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SOCIO-ECOLOGICAL ASPECTS AND REGIONAL INTEGRATION WITHIN STRATEGIC PLANNING FOR THE SUSTAINABLE DEVELOPMENT OF ST. PETERSBURG

1. Introduction

Since they are subjects of the Russian Federation, St. Petersburg and the Leningradskaya Oblast (Leningrad district), as well as other regions of Russia, are implementing the National Strategy of sustainable development. According to the Concept of Transition of the Russian Federation to Sustainable Development, balance between socio-economic goals and protection of the natural environment, together with preserving natural resources, is a real necessity at present [Concept, 1996].

One of the basic documents determining global policy towards sustainable development and preservation of the biosphere is Agenda 21 adopted by the UNO Conference in 1992 in Rio. As a natural continuation of this international document, the Baltic Agenda – 21 acts as a local agenda for the Baltic Sea Region, which formulated the goals of sustainable development for the Baltic States. The same objectives for continued improvement of the socio-economic situation and standards of living of the population were put into operation by the Strategic Plan for the sustainable development of the city of St. Petersburg, created for the first time in 1997 [Strategic Plan, 1997].

This paper analyses the achieved level of strategic planning of the city's development, as well as the sustainability indicators formulated. The authors suggest new indicators describing the condition of natural

resource management, which are based on material flows entering the economy of the region and thus providing information for proactive environmental protection activities and strategic planning. Such indicators have been presented by Eurostat in 2001 [Economy-wide material flow accounts, 2001] and investigated by specialists of Wuppertal Institute, Germany [Bringezu, 2002]. In the conditions of a lack of required material flow statistics, as a primary step, it is suggested to use MIPS-analyses of energy efficiency based on the energy balance sheet of the city.

2. St. Petersburg and the Leningradskaya Oblast: an evaluation of the achieved level of strategic planning

In St. Petersburg, as well as in other regions of the Russian Federation, strategic planning for sustainable development began in 1996. The first document, in which the problems of sustainable development were mentioned, became the Strategic Plan of St. Petersburg. The decision regarding the writing of such a plan was taken at the first city conference on December 12, 1996. The work on the drawing up of the Strategic plan took one year, and on December 1, 1997 it was adopted by the General Council for strategic planning.

In the conditions of the administrative command-and-control system of the economy, planning was widely applied in Russia. The state plans of socio-economic development, both in municipalities and territories, covering all spheres of community life were developed at that time. This planning was directive, *i.e.* the plan was supported by the full force of a law, and failure to implement entailed serious consequences. The disadvantages of this system of planning began to appear very clearly, especially after 80 years, when it became clear that directive planning is not capable of operatively taking into account achievements of scientific and technical progress, adapting supply to demand or providing efficiency of capital investment.

During the transition to a market economy in our country the concept of planning came into general disfavor for some time. However, it became clear rather quickly, that in comparison to other cities, St. Petersburg has very favorable conditions and at the same time potential threats to strategic planning for sustainable development.

The overall objective of the city development was formulated on the basis of analysis carried out, namely: formation of St. Petersburg as a multifunctional city integrated into the Russian and world economy

providing a high quality of the environment for living and manufacturing [Golubev and Sorokin, 2003].

This overall objective was broken up into two goals:

1. Increasing income and employment by means of economic growth;

2. Improvement of the living conditions of the populace by means of increasing the efficiency of the city's budget expenditure.

Assessing this objective from the point of view of the goals of sustainable development, it is possible to note that its formulation satisfies the concept of sustainable development through its influence on the state of environment. However, it does not reflect all the aspects of this concept, such as the role of the city as a source of technogenesis. The goals of the plan basically concern socio-economic conditions and the problems of the administration and usage of natural resources play a subordinate role. Nevertheless, important features of the "sustainable development" concept are reflected in this definition.

The plan is a wide-ranging document and, naturally, some of its positions are questionable. It is possible, in particular, to see that the principles and mechanisms of interaction between St. Petersburg and the Leningradskaya Oblast are not worked out. Thus, the city and Oblast inevitably enter into competition with each other, for example, when providing services within international economic relations or for transportation purposes.

