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Human solidarity in a divided world

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Climate Change. Russia Country Paper

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Climate Change
Russia Country Paper

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Summary

Climate change has potential long-term effects on the living environment, especially in countries with large territories and long coastal line, such as Russia stretching from sun-scorched pre-Caspian deserts to Arctic tundra and spanning 11 time zones (GMT+2 to GMT+12). The impact of climate change, including the adverse accompanying socio-economic consequences of natural hazards, plays a conspicuous role in the spatial and economic development of this country.

International significance of Russia's stance in regard to climate change is duly recognised worldwide. Russia's ratification, with its 17.4 % of the world's greenhouse gas emissions, of the Kyoto Protocol swiftly pushed its entering into force in February 2005. Annex B of this document set a limit to Russia's anthropogenic greenhouse gas emissions (GHG) by the end of the Protocol first commitment period (2008-2012) at the level of country's GHG emissions in 1990.

This paper discusses climate change impact on Russia's economy, health and wellbeing of its people as well as its policies with a view to implementing its international commitments to the Kyoto Protocol and adapting to the new environment. In developing Russia's national climate change policies it is important to forecast expected climate change impacts on the country's different natural zones, economic sectors as well as to assess climate change vulnerability of human and social systems, especially indigenous communities inhabiting permafrost areas, which are now subject to thawing. In conclusion, it is stressed that climate change for Russia is an essential additional stress further aggravating environmental, economic and social issues, although Russia's overall energy demands may markedly dwindle and could benefit national economy. A response to climate change challenges requires designing and adopting special mitigation and adaptation policies, an early warning system for climate change relating natural disasters

and abrupt ecosystem changes. In addition, Russia should play a constructive role in international climate change efforts.

Objectives

Drawing on current research, this ***Country Study*** paper will:

- Describe Russia's profile as GHG emitter and its role in carbon storage, including characterization of major emitting sectors of the economy;
- Summarize the country's policy environment, its institutional role in climate change mitigation (ratification of Kyoto Protocol), existing barriers for energy efficiency and development of renewable energy; analyze linkage between climate change mitigation and energy security;
- Summarize possible and emerging impacts of climate change on ecosystems, economy (or even broader – potential impacts on human development and prospects for achieving stated national development goals and priorities), and human health in Russia, emphasizing their multidirectional character, with the focus on: (i) impacts on sub-Arctic and Arctic environment and livelihoods of indigenous people; and (ii) threats to carbon sinks – boreal forest, bogs, permafrost; (iii) impacts on energy production and exports infrastructure (consequences for energy security and economic growth);
- Outline national efforts to-date to mitigate climate change (including GEF projects), Russia's potential role in carbon finance and Kyoto mechanisms and existing constraints, promising policies, measures and sectors vis-à-vis climate change mitigation potential linked to national development priorities[1];
- Offer a review of local and national adaptation efforts.

Recommendations for a climate change adaptation policy framework and priority measures are made in the conclusion of the paper.

[1] Russia's role in implementation of the Kyoto Protocol is further elaborated in a separate paper entitled "Russia and Kyoto Protocol: global and national human development perspective"

List of Acronyms

AAU - assigned allowance units

C - carbon

CH_4 - methane

CO_2 - carbon dioxide

ET - emission trading

GDP - gross domestic product

GEF - Global Environment Fund

GHG - greenhouse gas(es)

GIS - Green Investment Scheme

HFC - hydrochlorofluorocarbons

IEA - International Energy Agency

IER - Institute of Energy Research under the Russian Academy of Science,

JI - Joint Implementation

$MtCO_2e$ - megatons of CO_2 equivalent

N_20 - nitrogen oxide

PFC - emissions from aluminum production

SF6 - the industry's preferred gas for electrical insulation, current interruption, and arc quenching in the transmission and distribution of electricity.

UN FCCC - UN Framework Convention on Climate Change

UNDP - United Nations Development Programme

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Introduction

Climate change has potential long-term effects on the living environment, especially in countries with large territories and long coastal line, such as Russia stretching from the sun-scorched pre-Caspian deserts to Arctic tundra and spanning 11 time zones (GMT+2 to GMT+12). The impact of climate change, including the adverse socio-economic consequences of natural hazards, plays a critical role in the spatial and economic development of the country. Adequate responses to these impacts on regional development include mid- to long term strategies supported by decision makers and other stakeholders, including regional and local planners.

In October 2004, Russian Parliament *(Duma)* adopted a bill on the ratification of the Kyoto Protocol to the UN Framework Convention on Climate Change (UN FCCC) and Russia's President signed it into law in November 2004. Russia's accedance, with its 17.4 % of the world's human made greenhouse gas emissions, to the Kyoto Protocol pushed its swift entering into force in February 2005. The Kyoto Protocol contributes to transition of Russia to sustainable development through its efforts to reduce man-made GHG emissions as well as other pollutants, raise energy efficiency of the economy, and adapt to climate change.

Annex B of the Protocol set limits to Russia's anthropogenic greenhouse gas emissions (GHG) by the end of the Protocol first commitment period (2008-2012) at the level of country's GHG emissions in 1990 while the Marrakech agreements of 2001 establish carbon sink targets of 33 Mt per year for Russia. Russian GHG emissions decreased by 32 % (without LULUCF – land use, land use change and forestry effects) to 2,024.2 Mt CO_2 equivalent over the 2000-2004 period, while the growth resumed recently and country's emission were growing by 4.1% annually over the 2000-2004 period (GHG Data 2006).

In developing Russia's national climate change policies it is important to forecast expected climate change impacts on the country's human development and well-being. This paper discusses present and projected GHG emissions by Russia, climate change impact on Russia's economy, and its climate change mitigation and adaptation policies.

