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Sustainable Development and Energy Indicators

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The need to develop new indicators for social and economic progress has been long recognized by the world community. In the given article, it is proved the necessity of energy factor measuring in systems of sustainable development indicators. The author regards energy intensity as a key indicator of sustainable development for Russia. Indicator of energy intensity should be the principal national development index for Russia and should play a role in programmes, strategies, concepts, and projects at federal and regional levels.

Keywords: sustainable development, indicators of sustainable development, energy factor measuring, Adjusted Net Savings, energy intensity.

In search of a new development dimension

The global economic crisis has shown once again that traditional development indicators need to be adjusted. Humanity has been held hostage to economic and financial indicators, which often ignore or distort real economic, social and environmental processes. The crisis happened because distorting financial and economic mirrors had been used in decision-making processes.

The most widely used economic measure in the world – GDP – is a prime example of an indicator, which is inappropriate in a sustainable development perspective. Most countries (Russia included) still measure their development achievements by the yardstick of GDP. But growth of GDP thanks to the resource (energy) sector can prove unsustainable for countries with social problems and large natural resource endowment, of which Russia is a typical example. Many leading Russian experts are agreed that most of GDP growth up to the present has been caused by a favorable external environment, and primarily by high oil prices. So high GDP indicators have been mainly based on depletion of natural resources and transformation of the Russian economy into an energy and raw materials appendage of the global economy. The depth of the current crisis in Russia can be mainly explained by the fact that Russia has fallen into the 'energy and raw materials' trap. The GDP indicator fails to reflect major social problems, and it can grow even in a context of growth of income inequality, disease, mortality, etc.

Before the crisis, progress and growth in the world and in Russia were usually identified with GDP growth and maximization of profit, financial flows and other financial indicators, while the quality of growth and its costs (social and environmental) were mostly ignored.

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However, the need to develop new indicators for social and economic progress has been long recognized by the world community. New conceptual and methodological approaches to measurement of social and economic progress appeared as early as the end of 1980s and beginning of 1990s, offering alternatives to the traditional indicators GDP, GNP and per capita income. The role of the UN in this process deserves to be stressed. The conceptual approaches and specific indicators, which were developed under the UN aegis, have made a huge contribution to the theory and practice of human development, offering new priorities for humanity. Two new theories – human development and sustainable development – have made the biggest contribution. Both were forged within UN structures and were supported by all members of the Organization, which has given them official international status. It is very important that these conceptual approaches have been reinforced by specific indicators, of which the best known are the Human Development Index (HDI), Millennium Development Goals, and System of Sustained Development Indicators. Creation of the Human Development Index (HDI) in the 1980s was specifically intended as a counterweight to GDP.

Other international organizations (the World Bank, Organization for Economic Cooperation and Development, European Community, World Wildlife Fund, etc.) have also participated in this work. The World Bank created the Index of Adjusted Net Savings, which reflects the social, energy and environmental aspects of development in a more adequate way. Most developed countries now have their own system of sustained development indicators.

If the Russian Government wants to achieve its long-term social and economic development targets, starting from the crisis period, it needs to prioritize human development, movement away from the energy and raw material economy, and structural transformation in order to create an innovative and socially-oriented development model. This has nothing to do with chasing quantitative ratings, whether they are value indicators (GDP, etc) or physical volumes (output of oil, gas, metals, etc). The accent in the new economy must be on qualitative and not quantitative development.

Types of energy indicators

The energy factor is widely reflected in sustainable development indicators, because sustainable development depends on due attention to economic, social and environmental aspects, all of which have much to do with energy[1]. Two approaches are most widely used in both theory and in practice. The first is to construct an integrated (aggregate) indicator (index), which enables judgment of the level of sustainability of social and economic development. The aggregation usually relies on three groups of indicators: economic, social and environmental. The second approach involves construction of a system of indicators, each of which reflects different aspects of sustained development. The aspects chosen are most usually economic, environmental, social and institutional. This is the approach used by UN sustainability indicators.

