

# ***Complex method for regulation of air-technogenic influence from energy park enterprises in St.Petersburg and Leningrad Oblast (region).***

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## **1 - ABSTRACT**

Energy park (EP) in Russia and enterprises of the Energy sector provides more than a half of economic potential in the country at the same time making the main contribution to the environmental pollution.

One of the foreground problems is the problem of atmospheric emissions of harmful substances while producing heat and electricity from organic fuels.

This investigation was stimulated by evident drawbacks in evaluating quality of nature conservation measures based on quantity of picked up pollutants. Investigation was devoted to rationalization and development of a complex method for regulation of air-technogenic influence from EP enterprises in the region, which allows to optimize technological processes based on the criteria of ecological safety.

As a result of this research an idea of eco-metric analysis was introduced and a new method of technogenic characteristics evaluation was carried out for technological processes of energy production and atmosphere-protection systems at the big EP enterprises of the region.

Quantitative and qualitative eco-metric characteristics of this method led to quantitative data for different types of fuel used for energy production and allows to evaluate ecological efficiency of measures on decreasing atmospheric emissions.

In this study ecological-economic point was established and formula for calculation of level of technology air-technogenic risk was provided. This enables work on rank of enterprises by this level.

The proposed complex method for regulating impacts of EP enterprises applied to design energy strategy in the region and adopted for realization of policy for resource saving and environmental protection at the big EP enterprises.

## **2 - INTRODUCTION**

The importance of the chosen topic is implied by the high priority of the problem of decreasing emissions of harmful substances into the atmosphere from the heat and energy production processes at the Energy park (EP) enterprises and electricity from organic fuel in the processes of decreasing of air pollution level in industrial zones and large cities.

The traditional attitude to decreasing air-technogenic impact on the environment from energy park enterprises based on the evaluation of their environment protection measures are in contradiction to the resources conservation conception. Due to these circumstances it has become important to carry out a new complex method for regulation of air-technogenic influence from energy park enterprises in the region. This method enables to optimize the technological processes using ecological safety criteria over all stages of the technological scheme of heat and electricity production from organic fuel. The objects of the investigation were technological processes of energy park enterprises in St.Petersburg and Leningrad Oblast (region).

This paper is devoted to the analytical review of air-technogenic impact of energy park enterprises based on the econometric analysis. This work including generalization of main points of the econometric analysis methodology, evaluation and prediction of potential danger and impact, and regulation of levels of technogenic impact on the environment from different types of economic activity, based on the criteria of ecological safety was performed at the St.Petersburg Scientific-Research Center for Ecological Safety, Russian Academy of Sciences (SRCES RAS) by the director of the Center Prof. V.Donchenko. Authors of this paper adopted and evaluation of this methodology for the energy park enterprises.

### 3 - TRADITIONAL ECO-METRIC ANALYSIS

According to the econometric analysis methodology, the technological process of energy production from organic fuel can be investigated using the following indexes of econometric evaluation:

- indexes of air-technogenic impact from polluting substances (PS) generated during the fuel combusting — quantitative characteristics the level of air-technogenic PS impact, presenting their relative ecological danger comparing to some nominal substance which ambient air standard (maximum permissible concentration) is taken to be equivalent 1;
- general index of air-technogenic impact of PS flow produced in the process of energy production — the sum of combination of PS impact indexes with their weight coefficients in multi-component flow;
- general air-technogenic figures of potential and real PS flow — quantitative indexes respectively of the ecological danger level of PS flow generated in the energy production process and relative level of ecological danger of PS flow directly emitted to the air;
- expressed in energy figures the above mentioned general air-technogenic figures (kcal, kW-h) — specific quantitative indexes;
- the power of investigated sources of air-technogenic impact — figure depended on the amount of air-technogenic equivalent mass generated in time.
- The main reasons for choosing the following groups of PS are the toxicity level, spreading and life stay in the atmosphere: sulfur and nitrogen dioxides, carbon oxide, cinder (ash), containing heavy metals. For those Ps the following indexes of air-technogenic impact were detected:
- for individual substances based on the principle of "relation to the basic polluting substance" daily ambient air standard of which is  $1\text{mg}/\text{m}^3$ .
- for multi-component substances – cinder – generalizing individual substances indexes detect summarized index based on mean content of cinder components.