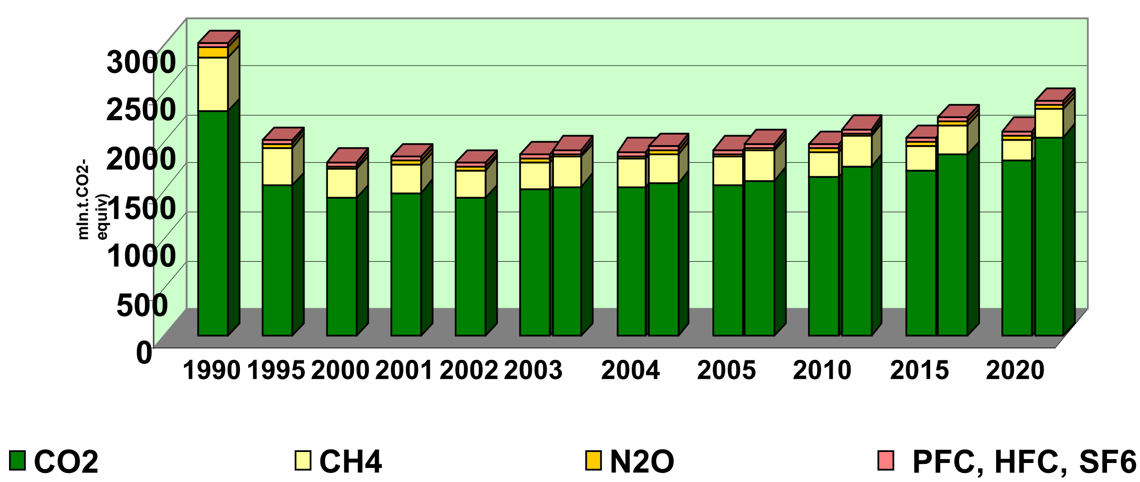
Recommendations for the future actions and policies are elaborated in conclusion.

1. Russia's contribution to global greenhouse gas emissions and sinks

Climate change threatens the basic elements of life for people around the world - access to water, food production, health, and use of land and the environment. It is recognized to be largely caused by the rise of greenhouse gas (GHG) concentrations in the Earth's atmosphere in which the human development component plays a significant role.

Calculations of Russia's GHG emissions are usually made on the basis of forecasts of CO_2 emissions caused by fossil fuel combustion since their share in overall national emissions is more than 80% (see Fig. 1). The human dimension of climate change emissions is revealed more vividly if they are calculated not only in physical levels but with the reference to the gross national product (GDP) of a country often referred to as carbon intensity.

Figure 1 Dynamics and share of different GHGs in total amount of Russian GHG emissions up to 2020

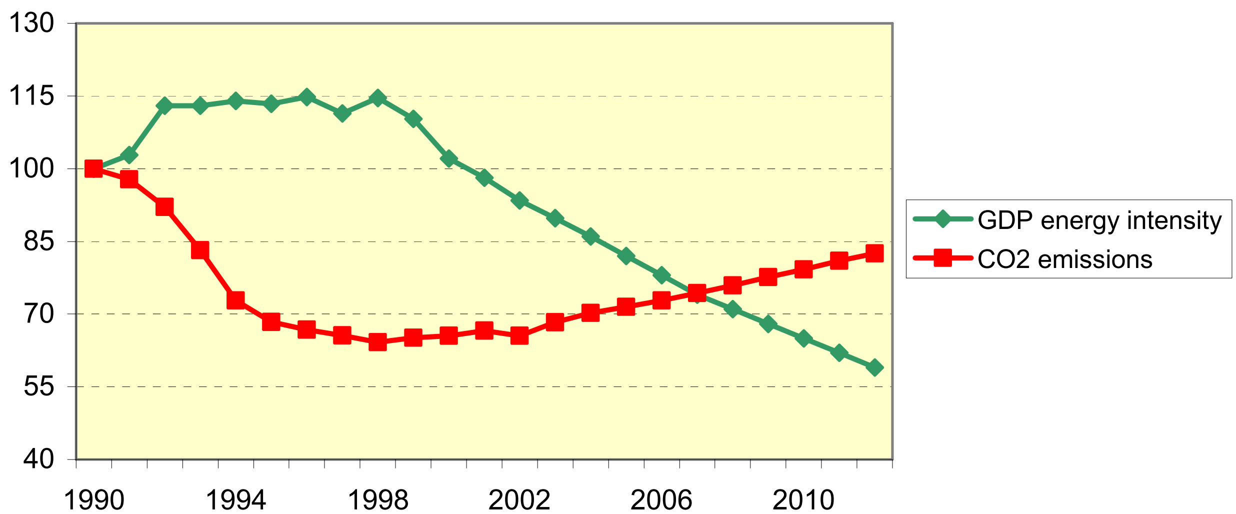


Source: RF Ministry of economic development and trade

Russia's economic growth is expected to be accompanied by greater CO_2 and, accordingly, GHG emissions in general. However policies to diminish the GDP energy and carbon intensity of the national economy that started in 1999 and led to structural change in industry should cushion the indicated growth of GHG releases.

The year 2003 saw such structural shifts that lowered carbon intensity of Russia's GDP to 82.1% in comparison to 1990. According to the Institute of Energy Research (IER) under the Russian Academy of Science, the declared doubling of GDP in 2003 – 2012 would maintain the annual rate of lowering carbon intensity of GDP at 4-5 % on average and the indicator is forecasted to be at 53% of the 1990 level by 2012. This scenario envisages the growth of CO_2 emissions at a rate of 2-2.5 % a year to achieve the level of CO_2 emissions equal to 82.5% of the 1990 level in 2012. (Fig.2)

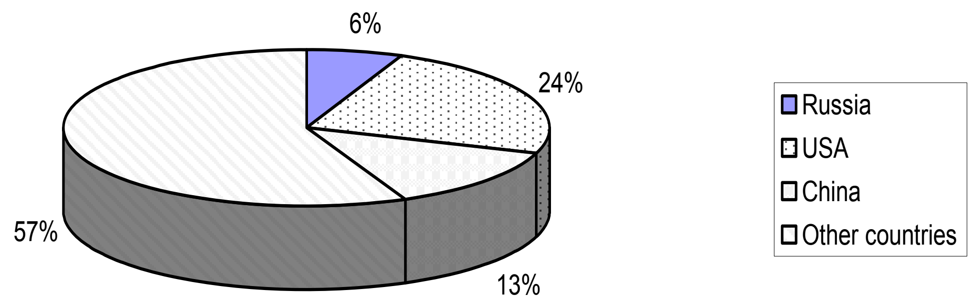
Figure 2 GDP energy intensity and CO2 emissions changes in per cent to 1990 (the GDP doubling scenario)



Source: IER

According to various estimates, Russia's share in the global GHG emissions at present and in the coming decade would amount to 6 to 7%. The World Energy Agency's estimate, based on data supplied by Russia, is 6.4 % (Fig.3)

Figure 3 Share of Russia's CO2 emissions in the world



Source: Key World Energy Statistics, 2003

Despite an increase in GHG emissions due to Russia's economic growth, it is expected that the country would keep a third place in the world in regard to GHG emissions in a foreseeable future, following the USA and China, and Russia's share in the world GHG emissions would not significantly change taking into account global economic growth rates. Annual global growth rates of CO_2 emissions are expected to be around 1.8% from now to 2030 which is comparable to those of Russia, with two thirds of that growth attributable to the developing countries (IEA, WEO 2002).

