Appendices

Appendix 1: Literature review for Russia (full text)
The links between science and policy-making in Russia

Appendix 2: Literature review for UK (full text)
Exploring science and policy linkages in the UK

Appendix 3: Schematic diagrams ('maps') showing science-policy linkages– Russia
- Federal executive Bodies
- Representative and Legislative Bodies
- Russian Academy of Sciences (RAS)

Appendix 4: Russian Foundation for Basic Research (RFBR)
Overview and relationships diagram

Appendix 5 Schematic diagrams ('maps') showing science-policy linkages– UK
- Funding routes for science and technology, and in particular climate science
- Key influences on climate change policy and science (information flows)

Appendix 1

Literature Review for Russia
The links between science and policy-making in Russia

Content:

The links between science and policy-making in Russia

1. Historical overview of the links between environmental science and policy-making in the USSR[1]

According to A.V. Smygleva [23], development of the environmental policy as a system of measures aimed at protection of the natural environment and sustainable use of natural resources was a complicated and controversial process in the Soviet Russia. Experts distinguish several phases of shaping the state environmental policy which typically coincided with the phases of socio-economic development in the 20th century:

1. 1917 – late 1920s,
2. early 1930s – 1st half of the 1950s,
3. 2nd half of the 1950s – late 1960s,
4. early 1970s - late 1980s,
5. 1990s.

After the establishment of the Soviet sovereignty, the state laid significant emphasis on preservation and rational use of the country's natural wealth. Between 1917-1920, the number of various governmental decrees, edicts, instructions that covered environmental issues reached 268. This had been triggered by the profligate practices of using natural resources in the preceding years.
The Constitution of the Russian Soviet Federative Socialist Republic (RSFSR) proclaimed all forests, subsoil and waters of the national importance as national assets. The title to natural resources belonged to the local Soviet authorities, while the central government enforced compliance with the environmental law.

In 1925, Russian Central Executive Committee enacted the Law On Protection of Natural Areas and Amenities Having Scientific or Cultural and Historical Importance. The Law prescribed that State Interdepartmental Committee for Environmental Protection to be established. The Committee was comprised of representatives of the People's Commissariat for Education, State Planning Committee, People's Commissariat for Finance, People's Commissariat for Public Health, People's Commissariat for Internal Affairs (NKVD), Academy of Science and the Russian Geographical Society. The Committee was responsible for the development of general environmental policy and control over its implementation.

During the 1920s, State Planning Committee instigated establishment of the interdepartmental commissions that united representatives of People's Commissariat for Education (Chief Science Committee), Soviet authorities, land administrations and local hunters and fishermen unions. The commissions were intended to steer activities of different organisations and institutions as well as to develop general recommendations related to the environmental issues. However, in practice the environmental protection functions were distributed between various institutions, which resulted in controversies and conflicts between the users of natural resources. [23]

The first phase in the history of Russian environmental policy marked the development of environmental initiatives by so-called *"intelligentsiya"* (intellectual elite) that were rather active despite their small numbers. Representatives of the scientific and educational elite of the pre-Revolution upbringing not only disseminated environmental knowledge, but also contributed to drafting of the Soviet legislation and facilitated foundation of the All-Russian Society for Nature Protection in 1924 and a number of other state committees and commissions, including State Committee for Environmental Protection in 1925. During that period, of widespread popularity were the naturalist societies that focussed on raising the public awareness of nature protection, together with exhibitions, lectures and publications.

Mass industrialisation accompanied by the expansion of metallurgical, chemical, machine building and timber industries and development of new territories gained momentum over the years spanning from the early 1930s until the 1950s. As a rule, the industrial development was pursued with little attention to environmental impacts, which subsequently led to a number of environmental problems. By the beginning of the 1930s, exacerbation of the environmental quality in urban areas resulted in urban management becoming one of the most crucial issues. The State Sanitary Inspection had oversight of

[1] The Union of Soviet Socialist Republics

the environmental situation, including environmental quality control, sanitary protection of waters, air, soil, habitations, food, anti-epidemic measures and public health.

