



**UNITED
NATIONS**



**Framework Convention
on Climate Change**

Distr.
RESTRICTED

FCCC/IDR.2/RUS
27 September 2000

ENGLISH ONLY

RUSSIAN FEDERATION

Report on the in-depth review of the second national communication
of the Russian Federation

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. The secretariat received the *Second National Communication of the Russian Federation under the Framework Convention on Climate Change*, further referred to as the NC2, on 10 June 1998. An in-depth review of the NC2 was carried out between May 1999 and June 2000, including a visit to Moscow from 28 June to 2 July 1999. The review team consisted of Mr. Javier Hanna (Bolivia), Dr. Natalya Parasyuk (Ukraine), Dr. Raissa Makipaa (Finland), Mr. Randolph Graezer (International Energy Agency), Mr. James Grabert (UNFCCC secretariat) and Dr. Katia Simeonova (UNFCCC secretariat, coordinator).
2. With a territory of 17 million km² stretching over two continents, Europe and Asia, the Russian Federation is the largest country in the world. In 1996, the population was 148 million, with around two thirds living in cities and urban areas, and the rest in rural areas. Forests cover the major part of the country's territory, 45 per cent, followed by reindeer pastures, 19 per cent, agricultural land, 13 per cent and water basins, 4 per cent. The remaining 19 per cent of the territory is classified as "others", which includes 2.2 million km² of tundra and 1.5 million km² of marshlands. The climate varies from maritime in the north-west to continental in Siberia and monsoon in the far east.
3. According to the Constitution of the Russian Federation, the political and administrative structure of the country includes 89 "subjects of the Federation", among them 21 republics, 6 territories ("krai"), 50 regions, 10 autonomous regions ("okrug") and two cities at the federal level: Moscow, the capital of the country, and St. Petersburg. The country is a presidential republic, executive power lying with the Government (Council of Ministers) and legislative power with the parliament, the two-chamber "State Duma". The president appoints the government and has a key role in the legislative process as he, along with the government and the parliament, represents the institution which approves the new legislation, including the ratification of international treaties. If a new policy document or a programme fits into the existing legislation, it is launched by a government decree.
4. Since 1991, the Russian Federation has been carrying out a process of economic, political and social reform unprecedented in scale, with the transition from a centrally planned to a market-driven economy as its cornerstone. The reform also aimed at integrating the Russian economy fully into the global economy. The price of the reform, however, has been very high as the country's gross domestic product (GDP) plunged by around 40 per cent within the period from 1990 to 1997. In 1997, the economy started to recover and for the first time in the recent decade it registered a positive growth. This was followed, however, in 1998 by a severe crisis in the finance and banking sectors, resulting in a GDP drop by 5 per cent for this year and the national currency losing more than two thirds of its value. In 1999, when the review took place, the GDP grew by 3 per cent and growth for 2000 was expected to be at least at the same level. However, a radical improvement in the Russian Federation's economic prospects was yet to be seen. From the structural point of view, the Russian economy bears the legacy of the past Soviet era, when the development of the heavy manufacturing and processing industry was seen as a priority. The share of services has been constantly increasing since 1990 at the expense of industry; in 1998, services accounted for around half of the GDP. Within the industrial sector,

structural reform was geared to improving the competitiveness of industrial production on the domestic and international markets.

5. The energy resources of the Russian Federation represent a substantial part of the proven world resources: 13 per cent for oil, 45 per cent for natural gas, which is considerably more than any other country, 25 per cent for coal and 14 per cent for uranium. The energy sector has played a central role in the country's economy. In the past, it had to support the development priorities of industry. Due to the abundance of its resources, this sector was in the past and continues to be a major source of foreign exchange earnings, providing around half of the foreign trade revenue for the state budget. The overindustrialized structure of the economy, abundant energy resources and very low energy prices have resulted in a high energy intensity of the Russian economy, at least twice as high as Western countries with a similar climate.

6. The total primary energy supply (TPES) plummeted by 35 per cent from 906 million tonnes oil equivalent (Mtoe) in 1990 to 592 Mtoe in 1997, driven by the decrease in economic activity. Over the same period, the share of natural gas in TPES rose steadily from 46 per cent in 1990 to 52 per cent in 1997, thus making natural gas the country's first energy choice. Coal mining and coal use diminished in absolute and relative terms from 18 per cent of TPES in 1990 to 16 per cent in 1997. The consumption of oil and oil products dropped from 29 per cent of TPES in 1990 to 21 per cent in 1997. The share of nuclear energy increased from 3 per cent in 1990 to 5 per cent in 1997 while that of renewables, including hydro and biomass, remained roughly the same at around 4-5 per cent of TPES. This shift in the structure of TPES mirrors well the priority given to natural gas, as an efficient and environment-friendly fuel, the difficulties in promoting the structural reform in the coal sector, which requires the closure of many inefficient mines, and the relative cheapness of nuclear-based electricity generation.

7. The drop in final energy consumption (FEC) was even greater than that of TPES, namely 44 per cent, from 695 Mtoe in 1990 to 389 Mtoe in 1997. This decline was attributed to a drop in consumption of almost two thirds in the transport sector, industry and others sectors, including agriculture and commerce. In contrast, consumption in the residential sector grew by almost 70 per cent in the same period, and its share of FEC went up from 12 per cent in 1990 to 33 per cent in 1997, mainly due to increased consumption of natural gas and gasoline for private cars, counted in this sector.

8. To coordinate the national climate policy and represent the country at international negotiations, an Inter-Agency Commission on Climate Change (ICCC) was set up in 1994, chaired by the Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) with the participation of high level officials of the key ministries and state agencies, as well as academic institutions with activities related to climate change. The composition of the ICCC was last revised in 1997, when it included high level representatives of 20 ministries and state agencies. It also included representatives of key businesses, such as RAO Gazprom¹, the country's largest gas company and, recently, from RAO EES, the Russian

¹ RAO stands for joint stock company in Russian.

electricity utility. The commission has mainly consultative functions, its task being to facilitate achieving consensus among the institutions involved in climate change policy making. Considering project proposals under activities implemented jointly (AIJ) and their coordination also falls within the competence of the ICCC, which is the national focal point on AIJ. So far, climate change policy in Russia has been seen as an area for intervention by the central government only, and the regional governments and municipalities have not been involved.

9. Important milestones in the Russian climate policy were first of all the ratification of the UNFCCC and the adoption of the aim of the Convention that anthropogenic emissions of carbon dioxide (CO₂) and other greenhouse gases (GHG) in 2000 should not exceed their 1990 level.² Another milestone was the preparation in 1995 of the first national communication (NC1) and in 1997 of the NC2. The information presented in both communications and the outcome of the discussions during the team's visit suggest that the Russian Federation expects GHG emissions in 2000 to be at least 25 per cent lower than in 1990, mainly due to the economic recession. Hence, the Russian Federation ranks among the few countries to meet the aim of the UNFCCC.

10. In 1996, the ICCC launched a new federal programme: Prevention of Dangerous Climate Change and its Impacts, further referred to as the Climate Programme, to support climate change activities. This programme, which represents an essential component of the contemporary climate policy of the Russian Federation was adopted by a government decree and contains a portfolio of research and development programmes aimed at monitoring climate and GHG emission concentrations, improving the GHG inventory, and developing mitigation and adaptation strategies. It also appointed an executive body of the programme with the task of coordinating its implementation. In 1996, this body included representatives of Roshydromet (head), the Ministry of Fuel and Energy, further referred to as the Ministry of Energy, Ministry of Science, Ministry of Transport, RAO Gazprom and RAO EES. The funding for the programme was estimated at 239 million roubles (1996 prices), with about one third of the funds coming from the federal budget.³ Due to the 1998 financial crisis, the financing of this programme has been marginal and the participants in the programme expressed serious concern about its future if the present situation continues.

11. The ICCC coordinated the preparation of both the NC1 and the NC2, while the Institute of Global Climate and Ecology (IGCE) was in charge of the analytical work and the drafting of the documents. Information provided by ministries with competencies related to climate change, literature sources and some of the results obtained under the project Support for National Action Plans (SNAP) supported by the United States of America were used as the main information sources in an attempt to present in a single framework different components of the climate policy of the Russian Federation. The team noted that the information included in the NC1 and the NC2 has not been disseminated even to some key institutions and acknowledged that it would be

² The Russian Federation did not use the flexibility clause provided to countries with economies in transition under Article 4.6 of the Convention, to select a base year other than 1990.

³ Before the financial crisis of August 1998 the exchange rate was around R 6 = \$1.

very useful, *inter alia*, to decision makers at all levels of government and also to the general public in order to increase the awareness of climate change challenges and opportunities.

II. INVENTORY OF ANTHROPOGENIC EMISSIONS AND REMOVALS

12. The NC2 contained an inventory of emissions by source and removals by sink for the years 1990-1994 and for some sources for 1995. It included estimates of the three main GHG, CO₂, methane (CH₄) and nitrous oxide (N₂O), and preliminary estimates of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). The inventory also contained estimates of nitrogen oxides (NO_x), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOCs) and partial estimates of sulphur dioxide (SO₂). Subsequent to the review, the Russian Federation submitted revised (and more complete) estimates for 1995, and new estimates for 1996. The team had a number of questions concerning the estimates, their consistency and the inventory documentation in the NC2. However, the additional information provided during the review and the additional estimates communicated following the review, were useful in clarifying some of these questions. The inventory was broadly in adherence with the UNFCCC guidelines, being based on the 1996 Revised Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, further referred to as the IPCC Guidelines, reporting on land-use change and forestry being a major exception in this regard. However, during the visit emission figures for land-use change and forestry following the IPCC Guidelines were provided.