The energy factor has priority in all the approaches, as seen most clearly in ubiquitous use of the energy intensity index. It is important to grasp that division of the indicators into economic, environmental, and social is relative. Some indicators can reflect several aspects of sustainability, and this is apparent from the example of energy intensity, which is included in different groups of indicators by the UN, World Bank, Organization for Economic Cooperation and Development (OECD) and various countries: economic (reflecting efficiency of energy resource utilization in the economy); environmental (the level of pollution and greenhouse gas emissions);

and social (since the volume and content of emissions has impact on human health).

Energy intensity is basic to global systems of sustainability indicators and to the systems used by specific countries. It is a key indicator for Russia, helping to gauge sustainability of its energy sector and of the country as a whole. As such, it should be included in programmes, strategies, concepts and projects at both federal and regional levels.

The following energy intensity indicators are most commonly used at the macroeconomic level:

- energy intensity of GDP as regards consumption of energy resources;
- energy intensity of GDP as regards production of energy resources (the proportion between primary energy production and GDP);
- energy efficiency (often identified as the reverse indicator of energy intensity);
- specific indicators of energy intensity of GDP (electric intensity, heat intensity, oil intensity, coal intensity, gas intensity of GDP) etc.

In Russia's case it is important to distinguish between two energy intensity indicators: intensity in terms of domestic consumption of energy as a share of GDP, and intensity in terms of the share of energy production in GDP. The consumption indicator is the classic and most widely used indicator. But it clearly fails to take account of many economic, environmental and social consequences of the extraction and production of energy for export, since (all else being equal) it only reflects that part of negative impacts on the environment and public health, which are conditioned by the process of energy consumption, so that it can only be a partial indicator of dependence of the Russian economy on energy exports and pressure of the energy sector on the environment and society. The main reason why energy intensity by consumption is the dominant indicator worldwide is that most countries do not have sufficient energy resources of their own, so that energy intensity in terms of production is of little concern to them.

Energy production as a share of total production is a much more important measure for Russia because volumes of natural resources brought into economic use, both to meet domestic needs and for export, give an indirect indication of levels of pressure on the environment and public health.

The degree to which the two indicators differ can be clearly seen in Table 1. Levels of Russian energy intensity in terms of consumption are three times higher than in developed countries, but differences in energy intensity in terms of production are much more drastic: the difference between Russia and the European Community is 11 times, and the divergence with Japan is more than 30 times. The two indicators could move in different directions: energy intensity in terms of consumption may decline, reflecting positive structural shifts in the economy, but in case of dramatic growth of energy resource extraction energy intensity in terms of production is likely to grow, reinforcing Russia's orientation to energy and resource exports. The long-run target should be to dramatically reduce energy intensity in terms of production by increasing energy efficiency and GDP while holding back rates of growth of primary energy extraction, i.e. by greater use of intensive growth factors. This course will not affect the country's export potential because, relatively simply energy-saving measures could reduce domestic energy consumption by half, i.e. Russia has enormous 'hidden export' potential.

Energy intensity in terms of production helps to raise energy awareness among decision makers and society, and should be recommended as a priority indicator in long-term national programmes and development strategies.

Table 1. GDP energy intensity in terms of energy consumption and production in different countries (1990, 2000, 2008*)

Country	1990		2000		2008		2008/1990 (%)		2008/2000 (%)	
	1	2	1	2	1	2	1	2	1	2
Great Britain	0,156	0,174	0,130	0,178	0,102	0,096	65	55	79	54
Germany	0,171	0,108	0,131	0,064	0,113	0,059	66	55	86	92
France	0,154	0,089	0,147	0,086	0,132	0,078	86	88	90	91
USA	0,246	0,234	0,209	0,172	0,175	0,145	71	62	84	84
Canada	0,331	0,418	0,301	0,427	0,275	0,395	83	95	91	93
Japan	0,134	0,026	0,141	0,033	0,126	0,025	94	96	89	76
Norway	0,287	1,057	0,234	1,397	0,194	1,121	68	106	83	80
Russia	**0,460**	**0,840**	**0,496**	**0,943**	**0,324**	**0,767**	**70**	**91**	**65**	**81**
China	0,549	0,451	0,288	0,206	0,274	0,179	50	40	95	87
India	0,176	0,206	0,169	0,152	0,138	0,112	78	54	82	74
Brazil	0,115	0,107	0,133	0,119	0,125	0,138	109	129	94	116
Ukraine	0,643	0,297	0,741	0,385	0,423	0,246	66	83	57	64