The sanitary institutions conducted substantial scientific research on water and air hygiene, as well as studied the impacts of the environmental factors on human health, including noise and radiation. The research complexes were centred in major cities, such as Moscow, Leningrad2, Magnitogorsk, Chelyabinsk, Novokuznetsk, etc. Data and findings of these research works were taken into account when drafting environmental and sanitary legislation, establishing industrial sanitary zones, and as a basis for the disposition of production complexes and housing.

During the 1930s, scientific institutions initiated development of the environmental norms for natural resource use, which subsequently gave rise to the introduction of Maximum Permissible Concentrations (MPCs) for 12 harmful substances. Over the first 20 years of the sanitary protection service, a number of crucial acts had come into force, including Regulations On Wastewater purity norms (1923), On Air pollution with power plant emissions (1937), etc. [23]

When evaluating Russia's state environmental policy, a reputable scientist I.P. Laptev (cited in [23]) wrote: «over a period from 1917 to 1941, the Party and Soviet authorities as well as public institutions had formed a socialist system of environmental protection that achieved substantial practical results». However, despite the whole range of measures aimed at solving environmental problems, the country was witnessing deterioration of the natural environment. The unsatisfactory condition of forests and air pollution in populated areas were a growing concern. In his analysis of the Soviet environmental policy, historian V.V. Sokolov (cited in [23]) noted that «during the 2nd half of the 1930s, environmental solutions that were developed as part of the implementation of economic plans were mainly of applied, technical character».

In the immediate aftermath of the World War II, the Soviet state placed principal emphasis on solving economic problems, frequently through the extensive exploitation of natural resources. A great number of natural reserves were abolished in the early 1950s [23]. During the post-war period, rapid progress of the research and development sector was triggered by the USSR Government's endeavours to modernise the armaments industry and primarily, to accelerate the creation of A-bomb. Branches of physics that focussed on the development of nuclear technology received the strongest support from the state and were the most influential. This in turn provided powerful stimulus to development of the fundamental science not directly related to the manufacturing of weapons. Against the backdrop of the adversarial relations between the Soviet Union and Western states, enormous resources had been allocated to develop the Russian science despite the country's dire economic situation.

Petrov [17] argues that by the end of the 1960s, lagging of the Soviet science behind its foreign counterparts gradually became obvious. Such a situation resulted from the fact that the Soviet system had demonstrated its inability to maintain large-scale scientific and technical progress and to benefit from the mass introduction of new technologies. Scientific research required state-of-the-art experimental equipment which the Soviet industry was producing in limited numbers. While the developed countries were successfully enhancing their scientific and technological capacities, both the Soviet economy and science were gradually coming to a standstill. In addition, atmosphere of the scientific institutions was pervaded with political careerism and the expulsion of scientists with dissident disposition who constituted a rather significant portion of the academia. Contacts with foreign scientists were limited to an absolute minimum. [17]

In March 1955, Interdepartmental Commission for Environment Protection was set up under the Presidium of the USSR's Academy of Sciences. Among the functions of the Commission were establishment of a scientific basis for conservation and restoration of the country's natural resources, development of recommendations on the environmental measures and co-ordination of the scientific research in this area. The All-Soviet Union Nature Protection Council convened regularly starting from 1958.

Some researchers note that from the mid 1950s a tendency to a more integrated approach to environmental protection and the use of natural resources was observed. On the one hand, such a situation was accounted for by the emerging liberalisation processes and on the other hand, by the scientific and technical progress and the appearance of zones with critical environmental situation

[2] Presently Saint-Petersburg

(even environmental disasters). During the 1950s, the most topical problems were those related to the chemicalisation of agriculture, urbanisation and the accelerated industrial growth. In the late 1950s scientists began expressing their warnings about potential adverse consequences of the anthropogenic activities. [23]

By the end of the 1950s, the quest for new effective solutions and approaches along with a critical analysis of the experience in the preceding years contributed to a paradigm shift: socio-economic, political and legislative aspects began to be considered when studying the environmental problems. Scientific research and environmental activities of the public were gaining strength. The Law on Nature Protection in the RSFSR was enacted in October 1960, proclaiming protection of the environment as a goal of the state and its people. This resulted in the country's environmental policy being progressed more actively.