13. Roshydromet has the responsibility for coordinating the assessment and compilation of the GHG inventories, while the calculations were performed by the IGCE, in cooperation with relevant ministries, agencies and institutions. The work was undertaken within the framework of the Climate Programme and built upon prior work done under the United States Country Studies Programme (1994-1996). The funding for work on inventories was unfortunately limited and the approach taken was therefore not very comprehensive. The team was informed that work is envisaged in the area of improving data collection and processing for all recommended IPCC source and sink categories, and conducting research on country-specific emission factors, in support of efforts to establish a national system for inventory calculations on a regular basis. Under the State Committee of the Russian Federation on Environmental Protection (SCRFEP), there are important efforts to develop a system of data collection by regions so as to compile inventories in accordance with the IPCC Guidelines.

14. Overall, the IPCC Guidelines were followed to a greater extent in the NC2 than in the NC1. However, the summary and overview tables were provided for only two years, 1990 and 1994, and sectoral report tables were missing. Not all sectors were included, and only a very limited amount of information on the underlying activity data and the emission factors used was provided. In addition, the team noted that some inventory figures reported in the NC2 differed from table to table. During the team visit, additional information and explanations on these issues were provided. Moreover, the team learned that accurate and relevant data are available in the country that could allow for the further development of inventories for some sectors and sources, such as municipal solid wastes or road transport, upon availability of funding.

15. The inventory data for 1990 and 1994 provided in the NC2 contained estimates for the major source categories (except for disaggregation by fuel combustion categories), though the inventories for 1991-1993 and 1995 did not always contain estimates for all source categories (e.g. solid fuels, oil and natural gas, chemical industry, agriculture, land-use change and forestry). The lack of consistent estimates from all source categories for the period 1990-1995 made it difficult to understand the trend in GHG emissions at a disaggregated level.⁴ However, compared to the NC1, a number of additional emission sources such as aluminium production, nitric acid production, nitrous oxide use in medicine, coal waste burning and waste water treatment were considered in the NC2. This list of sources was not extended further due to the lack of activity data and/or limited funding. While recognizing these limitations, the team indicated that the inventory could be improved by including emission estimates of other sources that could be significant in the Russian Federation.⁵

16. For the energy sector, all the calculations were done on a top-down basis using the IPCC reference approach. Mainly IPCC default factors were used for the energy sector and industrial processes and in some cases (cement, nitric acid and aluminium production) these factors were slightly adjusted using expert judgement. In a limited number of cases, country-specific emission factors were used, e.g. for natural gas production and flaring, hard coal underground mining and handling, and waste-water treatment. In the case of fugitive emissions from the natural gas systems, the emission factors used were the result of studies conducted by RAO Gazprom in cooperation with Ruhrgas (Germany) and the United States Environmental Protection Agency. These studies indicated that leakages and technical losses of natural gas amounted to about 1 per cent of the total gas produced and transported (0.1 per cent from production, 0.2 per cent from pipelines and 0.7 per cent from the compressor stations).

17. Estimates of non-CO₂ emissions were obtained using national aggregated statistical data without consideration of technologies or sources, including stationary fuel combustion, industrial processes, agriculture, forestry and waste. For HFCs and PFCs, in the NC2 the first expert assessments were made of emissions of CF₄, C₂F₆, HFC-23 and HFC-134a, for the years 1990 and 1994. As emissions of SF₆ were considered less significant in terms of quantity and resulting GHG effect, no quantitative assessment was made.

18. For other sectors, such as agriculture, land-use change and forestry and waste, detailed estimates of emissions were provided. However the team expressed some concern as to the

⁴ The 1990 and 1994 GHG emissions from the energy sector were estimated on the basis of detailed fuel balances developed by the State Committee for Statistics. However, the NC2 presented only aggregated estimates and no information as to sectoral breakdown of fuel combustion. For other years (1991-1993, 1995), the GHG emissions from the energy sector were estimated according to aggregated fuel balances. The NC2 did however, provide a separate table indicating the level of CO₂, CH₄ and N₂O emissions from solid, liquid and gaseous fuels for the years 1990-1994, and for 1995 for CH₄ and N₂O.

⁵ These sources include, *inter alia*, lime production, limestone and dolomite use, soda ash production and use, asphalt roofing production, road paving with asphalt, glass production, ammonia production, carbide production, iron and steel production, ferroalloys production, magnesium and other non-ferrous metals production, pulp and paper production, food and drink manufacturing and solvent uses.

quality or lack of some activity data.⁶ For the agricultural sector, the estimation of emissions was based on national statistics and IPCC default emission factors using the methodology from the IPCC Guidelines. For waste, the IPCC Guidelines and IPCC default factors were used, except for the CH₄ emissions from waste-water handling, calculated using national factors.

19. In the NC2, estimates of emissions from international marine and aviation bunkers were provided separately from other energy-related emissions. However, as the data were still not reliable, these estimates were approximated on the basis of limited statistics and the expert opinion of the Ministry of Transport. As a result of this situation, the level of uncertainty of these estimates is rather high. The team remarked that more detailed documentation on these estimations would be useful.

20. Estimates of uncertainty were provided in the NC2, unlike the NC1. These included only qualitative estimates, although during the visit the team was informed of efforts to estimate the uncertainty of CO₂ emission data for the energy sector on a quantitative basis. The results of the estimation of the GHG emission categories were considered to be of average or low quality, due to the fact that the inventory was conducted largely on a top-down basis, mostly default emission factors or expert judgement were used and the quality of the activity data was low.

21. During the visit, the team was able to meet with the representatives of RAO Gazprom and RAO EES, and discuss their work in developing GHG inventories related to their activities (natural gas production and exploration, and electricity generation and heat production). The inventory of RAO EES, for example, was calculated on a bottom-up basis for each of its 370 thermal power stations. RAO EES also provided the team with initial estimates of emissions of SF₆ from the high voltage equipment (0.055 tonnes per year, 1.3 Gg of CO₂ equivalent) and stated that such estimations will be conducted on a regular basis.

22. The team had the opportunity to discuss the inventory for land-use change and forestry with experts from the All-Russia Research and Information Centre for Forest Resources, of the Federal Forest Service. The Centre is responsible for forest resource assessment, including collecting inventory data and compiling the forest inventory every five years since 1968. The forest resource assessment is not based on statistical sampling, but on the actual forest inventory produced on the basis of stand volume data collected by each of the forest wards and remote sensing for a large share (40 per cent) of unexploited forests of Siberia and the far east.⁷ In some areas, the remote sensing methods are supported by field examination (10 million ha per year), but some remote areas have never been evaluated. The accuracy of the collected information on forest resources therefore varies across regions, being more accurate in the European part, where forests are managed and exploited more intensively.

⁶ These include, *inter alia*, direct emissions of N₂O from agricultural soils; N₂O emissions from use of fertilizers; N₂O emissions from human sewage; emissions other than CH₄ from field burning of agricultural residues; and overestimation of CH₄ emissions from disposal of solid wastes, due to the lack of data on waste incineration.

⁷ There are 1,763 forest management units in the Russian Federation. These units are further divided into forest ranges, compartments and wards. There are 68,200 forest wards, with a forester in each ward being responsible for the forest resources.

23. In the NC2, the assessment of forest carbon sinks was performed using a country-specific methodology and a Carbon and Climate in Boreal Forests model developed at the IGCE with highly aggregated data from the available forest inventory, as the host country experts acknowledged that the IPCC Revised Guidelines do not address the specificities of the Russian forest sector. During the visit, host country experts presented the most recent assessment of forest carbon sinks, which was based on the 1993 forest inventory data and the IPCC Guidelines. Since then, the most recent (1998) forest inventory has been completed and the above-mentioned centre has calculated the forest carbon sink on the basis of these data, following the same IPCC guidelines, and the results being included in the recent inventory for 1995 and 1996.

24. Emission estimates for 1990 for CO₂, CH₄ and N₂O were recalculated between the NC1 and the NC2. The difference in estimates was attributed mainly to the use of the 1996 IPCC Guidelines instead of the previous version of them and also to other reasons mentioned below. More specifically, estimates of CO₂ emissions reported in the NC2 were 2,372,000 Gg, i.e. 1 per cent lower than in the NC1, due to the exclusion of international marine and aviation fuel emissions from the national totals and inclusion of emissions from aluminium production. In the NC2, CH₄ emissions were estimated at 26,500 Gg, which is around 2 per cent lower than in the NC1. The difference is due to the use of more accurate activity data and country-specific emission factors. Estimates of N₂O emissions of 225.7 Gg in the NC2 were 72 per cent lower than in the NC1 as emissions were completely revised and recalculated using the 1996 IPCC Guidelines and an error noted during the in-depth review of the NC1 was eliminated.