Using and based on these indexes there were built air-technogenic spectra for PS flows for different fuels used – crude black oil, carbon, natural gas, ampelite, peat, and wood.

For the traditional energy enterprises the main problem is problem of fuel used. The main criteria for choosing fuel is maximum ecological-economic effect, what means economically reasoned fuel use in the technological process and minimal impact for the environment. Traditionally to achieve these purposes there is a technical analysis undertaken to determine several characteristics like ash and sulfur content, humidity and combustion heat.

### 4 - NEW APPROACH OF EVALUATION

There is another way proposed by the authors to reason and base arguments of ecological necessity and economic effectiveness of fuel use at the Energy Park enterprises on evaluation of quantitative and qualitative econometric indexes for the level of air-technogenic impact of energy sources.

In order to evaluate potential air-technogenic impact in eco-metric indexes studied objects were ranged in the following way:

- elementary level - individual boilers and aggregates;

- local level - separated Central Heating Electricity Stations and Recuperative Hydro-Electro-Stations;
- municipal (city) level - Central Heating Electricity Stations of St.Petersburg;
- district level - Central Heating Electricity Stations and Recuperative Hydro-Electro-Stations of the Leningrad District;
- regional level - Central Heating Electricity Stations and Hydro-Electro-Stations of the North-West Region.

In this work technological measures taking place at the Energy Park enterprises of St.Petersburg and the Leningrad Region were investigated. Correction factors were detected for air-technogenic potentials for the following technological processes: desulfurization, using hydro-fuel technology, combination of fuel with municipal and wood wastes, inclusion of re-circled gases, decreasing excess air coefficient, two-staged fuel combustion, steam-atomizing burners use, etc.

The authors proposed a scheme for calculation of eco-metric indexes of technological measurements efficiency to decrease air-technogenic impact from Energy Park enterprise, based on the decomposition analysis of all stages of the technological process of investigated object. Using statistics for emissions, the comparative analysis has been done of potential and real air-technogenic impact of Energy Park enterprises in St.Petersburg and the Leningrad Region over 1990-1996. It has been shown that the character of values' changes was similar over the whole period.

Thus, a methodology for eco-metric indexes and coefficients calculation was carried out, which allows to analyse the level of ecological danger for PS flows in the processes of energy production.

## 5 - PRACTICAL REALISATION

For the Energy Park enterprises practical realisation of directives and economic measures for air-technogenic impact regulation can be performed through the ecological taxing of energy. Percent of this tax should be fixed, basing on the evaluation and expertise of ecological-economic situation for each particular Energy Park enterprise. This provides a possibility to compensate form Regional Foundation for Ecological Safety both enterprises expenditure for decreasing air pollution and expenses related to PS emissions. At the same time, in the case of monopoly enterprises with high air-technogenic impact are not interested in its decreasing due to the fact that increased taxes by ecological part provides enterprise with full expenditure compensation. This is a contradiction when consumers suffering from air-technogenic impact pay for its increasing.

Only when means of Foundation for Ecological Safety would compensate Energy Park enterprises activity on decreasing air-technogenic impact, it becomes possible to realise practically "polluter pays" principle, what means that enterprise got compensated only expenditure for technological process organisation, using criteria of ecological safety. The amount of compensation is stated using Regional Compensation Index (RCI), the authors used mean value of the State Compensation Indexes for air protection in the European Countries under EMAS system. RCI allows to get values of potential and real damage of the environment. The process of air-technogenic impact regulation (in several stages) is based on the ranging of Energy Park enterprises by the potential damage level and "cost-benefit" analysis for environment protection measures.

In the process of practical realisation of the investigation results it was proved that the proposed complex method of air-technogenic impact regulation is an effective instrument for realisation of technical policy of resources saving and environment protection. It generalise technological and environment protection measures in one united system for decreasing harmful substances emissions into the atmosphere while producing heat and electricity at the Energy Park enterprises.