An increased interest in environmental issues in the late 1950s – early 1960s resulted in a number of new periodicals, publications, collections and the rising numbers of environmental research studies. Large-scale exploitation of natural resources, extensive development of the Soviet economy, degradation of the unique natural landscapes – all this instigated in the late 1960s the enactment of crucial resolutions by the USSR Council of Ministers on the Lake Baikal, Caspian Sea, the Ural and Volga Rivers. At the same time, preservation of the command-and-control system and a principle of "departmental" nature management hindered further strengthening of the environmental pillar. [23]

The extensive development of some industries in the Soviet period aroused scientists' interest in the issues related to industrial environmental safety. During the 1960-1970s, authors publishing works on the country's fuel and energy sector often covered these aspects. For instance, M.S. Androsov in his monograph «Efficiency of Energy Sector in the USSR» (1975) and A.N. Anufriyev and A.A. Kalinina in their joint paper «Fuel and Energy Base of the European North-East in the USSR» (1973) provided a thorough analysis of the environmental impacts that resulted from the establishment of new production complexes. However, a lack of factual data accounted for some findings made by the scientists being insufficiently substantiated. [1]

A number of comprehensive scientific works on certain environmental issues were published during the 1970s. S.O. Kolbassov in his monograph «Legal Framework for Protection of Water Resources and Fisheries in the USSR» (1974) focussed on the Party's and governmental policy in the protection and use of marine and oceanic resources of the country.

Some scientists concentrated on the issues of production and consumption of energy resources. Such studies covered not only an environmental aspect of the issues, but also analysed global environmental management problems and advanced trends in the area, such as the development of brand-new and environmentally safe sources of energy. [1]

In the 1970-1980s, the environmental issues were given priority. The 1972 Stockholm Conference on the Environment significantly influenced the Soviet environmental policy. Despite the fact that the USSR had refused to participate in the Conference on political grounds, its main principles and recommendations were subsequently reflected in the Soviet Party's decisions and acts. At the international exhibition EXPO-1974 that was held in the city of Spokane (USA) it was reported that «The Soviet Union in its environmental policy acknowledges the critical importance of environmental issues not only for the Soviet people, but also for humanity as a whole. The scale of anthropogenic impacts necessitates the consideration of issues related to possible climate change on our planet». It was admitted for the first time that the environmental problem was becoming global. [23]

In the 1970s, the country's hydrometeorological service was granted broader rights to the air quality data, given that previously Sanitary and Epidemiological Service had been the only source of the information on air and water quality. However, Scientific and Research Institute of the USSR State Committee for Hydrometeorology and Environmental Control did not enjoy a considerable authority until the very 1980. Collection of data and submission of the data reports to the superior institutions remained its primary functions. The situation changed in 1980 after the Council of Ministers passed an act that devolved broader authority to the hydrometeorological service, including enterprise auditing and a right to suspend or even close down enterprises in case of technological non-compliances that had led to the environmental contamination. [23]

In the *"Perestroyka"*[3] period (the late 1980s), researchers became more interested in environmental problems of the Soviet state and the attempts to solve such problems that had been made at the different historical stages of the USSR. This was primarily a result of the weakening control of the Party over science and society in the 2nd half of the 1980s. [1]

Mid 1980s marked the commencement of a closer analysis of global environmental problems. The monographs by I.P. Gerasimov «Environmental problems of the past, current and future geography of the world» (1985) and by B.N. Kitanovich «The Planet and civilisation are in danger» (1985) were in fact the pioneer scientific studies in the USSR which proclaimed that the Soviet state had been experiencing a number of major environmental problems that required the greatest attention of the government.