From the point of view of sustainable development the most important factor is the state of the city environment. However, this factor appears to have been treated superficially in the Strategic plan. The developers only paid attention to the processing of household and industrial waste, sewage and purification of drinking water. This is an excessively laconic evaluation of the state of the city's environment. Speaking about the quality of the environment of St. Petersburg, it is necessary to note such positive aspects as the rather high level of gardening in the city and the affinity to the unique landscapes of the Karelian Isthmus. At the same time it is necessary to highlight such negative features as the high level of contamination of the Neva delta waters and emissions into the air and soil.

As a political tool for sustainable development the Strategic plan needs some measurable, transparent, clear and scientifically based indicators, or rather a system of indicators, in order to evaluate the level of conformity of results achieved to planned results. Such indicators have already been prepared for the purposes of regional and national development in some European countries, the Baltic States and Moscow. The indicators of sustainable development used in St. Petersburg are shown in Table 1.

Table 1. Indicators of Sustainable Development used in St. Petersburg

#	Name of the indicator	Measurement	The purpose of the indicator
1.	Gross regional product per capita	Dynamics of development of the city's economy	This indicator shows how successfully the city economy is developing
2.	Investment attractiveness of the city	Ratio between investments in fixed assets to their cost in given branches of econ-omy	This indicator describes: – activity of the renovation process of fixed assets and imple-mentation of new technology and innovations – the rate of development of the main branches of economy
3.	Life expectancy (expected life expectancy)	Quality of life of the city popu-lation from the point of view of various aspects of this concept	This indicator is one of the most generalizing parameters of sustainable development, it reflects various aspects of quality of life in the city: health of the population, its ill-nesses, quality of health services, quality of nutrition, level of safety, etc.
4	Demographic structure of the population according to age group	Demographic structure of the population structure according to sex and age	This indicator reflects the character of demo-graphic repro-duction of the population. At present the demographic structure is of regressive character and has a low level of demographic reproduction, the birth rate of the population does not compensate for natu-ral loss
5	Demographic load	Demographic load reflects the proportion of people of non-working age in a community	This indicator measures the labor potential of St. Peters-burg
6	Unemployment rate	Unemployment rate reflects the proportion of unemployed people of working age in the popula-tion	This indicator characterizes the social envi-ronment and the level of social tension in the city
7	Crime rate	Crime rate characterizes the so-cial safety of the population	This indicator characterizes the safety of resi-dents in the city

Table 1. Cont.

#	Name of the indicator	Measurement	The purpose of the indicator
8	Balance of migration	Balance of migration re-flects the level of attrac-tiveness of the city to mi-grants	This indicator shows the attractiveness of the city as a place of residence
9	Quality of atmospheric air	Quality of atmospheric air char-acterizes the level of air pollu-tion in the city; index of air pollution	This indicator characterizes the environmental safety of re-siding in the city
10	Quality of surface waters	Quality of surface waters char-acterizes the level of contamina-tion of surface waters	This indicator characterizes the level of com-fort of residing in the city
11	Contamination of the soil	Suitability of the city for residince	This indicator shows the attractiveness of the city from the point of view of contaminated soils
12	Level of noise contamination	Comfortable conditions for resi-dence	This indicator shows the attractiveness of the city from the point of view of noise contami-nation
13	Formation of solid house-hold waste and level of their mechanized processing	"Contribution" of the city to contamination of the environ-ment	This indicator shows to what extent the city meets the re-quirements of a modern civilization
14	Level of gardening	Quality of urban environ-ment	This indicator shows the attractiveness of the city from the point of view of the quality of the urban environment

Source: Golubev and Sorokin, 2003.

Besides indicator #1, there are no indicators connected with regional sustainable development, either in an economic, ecological or social dimension. However, as analysis of Baltic Agenda 21 shows, strengthening the regional cooperation between St. Petersburg and the Leningradskaya Oblast would be a significant contribution to sustainable development, especially in the field of nature protection legislation and taxation.

2.1. Social-ecological aspects

Based on the Concept of transition of the Russian Federation to sustainable development, the designation of social and ecological tasks within the region should take local features into account. Such tasks are referred to as: "Realization of measures on the improvement of the living standards of the population, development of social infrastructure and maintenance of sanitary – medical well-being [Concept, 1996]."