In addition to industrial facilities, leaks from the fossil fuel extraction and distribution account for around 4 % of global greenhouse gas emissions. Within this, gas flaring - the burning of waste gas from oil fields, refineries and industrial plants - accounts for 0.4 % of global emissions. Increasingly, there has been a move to capture these gases, driven by economic as much as environmental reasons. This is by no means universal, and in some countries the potential for emissions savings in this area remains significant.

The post-Soviet collapse of Russia's energy-intensive economy cut carbon emissions and left it with a surplus of transferable emission quotas under the Kyoto protocol. Decades of under-investment, however, mean that current 6-7 per cent GDP growth, spurred by higher energy and commodity prices, is both raising emissions and putting pressure on the infrastructure. Sustaining growth requires very large energy and related infrastructure investment.

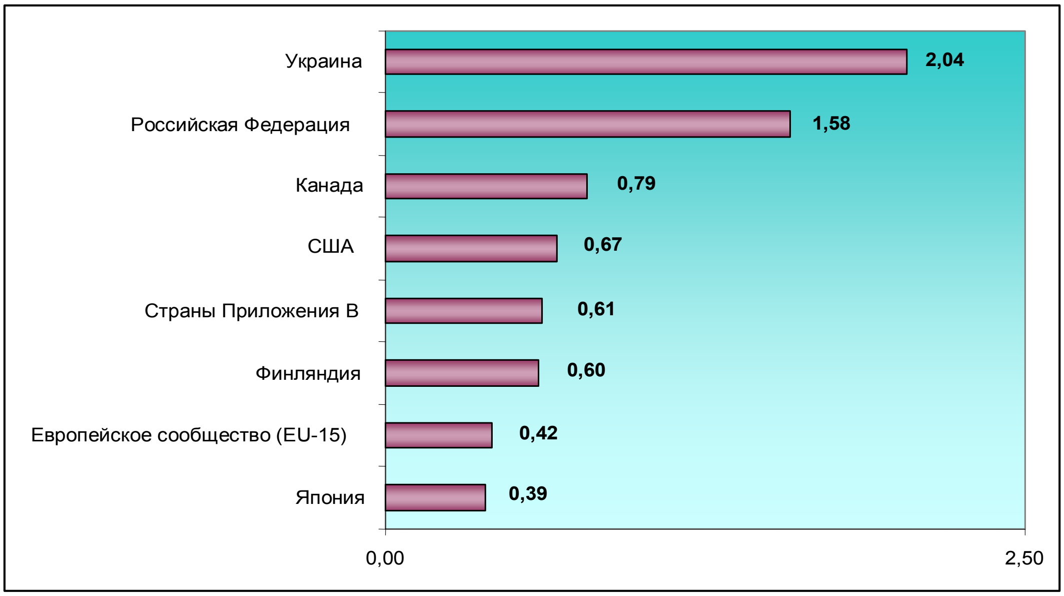
A recent IEA report on Russian gas flaring management, however, indicates that without accompanying price and structural reforms, especially in the gas sector, investment alone is unlikely to deliver the full potential for efficiency gains or reductions in GHGs. Gas flaring represents a clear illustration of the potential efficiency gains from new technology linked to more rational pricing policies and other structural reforms. These would also yield significant climate change mitigation benefits.

In 2004 Gazprom lost nearly 70 billion cubic metres (bcm) (or about 10% of its totals production volume of nearly 700bcm of natural gas) which flowed through its network because of leaks and high wastage from inefficient compressors. Gas related emissions amounted to nearly 300 MtCO2e of GHG, including 43 MtCO2e from the 15bcm of gas flared off, mainly by oil companies unable to gain access to Gazprom's pipes. On this basis, Russia accounted for around 10% of natural gas flared off globally every year. Furthermore, an independent study conducted by the IEA and the US National Oceanic and Atmospheric administration, calibrated from satellite images of flares in the main west Siberian oilfields, indicated however that up to 60bcm of gas may be lost through flaring - over a third of the estimated global total (Stern 2006).

If the current trends continue Russia's GHG emissions would totally amount to11.5-12.0 billion tons of CO_2 equivalent in the 2008-2012 period. **Thus, considering overall levels of GHG emissions, Russia is expected to easily remain within the established balance of GHG emissions and even could have a surplus**.

With regard to carbon intensity (level of GHG emissions per unit of GDP in US$ adjusted to PPP), Russia's carbon intensity exceeds the leading European countries by 3.8 times, average for transition economies by 2.6, the USA – by 2.4 and Canada by 2 times. Out of all developed and transition economies that joined the Kyoto Protocol, only Ukraine produced more GHG emissions per GDP than Russia (Fig. 4). This situation means that Russian goods and companies may become less competitive in world markets, but on the other hand possess a lot of cost-effective opportunities for GHG reduction.

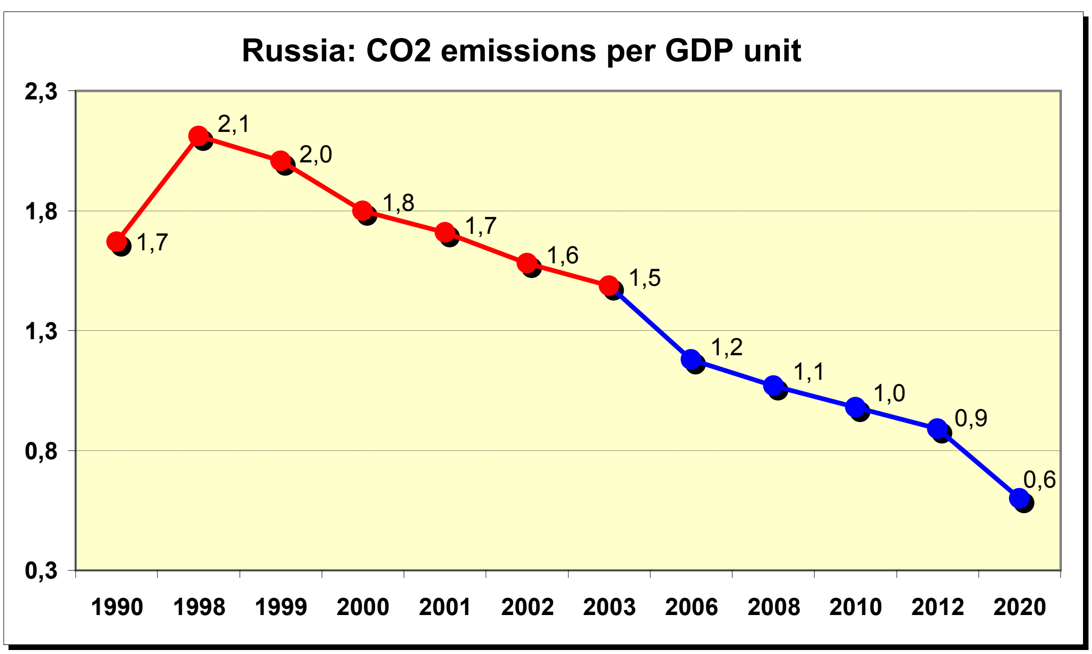
Figure 4 GHG emissions per GDP, in kg of CO2-equiv./US \$. (data for the Russian Federation refer to 1999, for other countries - to 2002