The *Perestroyka* period also gave rise to a large number of studies on the environmental management and protection in other Soviet Republics. This was deemed rather a new tendency as such studies were almost lacking in the 1960-1970s. The emergence of such studies was largely related to separatist trends that were manifested in the peripheral parts of the Soviet state and were supported by the local elite. [1]

Other studies focussed on the strategic environmental forecasts for the Soviet Union and recommended solutions to the major environmental problems. On the threshold of the 1980-1990s, scientists A.L. Yanshin and A.I. Melua (1991), in their joint study «Lessons from environmental blunders», attempted to undertake an objective and impartial analysis of the Party and government's environmental policy, as well as to delineate aspects of the environmental policy that required immediate solutions. [1]

Improved effectiveness of the activities carried out by environmental institutions in the 1980s was a result of the strengthened co-ordination of such institutions by the local Councils of People's Deputies. The Councils were endowed with a responsibility for overseeing compliance with the environmental law by organisations, enterprises, institutions and citizens and the implementation of measures to preserve and restore natural resources. Local councils also coordinated public universities and institutes for the environment as well as the faculties for advanced professional training that involved experts from the state environmental bodies and services together with higher educational institutions. Development of the programmes and methodologies was a joint effort of all these stakeholders. [23]

The late 1980s – early 1990s marked significant changes in Russia's environmental policy that had been triggered by a number of reasons, including the aggravated environmental pollution and deterioration of public health; alterations in the socio-economic and political spheres; strengthening of public initiatives in response to the environmental degradation; and low effectiveness of the environmental policy over the preceding decades. The long-term transition of the country's national economy to market regulation and the introduction of titles to natural resources necessitated the development of new mechanisms for environmental management and protection. [23]

In conclusion, it may be worth referring to N. Artemov who argues that most of the scientific findings made during the Soviet era may need to be revisited and rethought. This is explained by the fact that the USSR Communist Party controlled scientific research to a considerable extent in order to ensure political appropriateness of the findings. [1]

2. Interrelation of science and policy making in independent Russia

Dissolution of the Soviet Union in 1991 and formation of the independent Russian state triggered drastic changes in the country's society and science. Beginning of the 1990s was marked with scientists' endeavours to revisit the environmental policy of the Soviet Union. The scientific findings of that period revealed unflattering facts about some of the USSR Party's practices, namely a distinct lack of control over the activities and decisions made by some ministries and departments, disregard for the basic environmental norms for the sake of achieving immediate economic results, negligence that at times led to disastrous consequences, etc. [1]

Declassification of many archive materials in the post-Soviet period gave scientists an opportunity to access some informative documentation. Scientific analysis of this documentation has shed new light

[3] The Russian term for a period of economic reforms introduced in June 1985 by the Soviet leader Mikhail Gorbachev. Its literal meaning is "restructuring", referring to the restructuring of the Soviet economy. [Wikipedia]

on Soviet Party and government's policy on environmental protection and the use of natural resources. S.B. Lavrov in his monograph «Global problems of modernity» (1993) analysed the environmental situation in Russia and in the world as a whole. The author criticised the Soviet environmental policy and emphasised the importance of close cooperation with the international community when finding solutions to the major environmental problems in modern Russia. Similar findings were presented by V.I. Danilov-Danilyan, V.G. Gorshkov and Yu.M. Arskiy in their paper «The environment in between the past and the future: the world and Russia» (1994). This study did not focus on the hasty criticism of the Soviet environmental policy that prevailed in some publications in the early 1990s, but rather offered experts' recommendations on the interaction between Russia and foreign countries in the area of environmental protection. [1]