It is possible to assess the efficiency of actions undertaken by examining the dynamics of various parameters of the quality of life: life expectancy, state of health, deviation of the state of the environment from guidelines, level of knowledge or educational skills, income (GDP per capita), employment level, degree of realization of human rights [Concept, 1996].

Many social aspects of sustainable development in a region are directly or indirectly interrelated with aspects of the natural environment. Hence, the health of the population is under direct influence from ecological factors. In turn, the state of health is a factor, which affects other social aspects, such as:

- serviceability, and, hence, income and the employment level;
- ability to train, and, accordingly, the level of knowledge and educational skills.

Over the last five years the stabilization of atmospheric air pollution has been clearly visible. The proportion of unsatisfactory air samples decreased from 3.85% in 1999 to 1.04% in 2003. Reduction of atmospheric emissions in the city of such pollutants as oxides of nitrogen, particulates, phenol and formaldehyde is a priority. It is possible to note an insignificant reduction in the most common atmospheric pollutants [Golubev and Sorokin, 2004]. The common tendencies of the dynamics of the level of public health and changes in the state of the atmosphere can be traced. As the quality of the atmosphere increases, a decrease in the incidence of illnesses can be observed.

It is also necessary to add that, on the whole, the medical-demographic situation in St. Petersburg is characterized by a decrease in the

number of permanent residents [Golubev and Sorokin, 2004]. The quality of food is another category determining the quality of human life. The healthiness of food crops and foodstuff is one of the basic criteria determining the health of the population and its preservation. About 40–50% of harmful substances enter a human body in food products, and about 20–40% in water [Kisilev, 2005]. Food quality and safety depends on many elements, among them one of the basic components is the healthiness of agricultural products.

The overcoming of this spectrum of socio-ecological problems is only possible within the framework of tight integration with the nearest regional agrarian partner of St. Petersburg – the Leningradskaya Oblast. Sustainable development of agriculture in the Leningrad Oblast is a positive factor, which would influence the health of the inhabitants of St. Petersburg. Sustainable agriculture could provide high-quality products and services in a long-term prospective.

In addition, strategic planning should provide for the gradual replacement of unrenewable resources by renewable ones, maximal secondary use of unrenewable resources, satisfaction of the demands of society for food products, preservation of landscapes, cultural values and the historical heritage of rural regions, creation of stable, highly developed and safe rural areas and observance of ethical aspects of rural development.

Briefly summarizing the achieved level of strategic planning of St. Petersburg, it is possible to conclude that the necessary links between urban and rural development of the region were not emphasized. In the current Strategic Plan the main emphasis is on the social sphere. Despite the fact that social and ecological objectives are interrelated, less attention is paid to the status of the natural environment of St. Petersburg and the Leningradskaya Oblast. As a result there is a lack of environmental objectives within the plan and of relevant indicators of sustainable development, and those mentioned are too laconic and cover either the environmental impact or the output side of the city economy. Less attention is paid to the input side. However, the input side should be evaluated, in order to reveal all the environmental impacts of economic activity. These lead to a lack of accountability for material inputs into the city economy which have a negative effect on both the environment of the city and Leningradskaya oblast. The importance of such balancesheets of material flow is evident in terms of economic growth and at the same time eco- and energy-efficiency gains may be achieved in the region, if such an objective is added to the list of strategic goals of sustainable development.

Material flow accounting (MFA) is considered as the basis for creating transparent indicators of sustainable development. It is well known that

resource management requires properly organized resource accounting. MFA has been developed as a tool for systematically describing and monitoring resource use in the framework of the concept of industrial metabolism. The underlying principle of MFA is to account for all materials entering and leaving the economic system, based on a mass-balancing approach. MFA can be used to derive indicators on the metabolic performance of national economies, for instance resource inputs, and the efficiency of resource use [Eurostat, 2002].

So far, economy-wide MFA statistics have been established in only a few European countries. Practically no MFA data, either for raw material or energy resources are available for Russia or the other Central and Eastern European countries.

At present there are several commonly used indicators based on material flow analysis, such as total material requirement (TMR), direct material input (DMI) and direct material consumption (DMC) [Bringezu, 2002]. At the regional and company level it may also be recommended to use material input per unit of service or product (MIPS) [Schmidt-Bleek, 1998; Ritthoff et al, 2002; Sergienko and Rohn, 2004].