25. Due to the economic recession there was a significant reduction in energy consumption, and in industrial and agricultural production, which accounted for the decrease in emissions; when considering emissions of CO₂, CH₄, N₂O, HFCs and PFCs, total GHG emissions in terms of CO₂ equivalent fell over the period 1990-1996 from 3,040,062 Gg to 1,962,441 Gg, a 35 per cent decrease. CO₂ emissions declined by 37 per cent, CH₄ by 30 per cent and N₂O by about 42 per cent. Emissions of HFCs and PFCs declined by 39 per cent and 4 per cent respectively. The share of different gases in total emissions remained broadly the same: 77 per cent for CO₂, 19 per cent for CH₄, 2 per cent for N₂O, and 2 per cent for HFCs and PFCs combined.

26. In the NC2, total CO₂ emissions (excluding land-use change and forestry) for 1990 and 1994 were reported as 2,372,303 Gg and 1,643,003 Gg, respectively. Subsequent to the visit, the team received additional data for 1995 and 1996 indicating a continuing decrease, with emissions of 1,590,420 Gg and 1,495,920 Gg for 1995 and 1996 respectively (37 per cent decrease from 1990-1996). The bulk of CO₂ emissions are from fuel combustion, 96-98 per cent, with emissions from industrial processes and fugitive fuel emissions making up the difference.

27. In the NC2, there was no sectoral breakdown of the emissions from fuel combustion. The subsequent inventories for 1995 and 1996 went a step further in separating emissions from

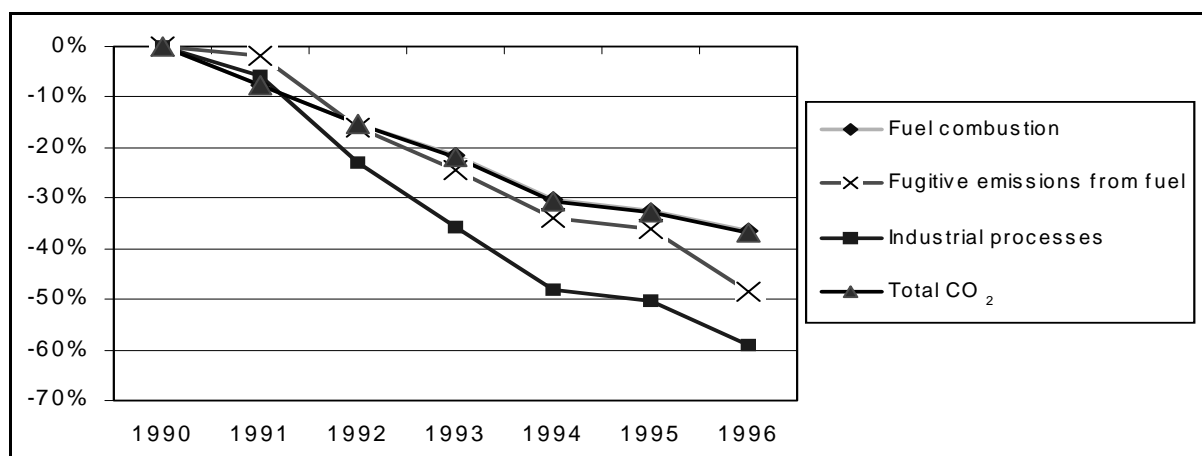
energy transformation activities from the total emissions from energy (516,890 Gg and 517,150 Gg for 1995 and 1996).⁸

Table 1. Carbon dioxide emissions by source, 1990-1996 (Gg)*

	1990	1991	1992	1993	1994	1995	1996
Fuel combustion	2 298 901	2 123 001	1 948 001	1 805 001	1 601 101	1 550 000	1 463 000
<i>including energy industries</i>						516 890	517 150
Fugitive emissions from fuel	27 100	26 600	22 800	20 500	17 900	17 340	14 000
<i>including from solid fuels, and</i>	10 900	10 300	9 600	9 100	8 500	7 810	7 000
<i>from oil and natural gas</i>	16 200	16 300	13 200	11 400	9 400	9 530	7 000
Industrial processes	46 301	43 604	35 703	29 802	24 001	23 080	18 920
Total CO₂	2 372 303	2 193 206	2 006 505	1 855 304	1 643 003	1 590 420	1 495 920
Land-use change and forestry	-392 000				-568 000	-840 000	-840 000
International bunkers -aviation	2 901				2 901	2 900	2 900
International bunkers -marine	9 501				7 101	7 670	8 290

* Data for 1991-1993 were not provided for all sources.

Figure 1. Carbon dioxide emissions, percentage change from 1990, by source



28. As reported in the NC2, in the period 1990-1994 estimates of removals by forest sinks increased by approximately 193,000 Gg of CO₂ to reach 585,000 Gg of CO₂ in 1995. The increase was explained mainly by reducing the planned forest cut. According to the recent assessment of forest carbon sinks based on the IPCC Guidelines, the figure is slightly higher, e.g. 590,000 Gg of CO₂ for 1995. In the most recent inventory submission removals by forest sinks of 840,000 Gg of CO₂ were reported for the years 1995 and 1996.

⁸ According to recent estimates by the International Energy Agency, the largest contributing sector is energy industries (49 per cent), followed by residential, commercial, and agricultural sectors (16 per cent), manufacturing and construction (13 per cent), and transport (9 per cent).

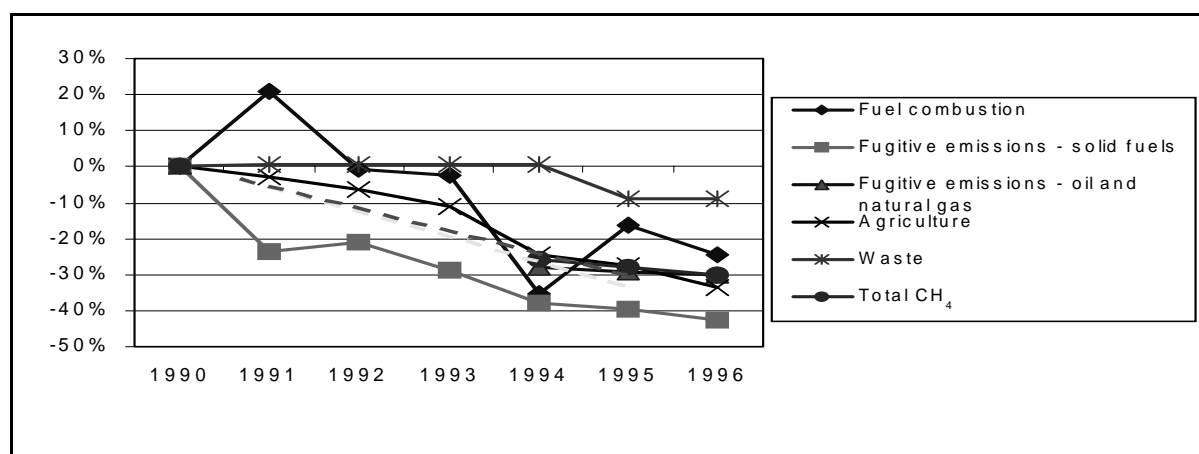
29. Over the period 1990-1996, CH₄ emissions declined 30 per cent to a level of 18,544 Gg in 1996. The decline in emissions was due largely to the reduction in fugitive fuel emissions from solid fuel and oil and natural gas, and in emissions from the agricultural sector driven by a reduction in the number of livestock. The fugitive fuel emissions were the largest source of CH₄ emissions in 1996 accounting for 69 per cent, followed by agriculture (18 per cent), waste (10 per cent), land-use change and forestry (2 per cent), and fuel combustion (1 per cent).

Table 2. Methane emissions by source, 1990-1996 (Gg)*

	1990	1991	1992	1993	1994	1995	1996
Fuel combustion	201	243	200	196	130	168	152
Fugitive emissions from fuel	18 900				13 300	13 050	12 860
<i>including from solid fuels, and</i>	2 900	2 220	2 290	2 070	1 800	1 750	1 660
<i>from oil and natural gas</i>	16 000				11 500	11 300	11 200
Agriculture	5 061	4 921	4 741	4 511	3 831	3 676	3 362
Waste	1 941	1 951	1 951	1 951	1 951	1 770	1 770
Land-use change and forestry	401	401	401	401	401	400	400
Total CH₄	26 504				19 613	19 064	18 544

* Data for 1991-1993 were not provided for all sources.

Figure 2. Methane emissions, percentage change from 1990, by source



Note: Dashed lines indicate that no data were available for 1991-1993.

30. Total emissions of N₂O declined by more than 40 per cent, in line with similar sectoral declines in emissions of CO₂ and CH₄. Emissions from industrial processes declined the most (69 per cent), although their share of total N₂O emissions is quite small, less than 1 per cent. Agriculture, waste and fuel combustion make up the largest share of emissions with 80, 9 and 7 per cent in 1996, respectively. Emissions from agriculture declined by 48 per cent and fuel combustion 44 per cent, while emissions from waste were reported as more or less stable up to

1994. Other emission sources, such as land-use change and forestry and solvent use, accounted for only 2 and 1 per cent of total N₂O emissions.