Political changes that were manifested in Russia after the disintegration of the Soviet Union were reflected in the country's environmental policy. The approaches to solving environmental problems were revised on the governmental level and new instruments for implementing the environmental policy were developed. At the same time, continual structural reorganisations of the environmental authorities undermined the established mechanisms of environmental protection, merging the environmental control and resource use functions and leading to the duplication of authorities. [23]

The period of 1991-1996 marked the heyday of the environmental initiatives in Russia. During that period the Ministry of Environmental Protection exerted considerable influence and controlled a broad remit. This remit had been significantly curtailed after the establishment of the State Environmental Committee in 1996 and almost dissolved in 2000 when the latter and the Russian Federal Forestry Service were abolished by the RF President's Edict #867 as of 17.05.2000 "On the Structure of Federal Authorities". The functions of both institutions were devolved upon the RF Ministry of Natural Resources whose primary activity was overseeing the use of natural resources in the country. The State Sanitary and Epidemiological Supervision Agency was converted into a department under the jurisdiction of Ministry of Health, which coincided with the limitation of the remit of the Russian Federal Supervision for Nuclear and Radiation Safety. As a result, the state environmental control functions had been weakened. [24]

The overall economic crisis of the 1990s negatively affected the prospects for the country's "ecologisation". Over those years, the priority was given to resolving short-term social and economic problems. Executive authorities did not place emphasis on the environmental issues, while the legislative bodies confined themselves to mere formalities. Funding of the environmental activities practically ceased. Social problems that had been exacerbated as a result of the economic crisis similarly undermined the importance of environmental issues for most social layers. At the same time, in 2001 nearly 93% of Russia's citizens opposed a government's initiative to import spent nuclear fuel into the country, which signified people's appreciation of the seriousness of potential environmental problems.

Preserving its centralised production structure, the Russian economy was principally based on oil and gas exports and partially on the military industry. Furthermore, high environmental intensity was one of the main characteristics of the modern Russian economy. [24]

In her article *"Environmental policy of contemporary Russia: from imperatives to arguments"* (2003), N. Shulenina [24] argues that Russia is in need of the scientifically substantiated environmental policy which would be supported both by the government and the public and be closely linked to the public health policy and programmes for environmental safety and social protection of the population from environmental catastrophes. Acknowledging that development and implementation of the environmental policy is a complex and multifaceted process, the author also notes that it becomes even more challenging both for the authorities and public institutions in the light of globalisation trends that influence the socio-economic processes in Russia. [24]

Doctrine on the Development of Russian Science (enacted by the RF President's Decree #884 as of 13.06.1996) pronounced support to the science as a priority goal of the state. The Doctrine focussed on the role and importance of science for the country's well being and introduced a mechanism for the state regulation of scientific activities. A key reforming aspect of this mechanism was the allocation of funds from the Federal Budget for scientific, research, design and experimental studies of non-military nature in the amount of at least 3% of its expenditure part, with an annual increase of the assigned amount in line with the stabilisation of the country's economy. Tax and tariff concessions to stimulate and support scientific activities were introduced. A need to create favourable conditions and to provide necessary resources thereby facilitating the participation of Russian scientists in international projects

was also acknowledged. The Doctrine stipulated that by making such commitments the State laid the foundation for the scientific community to contribute to Russia's transformation into a country that would demonstrate a high level of environmental safety. [6]

Another important act was enacted in August 1996: *Federal Law on Science and State Scientific & Technical Policy* (Federal Law #127 as of 23.08.1996). The Law regulates relations between scientific institutions, state authorities and consumers of scientific services. Article 4 of the Law (i. 4) states that a scientist may refuse to participate in research studies that adversely affect humanity, society and the natural environment. [9]

Environmental Doctrine of the Russian Federation (approved by the RF Government's Decree #1225-p as of 31.08.2002) stipulates that the development of science-driven environmentally friendly technologies is necessary for ensuring sustainable nature management. Section "Scientific Provision" of Chapter 5 reads that enhancing scientific knowledge about the environmental pillars of sustainable development and identification of new environmental risks are of priority for the interaction between science and environmental protection. Scientific research on the global and regional climate changes and their environmental consequences together with the development of state-of-the-art methods for environmental monitoring are proclaimed to be highly important. [8]