Sources: World Bank (World Development Indicators Online Database), BP Statistical Review of World Energy June 2009; МЭА (IEA World Energy Statistics and Balances – Energy Balances of Non-OECD Countries – Economic Indicators Vol. 2009 release 01)

* 2007 for the energy efficiency in terms of production

1 – energy consumption intensity (m. t. of oil equivalent / thousand USD in 2005 by PPP),

2 – energy production intensity (m. t. of oil equivalent / thousand USD in 2005 by PPP),

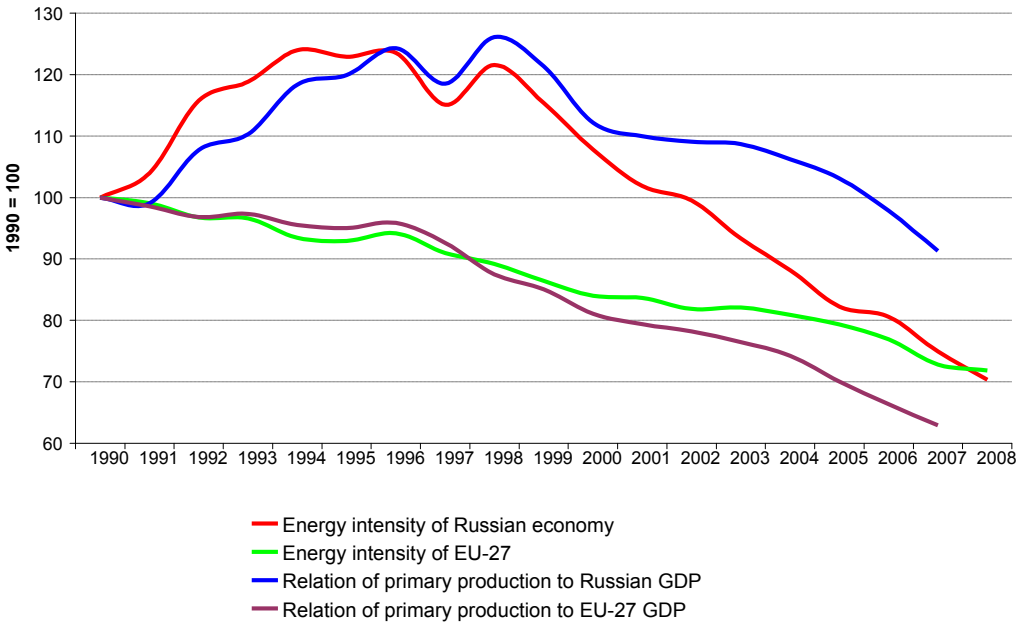
Both indicators of energy intensity in Russia have shown strong positive trends in the last decade, particularly in the early 2000s, when consumption intensity declined by 35 % and production intensity by 19 % (Table 1). These are among the best results in the world. But must faster decline of consumption intensity compared with production energy reflects major growth of Russia's energy export dependence (Fig. 1). The relationship between the two indexes was the reverse in EU countries. It should also be realized that Russia has already used its potential for structural improvement of energy intensity, but the gap between Russian energy intensity and that of developed countries remains huge in absolute terms.

Energy intensity of separate parts of the economy is also important: specific sectors, industry, transport, housing utilities, and efficiency of fuel use in electricity generation all deserve to be distinguished. The last indicator is defined as fuel expenditure in electricity production at various types of power station, and is particularly important, since it reflects developments in the biggest fuel consuming industry.

Reduction of all types of energy intensity will be a vital link in the chain, which will pull the Russian economy towards sustainable growth.