Source: M.A.Yulkin. Russia and Kyoto Protocol: how to meet challenges and not miss a chance? Moscow, 2005

As illustrated in Figure 5, CO_2 emissions per GDP have been falling since 1998.

Figure 5 CO2 emissions in kg per GDP unit in US\$ in Russia (real up to 2003, forecast after 2003



Source: Institute of Energy Research, Russian Academy of Sciences, 2004

A GHG inventory had been carried out in Russia by early 2007 and a system of assessments of GHG emissions and sinks was made under the RF Hydrometereology Service. In addition, Russia has gained experience of estimating GHG emissions at the regional and company levels in Arkhangelsk province according to the IPCC requirements and standards.

The balance of GHG emissions is achieved as natural and human-made GHG emissions are absorbed (or sequestrated) by natural terrestrial (mainly forests) and aquatic (mainly marine) ecosystems. The earth's ecosystems are the largest sink for CO2 emissions. A study made in Russia under a government research programme on global change of natural environment and climate in 1990-2005 attempted to assess the size of this sequestration which is estimated at about 4.4 billion tons a year (G. Zavarzin, 1999).

2. Climate change and its impact on the natural environment of the Russian Federation

A distinctive feature of present climate change is its unprecedented rate of its advancement as well as spatial and temporal heterogeneity. The distribution of impacts is likely to follow a strong north-south gradient - with countries such as Russia experiencing some net benefits from moderate levels of warming, while low latitude regions will be more vulnerable. At higher temperatures, the risks become severe for all regions of the developed world. The rise in temperature up to 2 or 3°C could bring benefits through higher agricultural yields, lower winter human mortality because more people are saved from cold-related death in the winter than succumb to heat-related death in the summer, lower heating requirements, and a potential boost to tourism. But these regions will also experience the most rapid rates of warming with serious consequences for biodiversity and local livelihoods.

Among negative consequences of climate warming on **ecosystems** in Russia that represent a threat to social and economic development are: non-uniform distribution of precipitation in cold and warm seasons, a growth of annual river throughput (e.g., by 10 to 15% to the Arctic ocean), an increase in size of underground waters, shifts of climatic zone borders, spread of desertification, more frequent river floods, etc. Climate change is likely to lead to significant **damage to buildings and roads** in settlements in parts of Russia currently built on permafrost. Increased drought would triple poor harvests in Russia straining inter-regional relations. (Tyndall Centre 2007).

The most fertile black earth regions of Southern Russia could suffer from increased drought. Warmer winters should reduce domestic heating costs and free energy for export. But higher summer temperatures will raise air conditioning energy use. The impact of climate change on Russia's main eco-systems is summarized below:

- ***Arctic:*** see Text Box 1
- ***Tundra****:* tundra will gradually shrink with noticeable thawing effects in summer. *As a result, millions of migratory birds would loose up to 50 % of nesting places which can lead to significant reduction in their numbers and breakdown of food chains*;
- ***Forested tundra****:* For the last 10 years, thawing permafrost has increased deformations of buildings in Norilsk by 42%, in Yakutsk - by 61 %, in Anderma - by 90 %. *In a few decades up to 50% of houses and factory buildings and constructions can be destroyed in part or completely, e.g.. in Vorkuta up to 80 %*. All forested tundra will be fully covered by forests that will move towards the north, pushing tundra to the Arctic coast.
- ***Northern taiga:*** if climate warming in northern taiga continue as fast on average as nowadays in Arctic regions (i.e. by 0.4-0.5 deg C a decade), ecosystems will not have time to adapt to the changes. Outbursts of forest diseases are expected. *Timber withdrawal from taiga will be made difficult by winter roads and new road infrastructure will need to be constructed. Houses built on permafrost will have to be pulled down*.
- ***Middle taiga****:* In the middle taiga zone, conditions for agricultural activity will probably, improve, with less frosty periods in spring it will be possible to raise more thermophilic vegetables and crops. On the other hand, *regular recurrence of early and warm spring will lead to encephalitis ticks spreading*. It is already now its expansion and penetration is observed into those areas of the central Russia where before the tick was not recorded.
- ***Southern taiga****:* European part of Russia may experience a softer "Baltic" kind of

climate: winter with temperatures above zero Centigrade and moderately hot summer. Heating costs for buildings will decrease, but the contribution of climate change will be much less energy saving measures. With global warming by 4 deg C, the temperature in the taiga zone will likely increase by 5-7 deg. C. *Then, possibly in the middle of the next century, about half of the forests will be degraded and the forest structure will change to deciduous trees.*

- ***Broad-leave forests and forested steppe****:* Already now the spring has began to come five days earlier and southern vegetation has moved towards the north. In future, the steppe zone will move northwards, and forest-steppes will start replacing forests. With global temperature rising by 3-4 deg C, *up to half of nature reserves will not be able to carry out its nature protection functions as they do now*.
- ***Steppes****:* With more frequent droughts, grain crop output will decrease. This effect will be less pronounced in the Russian steppe zone than in other countries. *By 2080, the loss of crop productivity can amount to about 5 %. In the mountain areas of Altai and Southern Siberia, the significant part of steppes will be replaced by forests by 2100/ and the Alpine vegetation will be on the brink of extinction.*
- ***Semi-deserts****:* Despite a likely small increase in annual precipitation, the frequency of heavy droughts will rise which will lead to semi-deserts to expand and encroach on steppes. *The lower Volga will feature unfavourable epidemiological conditions with outbursts of cholera and pest born diseases*. The increase in cases of disease and fever is probable.
- ***Deserts*****:** The deserts as any extreme territories will experience the general tendency of global climate change, such as greater climate instability and negative effects. There will be more rains in near Caspian deserts but more drought stricken years are expected with strong winds and dusty storms. (Kokorin *et al* 2007)