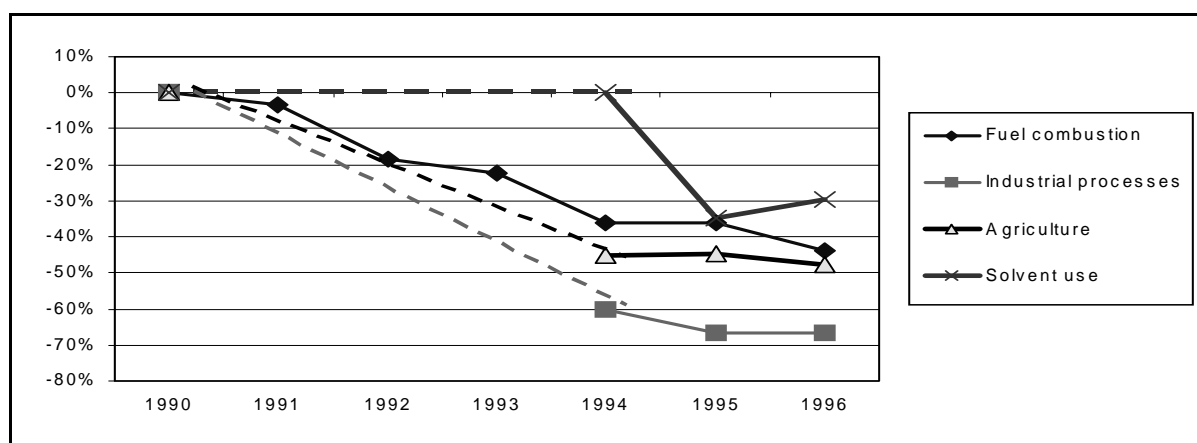
Table 3. Nitrous oxide emissions by source, 1990-1996 (Gg)*

	1990	1991	1992	1993	1994	1995	1996
Fuel combustion	17.4	16.8	14.2	13.5	11.1	11.1	9.8
Industrial processes	3.0				1.2	1.0	1.0
Agriculture	200.0				110.0	111.0	105.0
Solvent use	2.0				2.0	1.3	1.4
Waste**	0.3	0.3	0.3	0.3	0.3	11.5	11.5
Land-use change and forestry	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total N₂O**	225.7				127.6	138.9	131.7

* Data for 1991-1993 were not provided for all sources.

** Time series for waste and, therefore, the total emissions are not consistent due to the new approach adopted for 1995-1996 emission estimates.

Figure 3. Nitrous oxide emissions, percentage change from 1990, by source



Note: Dashed line indicates that no data were available for 1991-1993.

31. The NC2 contained estimates of actual emissions of HFCs and PFCs for 1990 and 1994, with HFC emissions reported as 9,665 Gg of CO₂ equivalent for 1990 and 1994, and PFCs as 31,630 Gg and 28,380 Gg of CO₂ equivalent for 1990 and 1994, respectively. In the most recent inventory submission, HFCs were reported as 7,553 Gg and 5,915 Gg of CO₂ equivalent for 1995 and 1996, and PFCs as 24,304 Gg and 30,262 Gg of CO₂ equivalent for 1995 and 1996, respectively.

III. POLICIES AND MEASURES

32. In its NC2, the Russian Federation presented an overview of the activities related to the development of a comprehensive climate change mitigation strategy. Given the importance of the energy sector in the Russian economy and its high energy intensity, it is well understood that

such a climate strategy should be closely linked to the priorities and strategic objectives of energy sector development and, in particular, to energy efficiency and the shift from coal to natural gas. Indeed, three out of five framework programmes and laws that form the foundation of the climate strategy are related to energy, including the 1995 Energy Strategy of Russia, the 1996 Federal Law on Energy Efficiency and the 1998 Federal Programme for Energy Conservation in Russia for 1998-2000 (FPEC). Another important law presented in the NC2 as an element of the climate strategy is the 1997 Forestry Code. Finally, the 1996 Climate Programme explicitly centred on the implementation of the Russian Federation's commitments under the UNFCCC. During the review team visit, very limited information was provided on the implementation of these programmes and laws with the exception of the Climate Programme and Forestry Code, and this is why the analysis in this report cannot go much beyond the information given in the NC2.

33. The NC2 contained information on policies and measures to mitigate emissions of CO₂ and CH₄. Other GHGs have not been addressed by policies in the Russian Federation. With regard to the presentation of information on policies and measures on CO₂ and CH₄, the team acknowledged that the information was, indeed, more complete than in the NC1. Still, in most of the cases this information was very limited and it continued to follow the NC1 pattern, i.e. presenting the policies and measures as strategic objectives at a very conceptual level, rather than as specific initiatives with clear links to climate change. There was no information on the type of policy instrument used, how the policy interacts with other policies, status of implementation and how the measure is expected to function (as requested by the UNFCCC guidelines). The team had particular difficulty in analysing the effects of policies and measures achieved so far, in order to distinguish between the contribution of the policies and measures and that of overall economic decline to the decreasing emission trend. The only exception in this regard was the presentation of information on the FPEC, being the only measure reported in the NC2 with the level of detail required by the UNFCCC guidelines. Some estimates of the expected effect of measures prepared by the IGCE were provided for both the FPEC and the Energy Strategy, without further explanation of how the estimates of CO₂ saved were obtained.

A. Carbon dioxide

34. The 1995 Energy Strategy laid the foundations of the contemporary energy policy of the Russian Federation. It called for a change of the then existing patterns of energy use to improved energy efficiency in all sectors of the economy, and set the goals of increasing the share of natural gas in the energy supply and reducing the impact of the energy sector on the environment (without explicitly mentioning climate change). In particular, the strategy included estimates of the potential for energy saving of the country within the range of 320-380 Mtoe for 1996-2005 and identified sectors where such saving could be achieved: industry (35 per cent), energy supply and transformation (33 per cent), households and services (15 per cent) transport (9 per cent) and other sectors. It also defined the new regulation and legislation needed to achieve the goals set.

35. By 1999, some of the goals set in the programme had been achieved. Important steps towards liberalization and privatization of the energy sector had been taken and new legislation, including the laws on energy saving and on gas supply had been adopted. In terms of climate

change, the highlight was that the share of natural gas leapfrogged from 38 per cent in 1990 to 47 per cent in 1998. Nonetheless, the energy sector continued to face a severe shortfall of new investment, especially after the financial crisis in 1998, resulting from the almost complete removal of state subsidies and non-payment for energy consumed. The level of investment in the sector dropped by two thirds, which worsened even further the efficiency and safe operation of energy facilities. The energy intensity of the economy did not improve and even increased in 1998 by more than 20 per cent compared to 1990.

36. In response to the changes in economic circumstances and to the need for the strategy to reflect the new priorities, a decision was taken by the Government in 1999 to update the 1995 Energy Strategy. The updated strategy, which at the beginning of 2000 was yet to be adopted, showed continuity with the objectives set in the 1995 Energy Strategy. More specifically, it reiterated the priority given to the policy to promote energy efficiency and the need to continue upgrading the regulatory and legislative framework to support the reforms in the sector. The most important element of this strategy from the climate change stand point is that the objective of mitigating the environmental impact of energy is given the same high priority as the objective of securing the energy supply and of ensuring the technical and economic efficiency of energy sector performance. It also includes consideration of the possible implications of the Kyoto Protocol.

37. In translating the principles and priorities set out in the 1995 Energy Strategy into practical steps, in 1998 the Ministry of Energy in cooperation with major industries developed and launched the FPEC. The FPEC represents a comprehensive package of measures to improve energy efficiency in three sectors: energy supply, households and the commercial sector, and energy-intensive industry. It also envisages measures aimed at the development and use of energy efficiency equipment and the obligatory measurement of energy consumption. Finally, it specifies the necessary upgrading of the regulatory framework for the implementation of the programme.

38. The measures contained in the FPEC are not mandatory, but are more in the nature of voluntary agreements with the already privatized industries. However, in areas such as the gas and electricity industry, they are indirectly mandatory, given that the federal government is the major shareholder in these industries. Total funding of the programme is R 55.3 billion, which was planned to come mainly from commercial profits (47 per cent), bank credits (30 per cent), local budgets (20 per cent) and the federal budget (3 per cent).⁹

39. The FPEC was designed to achieve 250-300 Mtoe energy saving within the 1998-2005 period, which corresponds to an annual reduction of 100-115 Gg CO₂. It was anticipated that the energy intensity of the Russian economy would be reduced by 13.4 per cent in 2005 compared to 1995. During the visit the team was briefed on some results achieved so far under the programme. Mainly due to financial difficulties, the funding of the programme had been very limited and the energy saving achieved was only 4.2 Mtoe in 1998.

⁹ US\$ 9.2 billion at the 1998 exchange rate.

40. The implementation of the FPEC was supported by the energy-saving law adopted in 1996. This is a framework law, which provides the tools to be used in implementing the 1995 Energy Strategy at federal and regional level. These tools include: establishment of an energy regulatory body, adoption of energy consumption standards, energy certification, statistical coverage of energy use, financing of energy efficiency projects through federal and local budgets, introduction of compulsory energy audits for companies with an energy consumption of more than 4.2 Mtoe annually, and development of seasonal and daily tariffs. Around 30 regional energy savings laws have been adopted over the last four or five years. Many energy efficiency funds have been set up, which could be beneficial for energy efficiency if well conceived, financed and managed. The non-governmental energy efficiency organization, Centre for Energy Efficiency (CENEF), was particularly instrumental during the development of energy efficiency funds in the Russian Federation, supported by local authorities and the Ministry of Energy.