Measuring the energy factor in systems of indicators

Multi-functionality of energy intensity as an indicator of sustainable development is evident in the Millennium Development Goals (MDGs), issued by the UN in 2000. The MDGs are well-designed and relatively simple to use, setting out goals, tasks for achieving them, and relevant indicators. The mission of Goal 6 in this system is to ensure environmental sustainability both globally and in specific countries. Adapted for



Source: World Bank (World Development Indicators Online Database), British Petroleum (BP Statistical Review of World Energy June 2009), International Energy Agency (IEA World Energy Statistics and Balances – Energy Balances of Non-OECD Countries – Economic Indicators Vol 2009 release 01)

Fig. 1. Trends in energy intensity by consumption and production (primary energy production to GDP ratio), for Russia and EU-27 (1990 = 100 %)

Russia, Goal 6 proposes three tasks and eight indicators, focusing on the need to solve two major problems for environmental sustainability:

- to reduce human impact on the environment and depletion of natural resources;
- to improve the environmental conditions for human development, reducing environmental threats to human safety, health and quality of life;

The importance of solving the second problem, connected with human development and improvement of the ecological conditions for human life and health, should be emphasized. This problem is often omitted when issues of sustainable development focus on environmental protection and utilization of natural resources.

In the MDG system energy intensity is referred to Goal 7, dealing with environmental sustainability and, specifically, to Task 1, which is to include principles of sustainable development in national strategies and programmes, and prevent wastage of natural resources. In this context, energy intensity acts as an environmental-economic indicator.

Other key indicators of sustainable development are also closely connected with trends in energy intensity. Emissions of carbon dioxide, volumes of which depend mainly on the energy industry are at the center of attention in issues of global climate change and ratification by Russia of the Kyoto Protocol. At present more than 72 % of GHG emissions in Russia are due to burning of fossil fuels[2].

The index of numbers of people living in severely polluted cities has great importance for Russia and also depends on the energy industry. The energy sector and its products make a decisive contribution to air pollution, accounting for about half of all pollution from stationary

Table 2. Energy indicators

Indicators	Russia	East Europe and Central Asia	Countries with high income level
GDP per unit of energy use (2005 PPP $/kg oil equivalent)	2,6	3,3	6,0
Energy use per capita (kg oil equivalent)	4517	2826	5498
Energy from biomass products and waste (% of total)	1,1	2,2	3,2
Electric power consumption per capita (kWh)	5785	3633	9760
Electricity generated using fossil fuel (% of total)	65,8	66,1	62,5
Electricity generated by hydropower (% of total)	18,2	17,5	11,5

Source: World development indicators 2008. World Bank, Washington DC, 2008

sources plus emissions from combustion of car fuel. Addressing this problem has high priority for Russia, particularly in big cities with high pollution levels (there are 135 such cities with total population of about 60 million)[3].

The energy factor is well reflected in the system of indicators developed by the World Bank, which are published annually in the Bank's 'Indicators of Global Development'[4] And include six main energy indexes (Table 2.) The macro ratio to GDP used by the World Bank is not energy intensity, but the index of energy efficiency, which shows the opposite relationship. The system also has three structural indicators, connected with biomass, fuel combustion, and hydro-electricity. Russia produces almost 30 % less GDP per unit of consumed energy than East European or Central Asian countries and 2.3 times less compared with countries that have higher income levels. The share of energy produced from biomass and waste is 2-3 times less in Russia than in the latter countries. Per capita electric power consumption is much higher in Russia than in East European and Central Asian countries (by more than a third), but much lower than the same index for rich countries (by 1.7 times). The share of electricity produced from fossil fuels is approximately the same: about two thirds of total production.

Constructive approaches to development of energy indicators have been proposed by the UN Economic Commission for Europe (ECE UN), including a special study for the transition economies of Eastern Europe, the Caucasus and Central Asia[5]. The approach is based on differentiation of indicators, using a system of 'driving force – pressure – state – impact – reaction'. ECE UN suggested four basic energy indicators: 1) final energy consumption (overall and by final consumers); 2) total energy consumption (overall and by major fuel types); 3) energy intensity; and 4) energy consumption using renewable sources. The first and second indicators relate to driving forces, and the third and the fourth to reactions.

Rates of GHG emissions are associated with energy indicators. For example, the World Bank considers CO_2 emissions per GDP unit and per capita, and growth of these indicators since 1990.