Based on DMI, TMR, DMC, MIPS and other material flow indicators it is possible to evaluate the environmental impact of the regional economy both on rural and urban areas, starting with the extraction of raw materials, including material and energy use for production and consumption, recycling, and final disposal of waste. Creating such indicators, as well as a system of appropriate accounts, is a challenge of great importance, which can significantly improve the achieved level of strategic planning in the city.

3. Approbation of MIPS-analysis on the energy efficiency of the St. Petersburg Region

In the conditions of a lack of required material flow statistic as a primary step it is suggested to use MIPS-analyses of energy efficiency based on the energy balance sheet of St. Petersburg.

The data presented in this chapter are of a preliminary nature, and are based on a study conducted at St. Petersburg State University of Refrigeration and Food Technology according to a commission from the Committee on Energy and Engineering Provision of the city of St. Petersburg Administration. The energy balancesheet for the city is shown in Table 2.

The major fuels necessary for the maintenance of industrial objects and household needs of St. Petersburg are natural gas, black oil and

Table 2. The Fuel and Energy Balance of St. Petersburg in 2003

Name	Unit	2001	2003
Energy production and purchase			
Total output of heat energy	ths Gcal	45,262.2	47,526.0
Total output of power energy	mln kW-h	9,427.7	8,429.6
Purchase of power energy	mln kW-h	no data	9,314.2
Fuel consumption by energy generating or-ganizations			
Natural gas	mln m3	7,723.4	7,577.4
	ths t.c.f*	8,860.6	8 805.8
Black oil	ths t	177.4	269.9
	ths t.c.f	239.6	370.3
Coal	ths t	241.3	347.0
	ths t.c.f	166.7	243.4
TOTAL fuel consumption by En-ergy Generating Or-ganizations	ths t.c.f	9,267.0	9,419.4
Fuel Consumption by other organizations			
Natural gas	mln m3	1,092.6	1,300.0
	ths t.c.f	1,253.2	1,491.1
Fuel consumption by the population			
Natural gas	mln m3	650.6	655.0
	ths t.c.f	746.2	751.3
Coal	ths t	37.7	43.0
	ths t.c.f	26.4	30.1
Total	ths t.c.f	11,292.8	11,691.9
including:			
Natural gas	mln m3	9,466.6	9,532.4
	ths t.c.f	10,860.1	11,048.1
Black oil	ths t	177.4	269.9
	ths t.c.f	239.6	370.3
Coal	mln m3	279.0	390.0
	ths t.c.f	193.1	273.5

* t.c.f – tonnes of conditional fuel.

Source: study conducted at St. Petersburg State University of Refrigeration and Food Technology.

coal. As there are no natural stocks of these energy resources in St. Petersburg or the Leningradskaya Oblast, its supply is achieved by transportation from other regions of Russia.

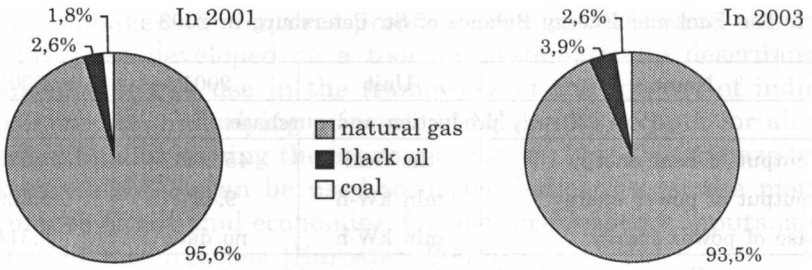

Fig. 1. Consumption of fuel by energy generating organizations in St. Petersburg
Source: study conducted at St. Petersburg State University of Refrigeration and Food Technology

The basic kind of fuel entering the urban energy balance is natural gas, whose share in total consumption of fuel increased from 75 up to 94% between the beginning of the 90s and 2003. This has considerably improved ecological conditions in the region. In the last decade the level of fuel consumption in St. Petersburg has decreased by 26% and amounted to 11.8 million tonnes of fuel in 2000. The reason for such a rapid reduction in fuel consumption is the considerable decrease of volumes of industrial output in connection with market reforms in the Russian Federation.