Doctrine's Section 5 *"Development of the State Management System for Environmental Protection and Natural Resource Use"* emphasises the necessity for clear division of the authority and responsibilities between Federal and regional governmental bodies and local administrations with respect to natural resource use and protection of the environment [8]. In practice, the RF Ministry of Natural Resources and Environment[4], known as Ministry of Natural Resources until very recently, coordinates the state policy and legislative regulation in the sphere of research, use, reproduction and protection of natural resources, including subsoil, forest, water resources, wildlife and their habitats, specially protected natural areas, as well as environmental protection. The Ministry consists of Federal Supervision Service for Natural Resource Use (Rosprirodnadzor[5]), Federal Service for Environmental, Technological and Atomic Supervision (Rostekhnadzor[6]), Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet[7]), Federal Service for Subsoil Resources (Rosnedra[8]) and Federal Service for Water Resources (Rosvodresurs[9]). [13]

Principles of the Russian Federation's Policy on Scientific and Technological Development until 2010 and in the Long Term (enacted by the RF President on 30.03.2002) acknowledge the contribution of science to the country's social and economic progress and recognise the support to fundamental science as one of the highest priorities of the state. Development of international scientific co-operation is also given great importance. The Principles stipulate that the scientific community, in accordance with the country's national interests and in line with the world's scientific and technological trends, should determine priority areas for the fundamental research studies. [18]

A list of priority areas for the scientific, technical and technological development in the Russian Federation was approved by the then President V. Putin in May 2006 (#PR-843 as of 21.05.2006) and included the following [19]:

- Security and anti-terrorism
- Live systems
- Industry of nanosystems
- Information and communication systems
- Military technologies and advanced armament
- ***Sustainable natural resource use***
- Transport, space and aviation
- ***Energy and energy efficiency***

[4] According to the RF President's Edict #740 as of 12.05.2008 Yuriy Trutnev was appointed as Minister of Natural Resources and Environment of the Russian Federation (formerly acting as Minister of Natural Resources over a period from 2004 to 2008). Source: http://www.mnr.gov.ru/
[5] http://control.mnr.gov.ru/
[6] http://www.gosnadzor.ru/
[7] http://meteorf.ru/
[8] http://www.rosnedra.com/
[9] http://voda.mnr.gov.ru/

In May 2006, the RF President approved the *List of critical technologies* that among other priorities distinguished atmospheric and hydrological monitoring and forecast, renewable sources of energy, risk reduction and mitigation of consequences of natural and man-made catastrophes. [12]

3. The links between science and policy-making in the area of climate change

In the 1950s, Russian professor Mikhail Budyko conducted quantitative studies of the global climate by calculating the heat balance of the earth's surface. He announced his findings in 1956 with the publication of a monograph "Heat Balance of the Earth's Surface" [2]. In 1958, the monograph was awarded Lenin National Prize[10] from the Soviet state [10]. Up until that time, climatology had essentially been a qualitative discipline. Budyko's book revolutionised climatology into a more quantitative and physical discipline, sending a shock wave through the world's weather- and climate-related academic community. Under Prof. Budyko's direction, an atlas of all components of the earth's heat balance was completed in 1963. The atlas still serves as the bible of global climate research and has played an important role in developing solutions to a number of global environmental problems. [2]

Only after 1970 the mechanisms of modern climate change were included in the research scope around the world. When investigating the effects of human activities, Prof. Budyko quantitatively analysed the atmospheric composition in the geological past and confirmed that an alteration in CO_2 concentration had been a major factor in the previous incidents of global warming [2]. In the early 1970s, such discovery was against the backdrop of many scientists' predictions that global climate was approaching a cool-down phase. In 1970, it was recognised that the surface air temperature had slowly decreased over the previous decades, although the causes of such cooling down were yet unclear. One school of climatologists believed that the cooling would continue in the forthcoming years, while most experts expressed their strong doubts about the possibility of sound and scientifically substantiated prediction of the future climate changes [3].