The energy factor in integral indicators

The energy factor is reflected in many integral indicators: its components are taken into account both directly and indirectly when statistical data are aggregated into single indexes. In particular, energy resources are reflected well in the Adjusted Net Savings Index, and the energy factor is indirectly reflected in the Human Development Index via prosperity (income) levels

and life expectancy (influence of the energy sector on health.

The Index of Adjusted Net Savings (sometimes referred to as genuine (domestic) savings), which was developed and is widely used by the World Bank[6], is probably the best-suited to reflect energy aspects, and also has the advantages of a good statistical database and potential to be calculated at country and regional levels. Estimates of adjusted net savings take more account of human potential, and energy and environmental factors than traditional macroeconomic indexes. The importance of measuring these savings when implementing a sustainable development policy is clear: consistently negative indicators reflect formation of an unsustainable development path, which will lead to decline of prosperity.

The Adjusted Net Savings Index takes particular account of the energy factor by adjusting the traditional gross savings index to reflect depletion of energy resources (Table 3), and by applying indicators of CO_2 and particular emissions to record impact of the energy industry on human health and environmental pollution.

The main merit of the Adjusted Net Savings Index is that it offers a single method of calculation for the whole world and for specific countries, using official national statistics, updated annually and published in 'World Development Indicators' (the main statistical digest of the World Bank) or in other World Bank statistical materials. This Index is already used by several countries as an official macroeconomic indicator.

Calculations published by the World Bank and based on adjusted net savings (genuine savings) for all the countries show a dramatic difference between traditional economic indicators and those adjusted for environmental factors. In Russia economic growth (in the traditional understanding) has been accompanied by depletion of natural capital and environmental degradation, and adjustment to reflect these factors turns the traditional economic indicators negative. Russia's Index of Adjusted Net Savings has been negative in recent years, despite growth of GDP. It is important to take this fact into account during the crisis and in the search for ways of overcoming it. For example, 2006 was a highly successful year for the Russian economy judged in traditional economic terms: GDP growth amounted to 7.4 %. But the Adjusted Net Savings Index was negative (-13.8 %), mainly due to depletion of natural resources (Table 3)

Comparison of adjusted net savings in Russia and some other countries of the world is also telling. The Index level in developed countries is 9.3 % (Table 3). Adjusted net savings for various countries (developed, developing and with transition economies) are presented in Table 4, and are positive in all cases except for Russia. Negative value of adjusted net savings in Russia cannot be explained only by dramatic depletion of natural capital (primarily energy resources), since international experience shows that countries with large and depleting natural capital can compensate the depletion by increase of savings, education spending, etc. Norway, Canada, the USA and Great Britain have positive Adjusted Net Savings Indexes (Table 4), and the Fig. for Norway is as high as 9.2 %.

The Adjusted Net Savings Index has several defects, but its importance is in giving an aggregate estimate of sustainable development and showing the need to compensate depletion of natural capital through increase of investments in human and physical capital.

The Index shows the need for dramatic increase of energy efficiency in Russia, which would raise the country's Index score by raising productivity and putting limits on extensive, low-margin extraction of energy resources. It is also advisable for a country to have a special fund or funds ('fund of future generations') such as exist in Norway, the USA some oil-producing

Table 3. Adjusted Net Savings Index

National accounting aggregates	Amount(in % of GDP)	
	Countries with high income level	Russia
Gross saving (% of GNI)	19.9	30.7
Consumption of fixed capital (% of GNI)	13.0	7.0
Education expenditure (% of GNI)	4.7	3.5
Energy depletion (% of GNI)	1.5	37.5
Mineral depletion (% of GNI)	0.2	1.9
Net forest depletion (% of GNI)	0.0	0
CO_2 damage (% of GNI)	0.3	1.4
Particular emission damage (% of GNI)	0.3	0.3
Adjusted net savings (% of GNI)	9.3	-13.8

Source: World development indicators 2008. World Bank, Washington DC, 2008

Table 4. Adjusted Net Savings in specific countries

Country	Adjusted Net Savings	Country	Adjusted Net Savings
Japan	15,8	EU	12,0
Germany	12,1	Russia	- 13,8
France	11,4	Czech Republic	14,7
Great Britain	6,9	Poland	7,8
Canada	5,4	Ukraine	4,1
USA	4,1	China	36,1
Norway	9,2	India	20,6