1. Energy supply and transformation

41. The policy reform in the energy sector was launched in the early nineties, when two large state monopolies were created, RAO EES for electricity and RAO Gazprom for natural gas, along with other large state-owned energy enterprises, such as Rosneft for oil, Rosugol for coal and a number of other smaller companies. The main goal of the reform was to raise efficiency in the energy sector mainly by privatization, *inter alia*, of these monopolies, and the creation of an enabling legislative and regulatory framework. As a result, in 1996 the private sector share in the energy sector was around 88 per cent and it accounted for 93 per cent of the energy produced. In 1997, the first step towards the liberalization of the energy market was made by means of a presidential decree, which covered both the electricity and the natural gas sectors.

42. RAO Gazprom, the state gas company, deals with gas production, transmission, distribution and export. It was set up in 1993 as a joint stock company and partly privatized in 1993 and 1994, when around 48 per cent of its shares were distributed to its employees and other Russian citizens via auction. In 1998, RAO Gazprom was one of the world's largest gas companies with a gas transmission system of 150,000 km and accounting for 94 per cent of domestic gas production, 50 per cent of the domestic market for gas end-users and 39 per cent of the world gas trade. It operates through 13 regional transmission companies and delivers gas directly to the large industrial consumers. The gas market experienced some decline following the recession in the 1990s, which resulted in a drop in annual production from 840 billion m³ to 600 billion m³ for the 1990-1997 period. The growing demand for gas on the European market and the active policy to shift from coal and residual fuel oil to natural gas on the domestic market suggest that natural gas production will recover soon.

43. The greatest challenge for RAO Gazprom is to control the losses in the gas transmission network and improve its efficiency. As a result of ongoing research work sponsored by RAO Gazprom, new units for the compressor stations have been developed, which should increase efficiency from the current 24 per cent to 35 per cent. In 1997, a joint pilot project with the German gas company Ruhrgas was implemented in the Volgotransgaz division of RAO Gazprom, aimed at optimizing the performance of the gas system. It led to a 2.5 per cent saving in the gas used in the compressor stations, which is equal to saving 75 million m³ gas, or 150 Gg

CO₂. This project is potentially replicable upon the availability of investment and it is envisaged in other divisions of the company.

44. The total installed capacity of electricity generation in 1996 was 214 million kW, of which 70 per cent was based on coal and natural gas, and a small quantity on heating oil, 20 per cent on large hydro, 10 per cent on nuclear and much less than 1 per cent on renewables. In 1996, RAO EES, the major generator in the Russian Federation, owned 82 per cent of the electric capacity, including 88 per cent of the coal and gas plants and virtually all hydro plants, along with the transmission network. The remaining 12 per cent of the coal plants belonged to regional energy companies. All nuclear power plants belonged to a separate company, Rosenergoatom. In 1999, as a result of the reform in the electricity sector, the situation changed and the regional energy companies gained ownership of most of the small and medium-size coal plants and some of the hydro plants. Still, RAO EES has shares in many of the 75 regional energy companies.

45. The carbon intensity of the electricity produced in the Russian Federation is low: in 1997 it was equal to 0.460 kg CO₂ per kWh electricity produced. The main reason for this is that around 30 per cent of the electricity in the Federation is produced from combined heat and power (CHP) stations and 80 per cent of the heat demand is met by centralized heat supply. The first CHP station in the Russian Federation was commissioned in the twenties and CHP continues to play a major role in providing industry and residential and commercial buildings with electricity and heat.

46. High energy losses in the heat distribution system, which in 1998 consisted of 250,000 km pipelines, and the lack of measurement of actual consumption hindered the efficient performance of the existing CHP system. What is more, due to the lack of the right price signals, in many cases less efficient heat boilers operated at their maximum capacity, while more efficient CHP remained underloaded. To address this problem, in 1996 a new regulation was put in place, requiring the measurement of heat and electricity consumption for all customers. This new regulation was backed by a programme launched in the same year to develop and install measurement equipment, which was also expected to help eliminate some of the market imperfections mentioned above. With regard to the heat losses, there are several projects, including projects supported by the World Bank, aimed at their reduction. Efficiency gains in the range of 20 to 30 per cent are expected from these projects, mainly by introducing adjustable speed drivers, better heat exchangers, heat regulation and better insulation of pipelines. CENEF, supported by the World Bank, has been implementing ten projects to upgrade district heating at a cost of \$233 million and with an emission saving estimated at 2,000 Gg CO₂.

47. Even more important in terms of carbon intensity of the electricity produced is the fact that it gradually declined from 0.478 kg CO₂ per kWh in 1990 to 0.460 kg CO₂ per kWh in 1997 as a result of the policy to increase the use of natural gas for electricity and heat generation and reduce coal subsidies. This trend is expected to continue in the future.

48. Despite the country's abundant resources of renewable energy and the potential for commercial or nearly commercial markets for renewable energy, the use of renewables for electricity generation is marginal, i.e. far less than 1 per cent. The Ministry of Energy has

considered the use of renewables in the remote regions of Siberia and the far east not currently connected to the grid as an economically viable alternative to the small boilers and electric generators now operating on fossil fuel. It has envisaged the installation of 102 MW wind energy, 134 MW small hydro, 190 MW wood chip and peat plants, 2 MW geothermal and others. To implement these projects, the Ministry of Energy in 1997 launched a programme to supply the far north, as well as the people of the north, Siberia and the far east, with renewable energy and energy from local sources.

49. As a result of the liberalization of prices in 1992, coal subsidies were removed and coal and oil prices were allowed to rise gradually within 2-3 years to their international levels. Still, electricity, gas and heat remained among the few products whose prices were controlled by the Government as part of its price and taxation policy. This policy was viewed by the Government as a pragmatic instrument to achieve the objective of energy and resource saving. However, due to the very low income of the population, only a phased approach for this policy was found acceptable from a social point of view. In this context, two presidential decrees were issued in 1997 and a federal programme was launched aimed at removing the subsidies for electricity, heat and gas consumption in the residential sector by 1998. Due to the financial crisis in 1998 the deadline was shifted to 2004, but it seems likely for social reasons that it will be very difficult to achieve the objectives of this programme and bring energy prices into line with their market value.

50. Gas prices were raised more than fourfold between 1990 and 1996. Removal of the state subsidy and the increase in taxes and excise duties were the main drivers of this growth. For example, the share of taxes and excise duties in the retail price rose from 18 per cent in 1990 to 65 per cent in 1996. Tax revenue was used to support other industries and the social security system. Within the gas sector, households were given an effective subsidy via the gas prices for industry. In 1996, for instance, the natural gas price for industry was set at \$63.5 per m³, which is close to international prices, and that for households at \$8.1 per m³. Non-payment of gas bills remains the main problem for the gas sector, reducing the impact of higher prices, and hindering new investment and increased efficiency.

51. Policy reform was expected to continue in the energy sector. The wholesale electricity market was established by the above-mentioned presidential decree and a regulatory body, the Federal Energy Commission, and its equivalents at regional level were set up. The decree also called for subsidies to be phased out and for prices to cover costs, and encouraged the independent gas and electricity producers to participate in the market. Further steps towards liberalization of the gas and electricity markets were considered, taking the United Kingdom model as an example. However, these steps are likely to be taken only when the existing companies have become competitive on both domestic and international markets.

2. Industrial sector

52. The industrial sector made up around 23 per cent of the FEC and the 1995 Energy Strategy ranked this sector second in terms of energy-saving potential, almost a third of this potential having been identified in this sector. The high energy intensity of this sector, more than

twice as high as in the countries of the Organisation for Economic Co-operation and Development, suggests that cost-effective ways of saving energy and emissions could be sought.

53. Energy efficiency has already been improved in a few privatized industrial companies. These companies were able to secure investments in energy efficiency outside the state budget, mainly from export revenues, and did achieve remarkable results in terms of energy saved and efficiency improved. However the number of these companies is still so small that they did not have any visible impact on the national energy intensity. Their effect may in fact have been outweighed by the increasing energy intensity of many manufacturing industries during the period of economic decline.

3. Residential, commercial, public and agricultural sectors

54. The 1995 Energy Strategy identified significant potential for energy saving in these sectors. Of the total energy-saving potential, 15 per cent was attributed to the residential, commercial and public sectors, mainly in buildings, and 5 per cent to the agricultural sector. Factors underlying the high energy intensity of the Russian residential sector include subsidized energy prices, lack of energy consumption measurement, lack of private ownership of most apartments and non-payment for the energy consumed. Nonetheless, some progress in improving energy efficiency in this sector has been made since 1990 and it is important to analyse which energy policies have been instrumental in achieving this progress.

55. A number of new building codes have been drawn up as part of the new buildings legislation at national, regional and local levels since 1993, establishing standards for insulation and for heat consumption per square metre, depending on heating degree-days in new and rehabilitated buildings. These codes ensure a transition from the old system, which specified the thermal characteristics of the building's components, to a new one, which specifies the thermal performance requirement of the whole building. When fully implemented, the new codes will help to reduce specific energy consumption by half. To strengthen these codes further, the CENEF is currently working on a new generation of building codes. However, the implementation of new codes and the obligatory heat consumption metering mentioned above require new and innovative investment schemes, and also the monitoring of implementation, which does not seem to be in place yet. In addition to new codes, much has been done recently by some ministries with regard to voluntary participation in according energy passports and certificates to buildings. Finally, in the building sector around 100 boilers were switched from residual fuel oil to natural gas. The relatively low prices of natural gas compared to those of oil and coal encourage such switching.