Analyzing the structure of industrial manufacture, the resource base and predicted volumes of consumption of fuel and energy resources, it is possible to conclude that the future of St. Petersburg's economy depends on an increase in the efficiency of consumption of fuel and energy resources and reduction in their consumption. This, in turn, requires the creation of an effective system of stimulating energy generating organizations, ensuring favorable conditions for credit and increasing the share of local energy carriers, such as coal, peat, different kinds of natural gas and energy from renewable sources in the power balance. The choice of these directions should be based on careful assessment and planning. The MIPS-indicator can serve as one criteria. This parameter describes the material input into production of energy resources determined over a product life cycle.

The consideration of the life cycle of production is a necessary condition for the effectiveness of MIPS-analysis, as the damage which a product makes on the environment is not always obvious, but according to the MIPS concept always exists and any product carries an invisible "ecological load".

This approach enables assessmnent of environmental impact and to decide on an optimal combination of ecological and economic interests. The techniques of MIPS-analysis have been used to examine the material intensity of existing power generating objects in St. Petersburg.

Table 3. MIPS-criteria for power energy produced in St. Petersburg

Resources	Amount, t
Input	
Material flow	2,403,475
Energy flow	449,660
Total	2,853,135
Output	
Power energy, kWh	7,716,290
MIPS	0.37

Source: study conducted at St. Petersburg State University of Refrigeration and Food Technology.

Initially, only the stage of manufacture of energy was examined because of a lack of data. In particular, data on fuel, heat, water and electric energy balances, provided by the Committee on Energy and Engineering Provision of the city St. Petersburg Administration, were used for the calculation of material and power inputs. MIPS indicators were calculated by averaging the appropriate parameters of 51 heat power stations in the city (Tables 3 and 4).

In the case of power energy the MIPS was equal to 0.37 t/kWh, and for heat energy – 0.27 t/Gcal. For comparison, in Finland the second indicator is 0.41 t/Gcal. The material input for transportation was not considered in MIPS-calculations because of a lack of data. Therefore, the MIPS for energy resources produced in St. Petersburg over the complete life cycle could be much higher.

Table 4. MIPS-criteria for heat energy produced in St. Petersburg

Resources	Amount, t
Input	
Material flow	13,766,471,318
Energy flow	791,038,292
Total	14,557,509,610
Output	
Heat energy, kWh	53,208,088,738
MIPS	0.27

Source: study conducted at St. Petersburg State University of Refrigeration and Food Technology.

Thus, using the MIPS-indicator, it is possible to estimate the eco-efficiency of the use of natural resources in the power sector. The universal character of this parameter makes it multifunctional for strategic planning purposes and enables the comparison of the manufacture and consumption of power resources in different countries. Table 5 illustrates the results of a comparison of the data obtained in St. Petersburg with those obtained in Finland and Germany [Sergienko, 2005; www.mips-online.org]

Table 5. Comparison of MIPS-values for energy recourses

	$MIPS_{RUS}$	$MIPS_{FIN/D}$
Heat energy, kg/kW-h	0.15	0.4
Power energy, kg/kW-h	0.358	0.41

Source: study conducted at St. Petersburg State University of Refrigeration and Food Technology.

6. Conclusions

One achievement of sustainable development in the region is ensuring a safe and healthy life for present and future generations. An increase in eco- and energy efficiency in the economy should serve as one of the strategic goals of regional development in St. Petersburg and the Leningradskaya Oblast. An energy balancesheet is vital for analysis of eco-efficiency and of trends in the sustainable development of the city.

Strategic planning should be based on transparent and measurable indicators such as DMI, TMR, DMC and MIPS. Usage of such indicators create a basis for a wider analysis of the environmental impact of the city economy on regional, urban and rural development and the same parameters in different countries.

Usage of such indicators can help to eliminate the negative impact of uncertainties connected with output environmental indicators when planning. In addition, it has a positive effect, as it helps to avoid negative impact on the environment and human health.

Usage of the DMI, TMR and MIPS indicators will call for proactive action within strategic planning in the city of St. Petersburg and the Leningradskaya Oblast. It also helps to ensure wide participation, partnership and shared responsibility from all interested parties.

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