Text Box 1 Russian Arctic: Climate Change Impact and Responses

The Russian Arctic covers about 6.2 million km2. The shelf of the Russian North-East Atlantic/Arctic and Pacific seas covers circa 5.3 million km2, equivalent to 17% of the entire World Ocean shelf. A vast swathe of northern Russia is permafrost, apart from a short, hot summer when the surface melts to form marshy lakes. Rising temperatures will push the permafrost boundary further north and deepen the surface melt. This may have big implications for future oil, gas and other investment projects as well as for indigenous peoples whose bodies and life-styles have for centuries been adapted to cold weather. De-stabilised, shifting permafrost conditions release greenhouse gases and could lead to flooding that will not only affect coastal and river bank human settlements, but will also require more expensive underpinning of buildings, refineries and other infrastructure such as the Baikal Amur railway and the planned East Siberia-Pacific export oil pipeline. This may increase the costs of pipeline construction because extensive trenching may be needed to combat the effects of coastal instability and erosion, especially that caused by permafrost melting.

Transport infrustracture

The impact of climate warming on transportation and communications in Arctic regions is likely to be considerable. Melting of the Arctic ice cap will prolong both the northern sea and Siberian river navigation seasons, make the Arctic marine route along the Russian coast line navigable most of the year which will lead to human migration to the Arctic coast with its subsequent development. Ships will be able to use these routes without strengthened hulls. There will be new opportunities for shipping associated with movement of resources (oil, gas, minerals, and timber), freight, and people (tourists). However, at higher global temperatures there is a possibility that Arctic warming could be reversed if the Gulf Stream weakens before it reaches the Barents Sea.

However, improved navigational aids will be needed, and harbour facilities probably will have to be developed. The increase in shipping raises questions of maritime law that will need to be resolved quickly. These issues include accident and collision insurance, which authority is responsible for removal of oil or toxic material in the event of a spill, and which authority or agency pays expenses incurred in an environmental cleanup. These questions are important because sovereignty over Arctic waters is disputed among polar nations, and increased ship access could raise many destabilising international issues. Increased storm surges are predicted that will affect transport schedules.

The number of scheduled flights in polar regions is likely to increase. This will require an adequate infrastructure over designated routes, including establishment of suitable runways, roads, buildings, and weather stations. These installations will require improved engineering designs to cope with permafrost instability. Because paved and snowploughed roads and airfield runways tend to absorb heat, the mean annual surface temperature may rise by 1-6°C, and this warming may further exacerbate climate-driven permafrost instability.

Food security

Polar warming probably will increase biological production but may lead to different fish, animals, and plant species composition on land and in the sea. On land, there will be a tendency for northward shifts in tundra and boreal forest along with associated animals, resulting in significant impacts on species such as bear and deer. However, the Arctic Ocean places a geographical limit on northward movement. Marine ecosystems will also move poleward. Animals dependent on ice may be at a disadvantage in polar areas.

Climate change and economic development associated with oil extraction, mining, and fish farming will result in changes in human diet and nutritional health and exposure to air-, water-, and food-borne contaminants. Indigenous people who rely on marine systems for food resources are particularly at risk because Arctic marine food chains are long.

Agriculture and vast Siberian pine forests rich in berries, mushrooms, and game should benefit from a longer, warmer growing season and the carbon fertilisation effect.

Population

The coastal human settlements have a population of approximately 1.8 million people (0.9 million if only coastal Yakutia's settlements (*uluses)* are included), which amounts to only 1.3% (0.68%) of Russia's total population. The average population density in this region is very low (0.32 persons per km^2), with the highest value in the Yamalo-Nenets autonomous district (0.68 humans per km^2). Because of the low ecological capacity of the tundra territories, the greatest population densities in settlements do not exceed 2 persons per 100 km^2 as compared to 17-18 persons per 100 km^2 in the forest-steppe zone. One can also observe an inflow of people to Arctic regions as intensive oil and gas mining activity has been deployed. With the development of the mineral extracting industry in nearly the entire Russian Arctic region, a growth of production output, transport activity and service sectors in traditional spheres of living of indigenous peoples are expected.

Indigenous people of the Arctic

In the past, when population densities of indigenous people were lower and there were weak links with economic and social structures in the south, northern peoples showed significant flexibility in coping with climate variability (Sabo 1991). Now, commercial, local, and conservation interests have reduced their options, and they may be less well equipped to deal with the combined impacts of climate change and globalisation (Peterson & Johnson 1995). Increasingly, the overall Arctic area economy is tied to distant markets. For example, in Russia 92% of exported oil is extracted from wells north of the Arctic Circle (Nuttall 1998). The value of native, local harvests of renewable resources has been estimated to be only 33-57% of the total economy of some northern communities (IPCC 2001). However, harvesting of renewable resources also must be considered in terms of maintaining cultural activities. Harvesting contributes to community cohesion and self-esteem, and knowledge of wildlife and the environment strengthens social relationships (Warren et al. 1995).

Predicted climate change is likely to have impacts on marine and terrestrial animal populations; changes in population size, structure, and migration routes also are probable (Beamish 1995, Gunn 1995, Ono 1995). Careful management of these resources will be required within a properly consultative framework, similar to recent agreements that are wide-ranging and endeavour to underpin the culture and economy of indigenous peoples (Nuttall 1998).

Oil Gas

Climate change means there are new opportunities for oil exploration and transportation on the market through the Arctic seas (along the Russian coastline - Sevmorput - the Northern Path). Negative impacts could be minimised through prevention - no go zones, risk assessment and effective environmental impact assessment (EIA) - and mitigation tools, applying the best available practice, all stage project monitoring, etc.