56. In the service sector, energy audits conducted so far suggested that a number of energy-saving projects could be implemented with a short payback period, i.e. less than three years. In 1998, a federal programme for energy efficiency in public buildings was put in place that attempts to tap the potential for energy saving in this sector, but no results of its implementation were made available to the team. In agriculture, steps to improve energy efficiency have yet to be taken, but the team felt that detailed studies on the best ways of doing this should first be made.

4. Transport

57. The share of commercial and private transport in total energy consumption in the Russian Federation is relatively small, only around 15 per cent. However, along with the privatization of commercial transport and the increase in the number of private cars, a tendency observed in the last decade, transport will become a larger and faster-growing energy consumer and, consequently, source of emissions. No measures were reported in the NC2 for this sector. Still, the FPEC envisages that in the long term specific energy consumption in the transport sector could be reduced by 30-40 per cent compared to the 1998 level by improving vehicle efficiency, using smaller vehicles and bringing about a shift to more efficient modes of transport. The team acknowledged that these measures are not likely to reverse the rising trend of fuel use in transport and the associated emissions, but they may help to slow it down.

58. The Ministry of Transport coordinates rail, water and air transport, while the Ministry of Roads deals with road infrastructure and car transport. Two of the achievements of transport policy in the past were the elaborate public transport system in the cities and the comprehensive coverage of the country by railways. After 1990, the focus shifted towards road-building in response to the changes in the economic situation, behavioural changes and changes in the demand for transportation. For example, the demand for heavy goods vehicles is growing and is expected to reach 20,000 new trucks annually by 2000. Cars sales have been growing by 1,000,000 per year, and this number is expected to double in 2005. Host country officials noted that these changes will not fundamentally change the transportation pattern of the country.

59. In 1994, a programme for air emissions abatement from the transport sector was launched by the Ministry of Roads. It envisaged the following instruments to achieve the objectives of energy efficiency and environmental protection: emission regulations, certification and monitoring, fines for non-compliance and tax incentives. The programme made an attempt to tackle the problem of the efficiency of, and pollution from, old cars, which constitute a large share of the existing fleet. In 1995, another programme called Efficiency of Fuel and Energy Resources in Transport was launched by the same ministry. It aims at increasing the number of diesel vehicles, replacing old aircraft and improving fuels and fuel additives.

60. The Climate Programme also encompasses a transport emissions component, the funding of which accounted for 12 per cent of the programme's total. The implementation of this component was hindered by the financial crisis in 1998. Nonetheless, support for research and the development of new technologies in the transport sector remains among the priorities of the Ministry of Transport. In the context of the efforts to improve efficiency in this sector, it is worth mentioning the projects supported by the World Bank to provide 13 cities with 1,500 new buses and 300 new trolleybuses at a cost of \$600 million.

61. Given the recent development of the transport sector, the review team felt that one of the most effective tools to improve efficiency in the transport sector is the price and taxation policy. A tax on the purchase of new cars exists in the Russian Federation, but it is set at only 7 per cent of the wholesale price and does not distinguish between cars with large and small engines. For imported cars, the purchase tax together with import duty accounts for 50 per cent of the retail

price. Gasoline and diesel fuel are heavily taxed through a very complex tax system, which includes a value added tax (25 per cent), combustible fuels tax channelled to the road fund (25 per cent), excise tax only for gasoline (10 per cent) and a large number of smaller special-purpose levies (road tax, land taxes, environmental charges, vehicle charges and so on). This has resulted in a huge difference between the wholesale and retail prices, which in turn has led to only a small fraction of gasoline and diesel fuel (10 per cent) being effectively covered by the tax system. To correct this, in 1999 an attempt was made to introduce a tax at gasoline stations, but it has not proved successful.

5. Land-use change and forestry

62. With one fifth of the standing volume of global forests and two thirds of the standing volume of boreal and temperate forests, the Russian Federation ranks as one of the largest holders of the carbon pool in the northern hemisphere. The Federal Forest Service controls 94 per cent of the total forest area and 91 per cent of the total growing stock. It is also in charge of forest planning, management and inventory data collection, which is organized through regional and local authorities.

63. The 1997 Forest Code establishes the legal foundations for efficient use, control, protection, and reproduction of forests and for increasing their ecological and resource potential. It stipulates that forests are federal property, but part of the management responsibility is delegated to the regional governments. It also stipulates that the regional authorities are responsible for improving forest production and for afforestation. Moreover, it sets goals for afforestation (establishing forests on non-forest lands, decreasing the proportion of non-productive lands and establishing protective forests in steppe and forest-steppe regions), in an attempt to arrest the decline of afforestation over the past few years, which was the result of funding problems.

64. The Forest Code served as a basis for the development of the concept of sustainable forest management, adopted in 1998, and the relevant criteria and indicators. Although the concept of sustainable forest management is not directly linked to climate change, climate change considerations are implicitly involved in it. In addition, forest restoration and afforestation are to be promoted by the Federal Programme Forests of Russia, by the Federal Complex Programme for Increasing Soil Fertility in Russia and by the Federal Programme of Silvicultural Amelioration in Russia.

65. Proper maintenance of the forest carbon sink is considered crucial to sustainable forest management. A key element here is the monitoring of the efforts made in the forestry sector to comply with the commitments under the UNFCCC to protect and enhance the sinks. A set of indicators has been established for such monitoring, which includes: the share of stocked area of hardwood and softwood species (every 5 years); the share of stocked area with mature and over-mature forest stands (every 5 years); and the total amount of accumulated carbon in forest stands. A long-term forecast of rates of biomass and dead-tree accumulation is thus prepared, which in turn helps to assess the role of Russian forests in global processes of regulating atmospheric carbon and climate change.

66. Forest fires remain a serious problem for the Russian Federation, between 18,000 and 31,000 wildfires being recorded every year. In 1990-1998, the total area affected by forest fires annually ranged from 0.35 million to 5.34 million ha, and the cumulative area of burned forests over this period was 12.2 million ha, which has significant implications on the carbon stock. To improve the situation, a system of early detection of forest fires was put in place, mostly using aircraft.

B. Methane

67. Measures to mitigate CH₄ emissions in the Russian Federation focus on reducing fugitive emissions from coal mines and the natural gas system, and on improving waste management. Although agriculture is the second largest source of CH₄ emissions, no abatement measures have been identified in this sector. As to waste management, the current policy is to move away from landfilling towards incineration and recycling. Specific problems which the local governments faced in the implementation of this policy were a lack of waste separation and the demand for final products of waste recycling as well as a lack of information on how to choose the most efficient waste processing technology.

68. In 1996, the Federal Programme on Waste for 1996-2000 was adopted with a financing of R 2,700 billion (in 1996 prices, before the denomination in 1997), of which 15 per cent was to come from the state budget, 60 per cent from the waste management enterprises, 10 per cent from the regional budgets and the remainder from the Federal Environmental Fund and the tax for landfilled waste (a tax paid by both industry and households, but at a marginal rate for households). The programme took a balanced approach to improving the current system of waste management, as the introduction of new legislation and regulations was backed by several specific research programmes, promotion of new technologies, pilot projects and provision of better information to the waste experts and the public at large. In 1998, the Federal Law on Waste was adopted, which calls for the inventorying of landfills and creation of a database of efficient waste management technologies and enterprises dealing with waste.

69. Fugitive methane emissions from coal mines were expected to decrease in the Russian Federation, mainly as a result of the closing-down of unviable mines and the shift from underground to surface coal mining in order to meet the demand for coal. Additionally, the Ministry of Energy launched in 1998 a programme for coal-bed methane recovery and use. The primary objective of the programme was to improve the safety of coal mining, but it also aimed at emission abatement and methane use for energy purposes. In 1997, the Russian Centre for Methane Utilization was set up jointly with the United States which initiated a pilot project for methane use for energy purposes, with an emissions saving estimated at 2.7 Gg CH₄ annually.

70. Fugitive methane emissions from natural gas were addressed in the NC2 in the framework of two RAO Gazprom programmes aimed at implementing a system for production and environmental monitoring, defining and reducing losses of natural gas during production, transmission and storage (noted in the inventory part of the report).

C. Nitrous oxide

71. The NC2 does not contain information on measures to mitigate N₂O emissions, nor was such information provided to the team during the review visit. Agriculture was the single largest source of N₂O emissions, accounting for around 90 per cent of emissions. Emissions from this sector almost halved from 1990 to 1996, mainly due to the decline in production and use of fertilizers as their prices rose sharply. The team learned of the programme to stabilize and develop the Russian agricultural sector over the period 1996-2000 by strengthening its institutional and legislative framework. While the primary objective of the programme is to boost productivity, it also has environmental impact mitigation, and especially soil conservation, among its objectives. The team noted that several aspects of this programme may have a link to climate change policy.

IV. PROJECTIONS AND ESTIMATES OF THE EFFECTS OF MEASURES

72. The NC2 provides projections for GHG emissions by 2010 using 1994, the last year with available data for historical emissions, as the base year. In contrast to the NC1, where only CO₂ scenarios were presented, the NC2 includes three scenarios for CO₂ emissions, and one scenario for each of the other GHGs, CH₄, N₂O and the new gases. Only emissions of CH₄ and N₂O were presented by source as required by the guidelines. Projections of emissions associated with bunker fuel and biomass and projections of sinks were missing. Projections were prepared by experts from Roshydromet, which, given the large uncertainties associated with the timing and the possible rate of recovery of the Russian economy, took an approach to projecting the future emission trend aimed at achieving maximum transparency and simplicity. Various scenarios presented do not have any explicit link with the ongoing programmes and scenarios, including those prepared by the Ministry of Energy. Little information was given in the NC2 on how projections were made and the team stressed the importance of providing such information as required by the UNFCCC guidelines.