Source: World Development Indicators 2008. World Bank, Washington DC, 2008

countries, which accumulate fixed contributions from extraction of finite fuel and energy resources to secure future economic growth. Russia set up such a fund – the Stabilization Fund – in 2007. It was subsequently decided, as part of the transition to a three-year budget cycle, to divide the Stabilization Fund into the Reserve Fund and the National Wealth Fund. The Reserve Fund is meant to play a stabilizing role for the Russian budget when oil prices decline, and the National Wealth Fund was earmarked as a fund of future generations. Unfortunately, most of the money accumulated has been quickly spent on stabilization of the social and economic situation in the country since onset of the crisis.

Calculations based on the adjusted net savings approach have been carried out in a few Russian regions, including coal mining Kemerovo Region[7]. Both the energy factor and the human factor had major impact when calculating the Index for this Region, which suffers from environmentally determined public health problems. Illness due to water and air pollution cause loss of up to 12 % of GRP. Depletion of resources by coal mining also reduces adjusted net savings in Kemerovo to a large extent. As a result, the Adjusted Net Savings Index for Kemerovo Region was around – 10 % in 2001–2005, despite significant growth of GRP.

Popular integral indicators that take account of the energy factor include: Environmentally

Adjusted Net Domestic Product, developed by the UN for national accounts; the 'Ecological Footprint' used by the WWF; and the Environmental Sustainability Index, constructed by specialists from Yale and Columbia Universities.

Conclusions and recommendations

The global economic crisis has shown the need for changes to traditional development indicators. Macro-economic indicators often ignore or distort real economic, social and environmental processes. The two most common approaches in theory and in practice of sustainability measurement are creation of an integral (aggregate) indicator (index) and development of a system of indicators, each reflecting a separate aspect of sustainability.

The energy factor is widely represented among sustainable development indexes, that are used by international organizations and by national governments, and which include: indexes attached to Goal 7 of the UN Millennium Development Goals, World Bank energy indicators, adjusted net savings, and the ecological footprint. Energy intensity has a key place in all these, offering measures, which are economic (efficiency of energy resource use in the economy), environmental (the relation of energy to levels of pollution and GHG emission); and social (the scale and content of energy sector emissions have impact on public health).

Energy intensity is a key indicator for Russia, characterizing development sustainability of the country in general and of its energy segment in particular. Energy intensity has a claim to be the principal national development index for Russia and should play a role in programmes, strategies, concepts, and projects at federal and regional levels.

The Adjusted Net Savings Index is particularly constructive, with a good statistical database and calculability at both national and regional levels. Compared with traditional macro-economic indicators, adjusted net savings achieve wider recognition of the factors of human potential, energy and the environment. Such adjustment radically changes assessments of development sustainability for Russia. By taking account of energy resource depletion, the Index shows negative results, despite GDP growth in the first decade of the 21st century, demonstrating the urgency of compensating depletion of natural capital through growth of investments in human and physical capital, radical growth of energy efficiency, and accumulation of natural resource revenues in 'funds of future generations'.

The country and its regions now have experience of using different indicators and there is much potential for their adaptation to take more account of energy factors. Main energy indicators need to be included in official statistical publications at federal and regional levels, so that they can be more widely used in decision-making processes. This refers particularly to energy intensity and its specific varieties, GHG emissions by regions, and numbers of people living in polluted areas.

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Устойчивое развитие и энергетические индикаторы

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Необходимость в разработке новых индикаторов социально-экономического развития уже долгое время признается мировым сообществом. В представленной статье доказывается важность измерения энергетических факторов при разработке систем индикаторов устойчивого развития. Автор рассматривает энергоемкость в качестве ключевого индикатора устойчивого развития России. Индикатор энергоемкости должен стать главным индексом национального развития для России и быть включенным в программы, стратегии и концепции федерального и регионального социально-экономического развития.

Ключевые слова: устойчивое развитие, индикаторы устойчивого развития, измерение энергетических факторов, «приведенные чистые сбережения», индикатор энергоемкости.