Climate change adaptation in the Lena Basin

The Lena is one of the world's 10 largest rivers. Due to climate change, floods have become very severe in the Lena and its tributaries. In the last five years, there have been two floods of extreme severity, surpassing all floods of this river since records began. Sixty-two towns and villages were badly affected by flooding in 2001 and the town of Lensk was completely inundated. The direct economic damage amounted to US$ 250 million. In order to raise awareness of climate change considerations in water management and policy decision-making, the Arctic Monitoring and Assessment Programme of the Arctic Council was set up within the framework of the Global Dialogue of Water and Climate, the project "Dialogue on Climate Change Adaptation Strategy in Water Management and Flood Preparedness at the Lena Basin". The Lena Basin Dialogue aims to establish a background to sustainable and climate change sound water management in the Lena basin. (source: August 2002 - THE ARCTIC ENVIRONMENT TIMES http://www.environmenttimes.net/_documents/arctic_09.pdf)

3. Climate change impact on Russia's economic development

Global warming will likely to bring more positive rather than negative effects for Russia's food security and agriculture since there will be less frost vulnerable and risk-prone agricultural lands, however large investments will be needed for changing the output structure of this sector and its protection from plant diseases. Housing, building and engineering construction, pipelines and their maintenance, as well as mining industries will require less heating and frost resisting equipment and therefore will become less energy-consuming, feature lower production costs and may become more competitive in world markets. However expected extreme natural disasters and risks should be factored into economic development more thoroughly than now. Human settlements on northern river banks with their infrastructure will be more vulnerable to more extreme seasonal river flooding and their location should be duly planned. Human migration to formerly inaccessible regions with harsh climatic conditions should be taken into account in planning economic development.

Russia could see a **30% increase in influx of tourists** with only 1°C of warming. In higher latitudes of Russia, rising temperatures may initially increase production of some crops - but only if the carbon fertilisation effect is strong (still a key area of uncertainty). In these regions, any benefits are likely to be short-lived, as conditions begin to exceed the tolerance threshold for crops at higher temperatures. Russia is likely to experience increases in water availability (runoffs), for example a 10 - 20 % increase for a 2°C temperature rise and slightly greater increases for 4°C, according to several climate models. (A.Kokorin *et als.*)

For Russia as a whole, climate change impact can be characterized as the warming accompanied by raising dryness. A major negative impact of climate change for **agriculture** in Russia is possible repetition of droughts and increase in dryness in some regions. Droughts that have been recorded, including Yakutia, affect crops covering an area of **more than in 2 million hectares**. Abnormal fluctuations of temperature (soft winter and frequent thaws) have led, in particular, to losses of crops on a territory of more than in 770 thousand ha in 2001. Positive effects of climate change include better conditions for survival of agricultural crops and vegetables, larger areas of arable lands, longer vegetation times. **The damage due to forestry fires during hot droughty seasons exceeds 150 million dollars annually.**

Text Box 2 Climate Change Impact on Human Health in Russia

As a whole, health and quality of a life of Russians in connection with global warming should improve. Comfort of a climate and the area of a comfortable zone of residing will increase. The labour potential as a whole would increase, positive changes in working conditions and labour capacity in northern areas will be especially appreciable. Global warming would improve conditions for providing better food security for people, which, in turn, could lead to substantial improvement of health and increase in life expectancy of Russians. However, sharp increases in air temperature may bring negative consequences for people. Among them are:

- Climate change related intestinal infectious diseases. The level of the intestinal infectious diseases among population directly depends on the quality of the water (both in the water supply systems and natural ponds) and on the food staff quality. In Russia, almost 1 million people per year suffer from intestinal infectious diseases. Early spring in Yakutia in 2002 caused floods and enteric fever outbreak.
- Climate change related "insect infections". As a result of the climate change, there is a chance of more precipitation and wetland areas would expand. The situation is endangered by the fact that wetlands are full of mosquitoes and their maggots. Their number is constantly increasing and 70% of natural lakes are infected by the malaria maggots which raise risks of this disease. In Russia, malaria cases have increased six fold during the past decade. Some of the cases are "three day malaria of the local origin". Up to 250 thousand people in Russia suffer from latent forms of the disease and increase in the temperature can transmit the mosquito natural habitat to the north, which can be proved by the cases when Western Nile fever was found in other Russian regions, including Moscow. Denge fever spreads fast as well. According to the Chinese scientist Din Ihoi, global climate change can lead to the fast spread of the malaria and Denge fever, which can affect half of the population.

- Climate change related "tick infections". Hot weather is favourable for ticks that cause lots of diseases they transmit. In Russia, every year tick encephalitis affect from 6 to 10 thousand people in Russia. In recent years, North-Western and middle-Volga areas were plagued by the spread of encephalitis tick natural habitat. It had not been recorded in the European part of Russia before. The most "affected" areas are those that suffer from the anomalous heat. During the 2002 summer heat only in Khabarovsk 1300 people were bitten by the ticks. Ticks can cause other diseases as well, like tick riketsiosis, boreliosis (Lime disease), KU fever. In 2001, the number of KU fever cases increased by 3 times in comparison to the previous year. (B. Revich. Climate change in Russia – possible consequences for the health. 2006. http://en.civilg8.ru/2239.php)
- According to medical studies climate change will affect **human health** and can already be considered along such important risk factors in Russia, as smoking, alcohol abuse, etc. Fast rates of climate warming will greatly affect especially indigenous peoples in the Arctic areas of Russia since it will be very difficult for then to change their lifestyles to new climatic conditions within one or two generations. (A, Krutko *et als*, 2005)

It should be pointed out that climate change impact has already been felt in Russian regions in which traditional industries have been driven out. For example, forestry in Arkhangelsk province suffers due to delayed winters since logging was practiced during the snowy season when it is easier to transport the timber from forests. Less snow cover of the North Dvina mollify its water stocks and its decreased spring flooding complicates timber rafting. Forests are teamed with insects that destroy millions of cubic meters of standing timber. The forest structure is changing with a shift to deciduous trees. Logging has markedly decreased over the last two years which affected sawmilling and pulp and paper production. Hot summer in Arkhangelsk with temperatures as high as 30 to35 deg C has introduced air conditioners in apartments and offices. Morbidity (mainly cardiovascular diseases) in the province has increased.

There are similar problems in Irkutsk province with the spread of silkworm attacking the tree foliage. The number and intensity of forest fires have grown. Permafrost thawing has led to the formation of lakes with water dissolved methane dangerous to humans. Southern Russia experiences a shortage of fresh water due to more frequent droughts.

The better use of new bioclimatic conditions could be part of a new agricultural development strategy in the non-black soil zone by promoting the output of spring grain crops, potatoes, flux, rapes, fodder, milk and dairy produce and by expansion in forest-steppe and steppe regions of late kinds of maize and drought resistant crops. More winter grain crops are recommended to grow in the European and Asian parts of Russia. Fire control services would be needed in those areas. Rent charges and better land valuation tools should be developed to improve the quality of forests affected by climate change.