Budyko, however, firmly believed that global warming would be observed in the near future, reaching few degrees Celsius in the 21st century. This argument, firstly expressed by Budyko on an international conference in Leningrad in 1971 and in a number of his subsequent publications, did not receive any support [3]. Based on the quantitative analysis, Prof. Budyko published a report warning that the consumption of fossil fuels was contributing to the rising atmospheric concentration of CO_2 which in turn led to a rise in the mean temperature [10]. In 1971, Budyko presented the findings of his research on the interrelation between climate and living organisms in his book "Climate and Life" that demonstrated the link between major climate changes in the past and the extinction of species [2].

In 1971, Budyko also attempted to forecast climate change until the end of the 20th century that has proved to be fair. In his aspiration to justify his theory, Budyko involved in the research a great number of his colleagues and experts from the various institutes of the USSR Academy of Sciences in Moscow, Leningrad, Novosibirsk and other cities. He established a number of expert groups that studied paleoclimate, carbon cycles, and impacts of climate change on agriculture, water resources and the biosphere. [10]
From the 2nd half of the 1970s, Budyko supervised the compilation of mean global temperature ranges: first for ground level in the Northern hemisphere starting from 1891and subsequently for the entire world. These studies gave an impulse to similar works in the UK and USA. [10]

In the mid 1970s, observational data were published that suggested a possibility of warming in the high latitudes. Similar evidence was found in certain regions of the middle latitudes. Ultimately, in the 1980s and 1990s a record rise in the mean surface air temperature was confirmed. [3]

Despite being renowned by the international scientific community, Budyko was not always readily recognised in his own country. Both in 1967 and 1972, the general assembly of the USSR Academy of Sciences refused to grant Budyko a title of the Academy member. The study "Anthropogenic Changes of Climate" that had been supervised by Prof. Budyko and was published in 1987 was rejected the Russian State Award. The title of Academician of Russian Academy of Sciences was conferred on him only in 1994. [10]

[10] Lenin National Prize was the highest award in the USSR that was conferred on authors of the most distinguished works in science, technology, literature and art. [FINAM Dictionary. URL: http://www.finam.ru/dictionary/wordf0197E00027/default.asp?n=1]

In June 1998, Academician Budyko[11] was the first Russian scientist to receive the Blue Planet Prize from Asahi Glass Foundation – an international award that recognises individuals and organisations who have made major contributions to solving global environmental problems. Mikhail Budyko was awarded the Prize for the establishment of physical climatology and the quantitative analysis of climate change and for being among the first to predict that the increasing atmospheric concentration of CO2 would lead to global warming and postulate that a nuclear war would cause a global "nuclear winter." [2]

Budyko's postulate on nuclear winter announced in the beginning of the 1980s is believed to have contributed to the process of signing off Intermediate Range Nuclear Forces (INF) Treaty[12] by the United States and the former Soviet Union in 1987 [2].

The VIII Working Group under the 1972 USSR-USA Agreement for Co-operation in the Field of Environmental Protection made a major contribution to the development of Russian and the world's science on climate and climate change. During 1976-1994, the Working Group coordinated joint Soviet-American studies on climate and atmosphere physics and over all these years Mikhail Budyko acted as Co-Chairman of the Group. Over the first 10 years working meetings and symposia were mainly held in the USSR due to Budyko's restricted status for travelling abroad. In the mid 1990s, the Working Group gradually faded, having been replaced by other activities jointly implemented by Russia and USA. [10]