73. The CO₂ emission scenarios included baseline, probable and optimistic scenarios. Broadly, all three scenarios could be classified as “with measures” scenarios, as they assume different levels of improvement in energy efficiency reflecting different degrees of success of the relevant policy. In this sense, a “without measures” scenario was missing.

74. Four sets of assumptions based on expert estimates were employed for projections: on population growth, on GDP, on energy intensity and on the carbon intensity of the energy supply. Recent statistics indicated that the population decreased between 1990 and 1997, and hence an assumption was made that the population will remain constant by 2000, in contrast to the NC1 where some growth was anticipated. The underlying assumption on economic development at the time the projections were made was that by 1996-1997 the recession would come to an end and steady economic growth would follow. The level of this growth was obtained by averaging the economic growth rate of 3.5-4 per cent recorded by the other countries with economies in transition after they overcame the recession and the rate of 5 per cent assumed in the 1996 strategy of the Ministry of Economic Affairs. This resulted in a 4 per cent GDP growth rate

being assumed for the baseline scenario, whilst for the probable and optimistic scenarios a slightly higher value of 4.4 per cent was taken.

75. The assumption on energy intensity was of central importance in the approach adopted for projections, as by using this highly aggregated indicator the Russian experts made an attempt to reflect the possible improvement in energy efficiency in all sectors of the economy. The FPEC envisaged the following figures for energy efficiency improvement: 5.3 per cent between 1998 and 2000, and 13.4 per cent between 2000 and 2010. These figures translated into a 1.6 per cent annual improvement in energy efficiency in the probable scenario, where full-scale implementation of the FPEC was anticipated, and a 0.5 per cent annual improvement in the baseline scenario, where only a partial success of the FPEC was assumed, including implementation of low-cost and no-cost measures. Finally, in the optimistic scenario it was expected that additional measures would be implemented, on top of the measures already envisaged in the FPEC, associated with efficiency improvement in the energy supply, which would result in a 2 per cent annual improvement in energy efficiency.

76. Based on historical data for 1990-1995, another important assumption was made on the carbon intensity of the energy supply mix and its structural change. This indicator was expected to remain stable for the baseline scenario and to decrease by 0.1 per cent annually for the probable and optimistic scenarios.

77. During the visit the review team was provided with the 1999 report *Fuel and Energy Complex of Russia: Yesterday – Today – Tomorrow. View from 1998* prepared by the Institute of Energy Strategy of the Ministry of Energy in the framework of the development of the new Energy Strategy of Russia for 2000-2020. The report envisaged the GDP to recover by 1 per cent in 2000 and to grow by an average of 4.2 per cent annually between 2000 and 2005. The energy efficiency was anticipated to improve on average by 1.75 per cent annually over the same period. The team found that these most recent figures broadly correspond to the assumptions used for projections given in the NC2 with one exception, namely that of the timing of the turning point in the Russian economy.

78. GHG emissions were projected in the NC2 assuming an exponential growth of emissions, with a power equal to the sum of the growth rates of the GDP, of energy intensity improvement and the change of carbon intensity of the energy supply. The projection experts believed that such an approach was adequate for Russian circumstances, given the large uncertainties associated with the pace of reform and economic recovery, the lack of detailed data on mitigation policies and measures, and the limited information available on energy consumption by sector, associated GHG emissions and its projections. In fact, several models already developed in preparing the Energy Strategy were used in the preparation of the NC1. These models include an input-output model, which projects energy demand by sector subject to specific parameters of energy consumption by sector and relevant international data, and a macroeconomic model developed by the Institute for Systems Analysis. Projections reported in the NC1 were linked to the main indicators outlined in the Energy Strategy.

79. During the team visit, the host country experts expressed the opinion that the future emission trends reported in the NC2 are robust if they are shifted from 1997, the turning-point year assumed in the projection exercise, to the year when economic recovery actually starts. There was no sensitivity analysis to explore the impact of changes in the key variables on the future emission trend.

80. In terms of the results obtained, the CO₂ emissions were projected to start growing in 1997, but to remain in 2000 well below the 1990 level, by 24 per cent in the baseline scenario, by 26 per cent in the probable scenario and by 27 per cent in the optimistic scenario. This situation was attributed mainly to the economic recession in the recent decade. In 2010, these emissions were projected to be 7 per cent higher than their 1990 level in the baseline scenario, 3 per cent lower in the probable scenario and 8 per cent lower in the optimistic scenario. In contrast, in the NC1 emissions were projected to grow at a somewhat slower pace and to remain below their 1990 level even in 2010. Given these figures, the team noted that depending on the timing and speed of economic recovery, the Russian Federation may need to strengthen its existing policies, including the energy efficiency policy, if long-term stabilization of emissions is to be attained.

81. Projections of CH₄ emissions were prepared following a more disaggregated sectoral approach than for CO₂ emissions, and included projections of emissions from energy, waste and agriculture. Again, expert estimates were used to evaluate the possible effect of measures taken by RAO Gazprom to mitigate emissions from the natural gas network, which led to the assumption that these emissions would grow by no more than 1 per cent annually from 1998 to 2010. The anticipated growth rate of emissions from the other sectors was around 2-3 per cent annually. The total CH₄ emissions in 2000 were then expected to be 20 per cent lower than in 1990 and 10 per cent lower by 2010.

82. Emissions of N₂O were projected using a simple trend analysis taking into consideration two main sources, fertilizer application and all other sources, including fuel combustion, industry, industrial processes, waste management and manure. For fertilizer application, the Ministry of Agriculture assumed that, given the historical level of fertilizer application, emissions would grow by 1.5-2 times between 1994 and 2010. For all other sources, the increase was estimated at 1-2 per cent per year. This resulted in total N₂O emissions in 2000 and 2010 being expected to be respectively 38 and 21 per cent lower than the 1990 level.

83. Only a rough estimate of 2 per cent possible growth in total emissions of HFCs, PFCs and SF₆ was provided in the NC2. This estimate was based on the assumption that the emissions of HFC-23 associated with freon manufacturing are likely to decline, while emissions of HFC-134a related to its application in the refrigeration sector could grow significantly. Although the major share of PFC emissions came from the aluminium industry, the projections of these emissions were not linked to the business plans in this industry because of the high uncertainty associated with its privatization and its future markets.

84. During the visit, the review team was provided with the most recent GHG emission projections, prepared before the 1998 financial crisis by several institutions, including the SCRFEP in the framework of the 1999 *Study on Russian National Strategy of GHG Emissions*

Reduction supported by the World Bank. A combination of top-down macroeconomic modelling and bottom-up sectoral analysis, i.e. an approach similar to that employed in the NC1, was used in this study to project the future emissions by 2012. This model is a comprehensive one as it accounts for a range of key drivers, such as price and taxation policy, including policy to remove energy subsidies, rate of capital turnover, impact of a possible energy/carbon tax, impact of new, more efficient and environmentally friendly technologies, etc.

85. The three scenarios envisaged in this study were broadly similar to the NC2 scenarios, i.e. baseline, probable and optimistic. The last-mentioned includes a carbon/energy tax and possibilities for emissions trading (with maximum effect of measures). The underlying assumptions behind these scenarios were different rates of GDP growth, changes in the fuel mix and changes in fuel prices. The results pointed to a markedly lower level of future emissions than the NC2 projections. Another interesting result was that the introduction of a carbon/energy tax would stimulate the penetration of new, more efficient and environmentally friendly technologies.

Table 4. Comparison of the CO₂ emission projections in the NC1, the NC2 and the recent projections presented in the *Study on Russian National Strategy of GHG Emissions Reduction*, in 2000 and 2010 (expressed in percentage of the 1990 emission level)

Scenario	NC1		NC2		Recent projections	
	2000	2010	2000	2010	2000	2010
Baseline	87	96	76	107	56	88
Probable			74	97	51	84
Optimistic	83	90	73	92	46	76

* In the case of the NC1, only two scenarios were given and the results for them were translated in table 4: baseline figures reflect the scenario with maximum energy consumption from the NC1; the optimistic scenario figures reflect the scenario with minimum energy consumption from the NC1.

86. The approach used to project CO₂ emissions in the NC2 did not allow for assessment of the effect of policies and measures within the model and this is one of the reasons why such information was not provided in the NC2. Nor did it allow for the analysis of future emissions by sector. Finally, it was not possible to simulate the impact of macroeconomic policy, including the price and taxation policy, typical of macroeconomic models, or to obtain a detailed presentation of options for fuel switching and technology evaluation, which is typical of engineering bottom-up models. The draft climate change action plan completed in 1999 contains comprehensive estimates of the effect of policies and measures. This plan, however, has not been approved by the Government and was not discussed during the team visit.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

87. The Russian Federation has taken a comprehensive approach to evaluating the vulnerability of the ecosystems in different sectors to climate change, using a combination of expert estimates and modelling. This is a challenging task, given the size of the country, the variety in climate and ecosystems, and the existence of unique ecosystems such as boreal forest.