4. Climate change mitigation policies in Russia

According to Russia's Ministry of Economic Development (MEDT), Russia will not only meet its obligations under the Kyoto Protocol but will have significant GHG emission quota surplus equal to over 3 billion tons of CO_2-equivalent, which may partly be transferred to the next Kyoto compliance period. Russia has basically completed the first stage of development of regulations and legislation needed for implementation of the Kyoto Protocol. By its decision, Russian Government has established a national system of assessment of GHG emission and sequestration. An AAU registry has been established. Relevant normative acts and regulations have been made by the Russian Federal Service for Hydrometeorology and Environmental monitoring and Ministry of Natural Resources of the Russian Federation. Russian Government has also recently approved (May 2007) the National rules and regulations for Joint Implementation scheme of the Kyoto Protocol, which is based on several federal laws, such as a Law on Ratification of the Kyoto Protocol, a Federal Law on Investment Activity in the RF, the RF Tax Code and Civil Code. On 28 May 2007, Russia's prime-minister signed an act of the Russian government that sets up a legal base for signing and implementing joint implementation (JI) projects to reduce GHG emissions. 54 such projects offered by Russia are ready for implementation that would result in GHG emission cuts amounting to 79.2 mln tons.

Table 1 Project proposals submitted to Ministry of Economic Development of Trade (MEDT) of the Russian Federation

Economic sectors	Expected emission reductions, thousand tons of CO_2-equivalent.	Total carbon project investments, million USD
Communal sector	8 105	57.6
Natural gas industry	9994	72.,7
Electric energy	9 120	75.4
Coal industry	600	0.5
Chemical	3 500	4. 7
Forestry and wood	2386	28.2
Total	33 705	239.1

It is argued that classical JI cannot be considered as an efficient vehicle due to bureaucracy, high transactions costs, and potential corruption. However, JI could be still used to start the process and also to participate in the EU ETS pre-Kyoto phase of GHG management (2005-2008). Regardless of the system chosen, necessary components are: transparent rules for resource allocation to business units; efficient monitoring and accounting; and official or third-party verification of GHG reductions, complemented by the enforcement of contracts. Also, the centralization of AAU trade would prevent corruption and arbitrage known in the early 90s, when export quotas issued by state agencies regulated exports (D.Dudek *et al.* 2006).

In remains unclear whether Russia will continue to participate in the Kyoto process after 2012. Asked about Russia's future participation, a MEDT senior official remarked « This will be a matter to be discussed at international negotiations. It depends whether we shall manage to protect our interests or not. Then we shall think if it is worthwhile to join the next period' (Ibid). Some experts also express concern that Russia may exceed its GHG emission limit and incur considerable financial losses under the Kyoto Protocol, if carbon intensity of Russian economy is not radically reduced (A.Kokorbn. Ibid., p.58).

In this regard, Green Investment Scheme (GIS) may play an important role in the Russian Federation. Under this scheme, the proceeds from emission trading (ET) should be reinvested in environmental projects. This scheme may be regarded as a mix of the JI and ET mechanisms. Such a scheme may allow establishing more direct and less bureaucratized relations with foreign investors.

Different countries may apply different approaches to organization of the green investment scheme in Russia that is interested in thorough discussions with potential investors on a broad spectrum of issues. Such a dialogue is actively carried out with the World Bank which considers cooperation proposals of Russian official organizations and business structures. Several Russian companies, in cooperation with their foreign partners, have developed and submitted such proposals. A total economic effect from sales of "Kyoto" emission reductions under these projects shall be about 240 million USD (Table 1). A total amount of required investments is over US$ 1 billion. Most of these projects were initiated in communal, natural gas and electric energy sectors. (V. Gavrilov, 2006)

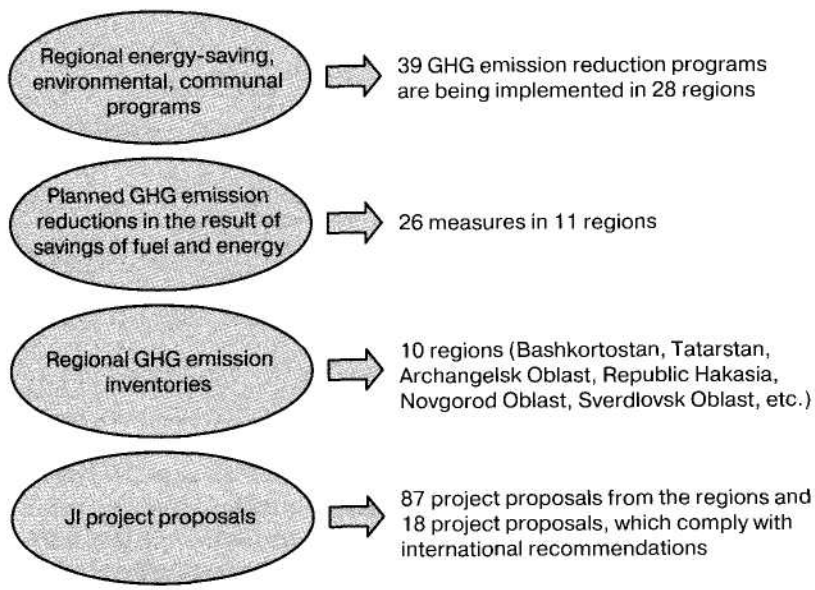
5. National and regional climate change mitigation policies

Global climate change is characterized by significant regional heterogeneity. However, there have been made few serious studies of these processes. There are data on GHG emissions from several Russian regions (for example, Arkhangelsk province). But what is a share of GHG emissions of Russian regions is not really known, especially taking into account inter-regional transfers of fuels and energy. All these features are important for selection of relevant climate change mitigation and adaptation policies that should take into account specific regional peculiarities.

For example, a key role for Northern Russia will likely to play thermal energy savings in manufacturing, housing and communal services, utilization of bio-fuels (primarily, wood waste products) as well as sustainable forestry. Southern Russia should gain from the use of a solar energy and promotion of sustainable land use. Geothermal power will be important for Kamchatka as well as the disposal of methane for coal mining regions.

Moreover, it is pointed out that GHG emission quotas are a national climatic resource that should be used for mitigation of climate changes and its consequences at the regional level. Russian regions actively participate in implementation of the Kyoto Protocol. Figure 6 shows programs and specific measures on the regional level. Members of the Russian Federation have expressed their interest in investment projects in the area of energy efficiency and energy saving. This interest is largely explained by their expectations of the benefits of Kyoto flexibility mechanisms.

