Crude Oil	Manufacturing	43.3	40.8	39.1	90.3
	Export	52.0	155.0	18.4	35.4
	Import	_	135.3	_	_
Oil Products	Import	1152.2	1382.5	1526.6	132.5
	Export	16.0	83.6	108.2	676.3
	Manufacturing	_	11.6	_	_
Natural Gas	Import	1825.3	2090.6	1885.3	103.3
	Manufacturing	8.6	9.5	5.5	152.7
Hydro power	Manufacturing	716.7	726.9	802.2	111.9
	Manufacturing total KwT/hour	10371.2	10592.5	11573.6	111.6
Electricity	Import	73.2	60.1	114.2	155.8
	Export	52.0	56.7	121.1	232.8
Geothermal, Solar and other types of energy	Manufacturing	1.68	18.5	21.2	126.2
Biofuel and Waste	Manufacturing	456.0	399.0	387.9	83.4
Total	Manufacturing	1372.0	1330.4	1376.3	100.3
	Import	3229.4	3820.7	3735.1	115.6
	Export	121.1	408.1	249.6	206.1

Source: Chomakhidze D. Energy Balance of Georgia, Science Direct, Vol. 14, Issue 3, 2016, p. 196-200.
Statistical Yearbooks of Georgia, 2000-2016.

In such circumstances the negative impact of the energy complex on the environment is huge and, as it has been stated, it increases gradually. What needs to be taken into consideration here is the fact that there is a "boom" of construction HEPSs in Georgia. 18 HEPSs were gradually put into operation from 2010 to 2017 with the overall capacity of 174 megawatts and higher scale of growth are anticipated for the future [14]. In this respect, new "surprises" are anticipated from electric energy. As it is known, this field is a significant user of water. The main part of water supply of energy accounts for it, the largest contaminating level in flowing waters. The rivers are also contaminated by waters flowing from the coal enriching factories, etc.

3. Objectives of Ecological Security

It is necessary to meet the following objectives with the view of implementing the energy ecological security policy:

1. To create ecologically clean technologies with little or no waste, energy and resources saving for rational production and use of fuel and energy resources, reduce environmentally contaminating sprinkles and heat gases as well as creation of industrial waste and hazardous actions of other agents, utilize waste;
2. To construct and reconstruct environmental sites, including, increasing the rates of re-cultivating the soil contaminated and eroded in the processes of holding hazardous substances from burnt gas and neutralizing and cleaning seeping water, constructing and using energy sites and using the industrial waste as secondary raw material;
3. Stimulating economically rational application of gas flowing with oil, restricting the practice of burning it in torches (first of all, at the expense of creating economically useful conditions for applying such gas);
4. Introducing ecologically clean technologies of combustion at coal thermal electric stations and other enterprises as the condition for implementing the prospect of using coal;
5. Improving the quality of coal (including, use of enrichment, processing, briquetting and other means) and using methane in mines;
6. Ensuring full structure of the normative base of products as a result of burning of oil products and contaminating substances in accordance with international norms. Increasing the production of fuel having improved economic qualities for high quality engines;
7. Developing and using the programs of minimizing ecological harm caused by functioning of HEPSs and their construction;
8. Organizing works for certifying environment protection technologies and technical means [8].

To meet the above-mentioned objectives it is necessary to form the level of present-day requirements and scientific-technical achievements as well as a unified information system of ecological monitoring; ensuring the conditions commensurate with ecological security, stimulating and regulating the investment and creating a harmonious legislative basis.

The ecological strategy of the energy complex is based on the necessity of complying with the international obligations of Georgia in the field of ecology and is structured in accordance with the problems of global nature of the development of present-day energy which are related with the environment protection and solving them will ensure sustainable future of humanity.

On the basis of the Kyoto Protocol (ratified in Georgia in July 1999), out of several financial mechanism of implementing the framework convention on climate changes, Georgia, as the developing country, has the right to enjoy the "Clean Development Mechanism" (CDM, which will enable Georgia to formulate the long-term and sustainable strategy of developing energy based on the growing rate of energy efficiency and using the sources of renewable energy sources.

4. Conclusion

Provided that the energy complex is one of the main sources of polluting the environment, energy functioning and development in the recent period encounters most acute and ecological problems. Out of all types of energy sources the majority is represented in Georgia and hydro-energy resources represent invaluable wealth.

Hydro-resources are so far considered as the main energy wealth of Georgia and it is essential to ensure full-scale consideration of the requirements of ecology in this respect. Namely, it is necessary to [3, 17]:

1. Continue ecologically and economically efficient use of local hydro-energy resources;
2. Construct complex hydro-stations which will enable to regulate river run-offs and use of water resources for the purposes of irrigation, water supply and energy;
3. Develop and implement such measures by means of which it will be possible to restore and protect the Black Sea coastline due to the decrease of hard debris brought by the river;
4. Organize the complex of hydro-accumulating electric stations as much as possible.

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