88. As a first step for impact assessment, climate change scenarios were developed by the IGCE in cooperation with the Hadley Centre (in the United Kingdom) and the Max Planck Institute (in Germany) using the outputs of five global circulation models. The climate scenarios in terms of expected change in temperature and precipitation were then supplied to different sectoral models. For agriculture this was a climate-weather yield model run by the Academy of Agricultural Science, for forests this was the model for boreal forest run by the Institute of Forestry, and for water resources this was a set of water balance models for large Russian river basins of Roshydromet.

89. Agriculture and water resources were found to be the most vulnerable to possible climate change. However, the ecosystems in these sectors have also been affected by unfavourable management practices and consequently it was very difficult to distinguish between the impact of climate change and that of management practices. Still, it was found that the climate change component was likely to affect agriculture directly, due to the increased frequency of drought, which would lead to a drop in yields of the major crops. Agriculture in the Russian Federation already faces serious desertification problems (e.g. in the area west of the Caspian Sea). Major agricultural areas in the lower Volga and lower Don are also affected by periods of drought and increased wind erosion. The analysis of water management systems suggests that in the future under dry year conditions the water supply might be restricted.

90. According to Russian authors, forest ecosystems have not been very vulnerable to climate change. Moreover, it was found that forests in general would even benefit from it and the forest carbon sink might increase. Nonetheless, global warming would have an extremely harmful effect on forests and peat-lands in the permafrost areas, where both natural ecosystems and the urban environment (including infrastructure) were likely to be greatly affected.

91. In the Russian Federation, a strategic approach to adaptation has yet to be developed. Russian forests are a major sink, which could be enhanced by climate change. Thus, adaptation of forests is closely linked to mitigation. Adaptation of agriculture appears crucial and some efforts are already under way in this sector, centred on enhancing stability of agriculture, optimizing soil fertility, developing an ecological and genetic basis to optimize selection of production crops, etc. Adaptation in water management was also seen as a priority.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

92. As a country with an economy in transition, the Russian Federation provided in this section of its report a summary of activities in the field of international cooperation on climate change. During the meetings, the team was informed of a number of bilateral agreements on the environment concluded with many Annex II countries, including Scandinavian countries, Germany, Japan and the Netherlands, among others. While climate change was an important element of each of these agreements, the recently signed agreement with Japan centred exclusively on it, more precisely on improving the quality of the GHG inventory. Another important step was the signing in 1999 of a statement of intent by the ministers of energy of the Russian Federation and the United States of America on cooperation on the Kyoto Protocol mechanisms.

93. Another important activity in the field of international cooperation is the participation of the Russian Federation in AIJ. First steps to identify and launch AIJ projects were taken in 1996 and the SNAP report provides a complete list of AIJ projects which are either under implementation or at the planning stage. The National Pollution Abatement Facility, set up under the agreement between the Russian Federation and the World Bank actively participates in the preparation of AIJ projects. The 1999 edition of the report, *Kyoto Protocol and Russian Energy*, provides updated information on the status of implementation of the nine existing AIJ projects in the Russian Federation, together with the expected emission reductions and cost of the unit of carbon saved. These projects were found attractive as, along with the efficiency improvement which is the main goal of most of them, they offer carbon savings at very low cost (around \$5 per tonne of CO₂ saved on average).

94. RAO EES and RAO Gazprom provided the team with information on a cooperative programme between the Russian Federation and Japan to mitigate the CO₂ emissions from Russian enterprises, particularly power plants, supported by \$20 million. As of mid-1999, feasibility studies for 16 plants and two projects in RAO Gazprom were finalized and up to four more plants will be considered for AIJ projects, with an expected credit line of \$2 billion.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

95. Climate change research in the Russian Federation centred on systematic monitoring of the climate, simulation of climate scenarios and climate forecasts. The research was conducted in the framework of three main programmes: (1) the Climate Programme; (2) the programme of the Ministry of Science and Technologies, Global Change of Environment and Climate; and (3) the scientific programme of Roshydromet, Methodology to Forecast the Changes in the Climate, Environment and Resources and Consequences of these Changes. The country is also a member of the World Meteorological Organization and has been active in the work of a number of programmes of this organization such as World Weather Watch and Global Atmosphere Watch.

96. Roshydromet is the main organization to coordinate and conduct climate change monitoring. The monitoring of current climatic anomalies has been based on world data from meteorological observations (of 2,000 stations having observations from the beginning of the century, 455 are located on the territory of the former Soviet Union), data from marine observations and the actinometric network. Analysis of the current climate is provided in the monthly bulletin, *Data on Climate Monitoring*, and in the annual review, *Climate Change*.

97. The Ministry of Science and Technologies coordinates the research on new technologies and mitigation. In 1998, it financed the above-mentioned programme, Global Change of Environment and Climate. Around half of the projects under this programme dealt with the development of new technologies and materials and improvement to the environmental performance of existing technologies and materials. The funding for this programme in 1999 amounted to R 8.5 million. Other ongoing programmes worthy of mention are Fast Environmental Transport (R 7.5 million), Environmental Energy (R 28 million), the Baika Drilling Project, supported by the United States of America and Japan under a joint programme with the Russian Federation, and the Study of the World Ocean (R 84 million).

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

98. The team was informed of various initiatives contributing to raising public awareness of climate change. These included a study on climate awareness supported by the United Nations Environment Programme, annual workshops on climate change organized by a non-governmental organization, the Social-Ecological Union, and information on climate change prepared and distributed by CENEF. Businesses, such as RAO Gazprom and RAO EES also disseminate information on climate change and energy efficiency through their network. Several scientific journals, mainly published by the Russian Academy of Sciences, provide up-to-date information on climate change. The NC2 contains a list of several universities where climatology and renewable energy are separate majors. Additionally, the team learned that environmental protection and climate change are included in the curricula of some leading Russian universities.

99. The team felt that it is important to disseminate statistical, legislative and economic information on energy saving among the business community, energy planners, project managers and the public at large. It also felt that it is important to promote general awareness of energy use and global warming and highlighting the connection between the two. This could be achieved by using both media campaigns and special courses in high schools and universities, and postgraduate courses for professionals.

IX. CONCLUSIONS

100. The team acknowledged that the GHG inventory was clearly an area where significant improvement had taken place: steps had been taken to resolve methodological problems, improve the quality of activity data and emission factors, increase overall transparency and add emission sources. The reporting had also improved, as the IPCC Guidelines were followed to a greater extent in the NC2 than in the NC1. The team felt that the efforts of RAO EES and RAO Gazprom in producing inventories related to their own activities were unique and impressive, given the size of the country and these companies. It advocated further efforts to integrate the results of the RAO EES and RAO Gazprom inventories into the national one and to further develop the capacity to produce a GHG inventory of good quality. In this context, financial support appeared essential.

101. The NC2 represents a step forward in developing a comprehensive climate strategy, which, given the prominence of the energy sector in the economy and the high energy intensity of economy, is closely linked to the priorities and strategic objectives of the development of this sector. Improving energy efficiency was seen as a key response measure and the Russian Federation has in place many instruments to promote relevant policy. Notwithstanding the fact that many of these instruments were put in place in recent years and that their impact is difficult to assess, efforts have yet to be made to monitor the implementation and assess the effects, which in turn may strengthen implementation. Some evidence of the lack of impact at the macro level is provided by the fact that the energy intensity of the economy, and in particular of industry, has remained practically unchanged over the past decade or even risen.

102. The team noted that the information on policies and measures contained in the NC2 provides a synopsis of measures, rather than a policy framework. There are many programmes that have no apparent link between them and there is little information on the actual status of implementation. The one common feature, lack of financing, hinders implementation and makes the effect of many of these programmes marginal. In addition, it remained unclear to the team whether any significant steps had been taken to integrate climate change into sectoral policies and strategies. The team also noted that more attention to policies on non-CO₂ gases and to the integration of existing climate-relevant policies into the sectoral policies would give further impetus to climate change policy. Finally, the team noted that many policies and ongoing activities at regional level associated with transport, waste management and energy saving might also gain impetus if considered in the broader context of the national climate policy. A possible approach to strengthen the implementation process could be through more active involvement of regional administrations and municipalities in matters of climate change, which in turn could help to raise further awareness of climate change.

103. The team considered the underlying assumptions used for projections reported in the NC2 to be realistic for the time the projections were made. The results obtained indicate that, while the Russian Federation will meet the aim of the Convention that the emissions in 2000 should be lower than their 1990 level by at least 24 per cent, it may have problems with long-term stabilization of emissions after the economy recovers, if the policies in place, in particular the policy to promote energy saving, do not attain their objectives. Some limitations of the model used and, even more important, the impact of the 1998 crisis and the uncertainties associated with it require these projections to be interpreted very cautiously.

104. Comparison of the projection results contained in the NC1, the NC2 and the most recent projection indicates a very wide range of possible future emission levels, which, together with the vast range of possible changes in underlying assumptions, gives some idea of the great difficulties the Russian Federation faces in assessing future emission trends. Nonetheless, the team noted that the explicit consideration of existing programmes to address climate change in projections is important as it may help to use the projections as a real tool to support the decision-making process on climate change, to illustrate the impact of different programmes, policies and measures and, therefore, to take corrective action if and when necessary.