Figure 6 Interest in the Kyoto Protocol by Russian regions



Source: V.Gavrilov, O.Pluzhnikov. The Kyoto Protocol: One year after its entry into force: preliminary results and prospects of implementation of Kyoto mechanisms. In book: Global Climate Treaties: Risks and Benefits for Russia and other countries. Moscow, 2006.

It is only in the electric power industry of Russia that 70 concrete small and medium size projects have been designed with possible investments using carbon credits amounting to Euros 580-850 million. These are also projects aimed at the use of «Kyoto investments»: in the oil-and-gas sector (recycling of flaring gas and reduction of losses during methane transportation), the coal sector (methane disposal in mines), in the energy consumption sector (for industries, housing and communal services), etc.

However until now, there is been not a single JI project has been registered, mainly due to a lack of the proper national legislation concerning Kyoto Protocol implementation. It is expected that with recent approval (May 27, 2007) by the Russian Government of the National rules and regulations on JI, this problem will quickly be overcome.

With regard to adaptation to climate change, it may be suggested that successful climate change adaptation policies should deal with restoration of disturbed ecosystems, in particular forests that have been decimated because of large tree cutting operations and fires. Forest restoration can be effected on depleted forest lands and by means of making forest bets on agricultural lands. These measures, on the one hand, will enhance GHG sequestration and, on the other hand, will create steady microclimate. Although on limited scope, but such actions can be carried out by applying market mechanisms of by the Kyoto Protocol. It is expected that the second phase of the Kyoto Protocol (after 2012), the scope of bio-sequestration projects will broaden.

These natural carbon absorbers are not well attended to in Russia. After 1990, the situation in the forestry sector has considerably worsened. Forest fires and insect invaders annually destroy millions of cubic meters of timber from the standing forest, including young forests. Illegal tree cutting is growing in scale in Russia and has increase 3.6 times over the last 15 years. (A. Kokorin, 2007)

6. National policies to support adaptation to climate change

The array of potential adaptive responses available to Russia is very large, ranging from purely technological (e.g., coastal and river bank defences), through behavioural (e.g., altered food and recreational choices) to managerial (e.g., altered farm practices), to policy (e.g., planning regulations, awareness raising). Their purpose is to reduce risks, particularly at higher levels of warming and related impacts, and for vulnerable groups. Those risks are related, in particular, to:

- human health (increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated; injuries because of engineering and technological accidents, heat waves, floods, storms, fires and droughts, inadequate water and food availability, zoonoses, the increased frequency of cardio-respiratory diseases due to higher concentrations of ground level ozone related to climate change; the altered spatial distribution of some infectious disease vectors),

- food security (sustainable yield with the use of organic fertilisers, agroecosystem sustainability, adequate crop management, land amelioration improvement),
- societal disruption (indigenous peoples in the Arctic area, migration of vulnerable groups and individuals, poor communities can be especially vulnerable, in particular those concentrated in high-risk areas; they tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies; public preparedness and participation should be promoted, relevant legislation should be adopted relating to climate change policies); .
- economic development (especially in infrastructure projects, coastal, flooded, seismically hazardous areas affected by climate change),
- energy security and energy systems (they should function at higher ambient temperatures),
- housing construction (buildings should be less cold resistant and therefore lighter but sturdier and more robust to withstand storms and hurricanes),
- Arctic permafrost thaw (60% of Russia's territory) consequences (Permafrost thawing will require heavy investments for industrial and infrastructure development, such as roads, electrical transmission lines, etc.;
- inadequate forecasting, monitoring, and prevention of climate related natural and technological hazards and accidents and information dissemination systems, education and training about climate change.

It is argued that sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience. At present, however, few national plans for promoting sustainability in Russia have explicitly included either adapting to climate change impacts, or promoting adaptive capacity. This suggests the value of a portfolio or mix of strategies that includes mitigation, adaptation, technological development (to enhance both adaptation and mitigation) and research (on climate science, impacts, adaptation and mitigation). (Climate Change 2007). Guidelines should be prepared for reducing vulnerability and for a better policy and strategy to face climate change impacts have been provided, taking into consideration the current economic, social, environmental and political scenarios. Climate change related research and development projects should be envisaged.

References

Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report, IPCC WGII Fourth Assessment Report April 2007.

Dudek, D., A.Golub, D. Marcellno (2006). Suggestions for the implementation of the Kyoto Protocol in Russia. In book: Global Climate Treaties: Risks and Benefits for Russia and other countries. Moscow.

GHG Data 2006 (2006). UNFCCC International conference on hydrometeorological security (forecasting and societal adaptation to extreme climatic changes. 26029 Sept. 2006, Moscow http://hms2006.meteoinfo.ru/progr).

Key World Energy Statistics, 2003

Kokorin, A., Kuuraev, S., Minin, A., Stetsenko, A. (2007) Problemy adaptatsii k klimaticheskim izmeneniyam (Climate Change Adaptation Issues), (unpublished paper).

Krutko V.N., Pegov S.A., Smolina, S, Homyakov P.M., *et al*. (2005). Global change impact on Russia's economy and human health. Moscow,.Lenand Publishers

Round Table of Non-Governmental and Public Organizations "A Social Forum on Climate Change" under the World Climate Change Conference (29 September . October 3 2003, Moscow). Proposals by International Working Groups of Independent Experts. Moscow 2003. http://www.ecopolicy.ru/en/SocForEng.pdf

Safonov, G., Drobyshevsky, S, Lugovoy, O., Bondarenko, A., Kim, I (2005) An analysis of development of economy and dynamics {changes} of emissions of GHGin Russia (Analysis of economic development and GHG emission in Russia. The center of environmental and natural resources economics. Higher school of economy. Academy of national economy at the Government of the Russian Federation. Institute of economies in transition. Moscow.

Stern, Nickolas (2006). The Economics of Climate Change. The Stern Review.. Cabinet Office – HM Treasury, UK. <http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm>

The Stern Review on the Economics of Climate Change. Tyndall Centre, 2007 <http: //

www.tyndall.ac.uk/publications/stern_review.pdf>

Yulkin, M.A. (2005). Russia and the Kyoto Protocol: How to address challenges and to not miss its chance? Moscow, 2005)

Zavarzin G.A. (Ed.) (1999) « Carbon cycle on Russia's territory». The selected proceedings on « Global evolution of the biosphere. Human made contribution ». Scientific and technical program "Global change of the natural environment and climate. The Ministry of science and technology. Moscow