According to Sergey N. Kurayev [11], following the country's ratification of the UNFCCC in December 1994 Russian scientific community provided all the required baseline information on the effects of climate change on human health, the nation's economy, the status of ecosystems and biological species. Research had been conducted to investigate issues related to adaptation of the national economy and the biosphere to changing climatic conditions. Response measures to changes in the ambient temperature and precipitation rates for different regions of the Russian Federation were recommended. Scientists also developed forecasts on emissions of main greenhouse gases from the energy sector, industries, transport and agriculture. The country's leaders based their decision to ratify the UNFCCC on the comprehensive information about climate change that had been provided through constructive and productive efforts of the Russian scientific community. [11]

Russia participated in the first Conference of UNFCCC Parties in the status of a full member of the Convention. The country's scientific community made a significant contribution to studies undertaken by the Intergovernmental Panel on Climate Change (IPCC) with respect to social and economic consequences of climate change. A Russian representative led an IPCC working group on this subject. Research studies by a group of renowned Russian scientists provided continuous support to Russia's delegation on the negotiations held within the UNFCCC framework. Thanks to these scientific data, the country's negotiators had at their disposal an adequate set of arguments to uphold their position. In the mid-1990s, Russian science was a driving force behind the national policy on climate change. Directions of the scientific knowledge and political processes fully coincided. [11]

The fact that the climate change issues were handled by Roshydromet had positive influence on the development of related activities. Roshydromet supervised virtually all scientific research institutions involved in climate change studies, including the Institute of Global Climate and Ecology, Russian Hydrometeorological Centre, State Hydrological Institute, Chief Geophysical Observatory, Institute of Applied Geophysics, State Oceanographic Institute, Russian Scientific Research Institute for Hydrometeorological Information – World Data Centre, Russian Research Institute for Agricultural Meteorology, etc. [11] In 1994, Aleksander Bedritsky - the head of Roshydromet since 1993 – was appointed the Chair of Russia's Interdepartmental Commission on Climate Change (the RF Government's Decree #34 as of 22.01.1994. [15] Bedritsky also acted as Head of the Russian Delegation to the UNFCCC COPs for many years. [25]

The Russian Ministry of Foreign Affairs provided Roshydromet with substantial support during all the UNFCCC negotiations. Initially experts from the Ministry's Department of International Scientific and Technical Cooperation and subsequently Department of International Organisations ensured all the necessary diplomatic components of the negotiation process. The role of other Russian ministries and agencies was minimal during that period, coming down to the occasional inclusion of their

[11] The then Head of the Division for Climate Change Research, State Hydrological Institute, St. Petersburg
[12] The Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles.

representatives in the delegations. The then Ministry of Fuel and Energy of the Russian Federation was most involved. Initiatives by one of the Ministry's officials resulted in the climatic issues being taken into account when developing the national energy policy. [11]

S. Kurayev [11] claims that in the beginning of the 2000s first initiatives in Russia in relation to ratification of the Kyoto Protocol faced strong scepticism by rather a large number of Russian scientists. At the same time, the author emphasises the consistency of the endeavours by the Russian Ministry of Foreign Affairs in bringing the Kyoto Protocol into force. Russia ultimately ratified the Protocol in November 2004 (pursuant to Federal Law #128 as of 04.11.2004). [16]

In autumn 2003, the city of Moscow hosted the World Scientific Conference on Climate Change initiated by the then President of the Russian Federation Vladimir Putin. The Conference aimed at comprehensive discussion of the climate change problem, adaptation measures for population and the economy, as well as the development of recommendations on reducing anthropogenic impacts on the climatic system. These activities were intended as joint effort of scientists, governments, businesses and the public. The issues that were discussed at the Conference included regional and global aspects of climate change; scientific aspects of the problem: ocean, atmosphere, carbon cycle; climatic models and their reliability; climate change forecasts and scenarios; climatic monitoring; extreme events; adverse and beneficial environmental, social, health and economic consequences of climate change; adaptation and vulnerability; economic assessments of damage and loss prevention; the role of businesses in the implementation of the UNFCCC and its protocols; opportunities of the Kyoto mechanisms; and scientific substantiation of political decisions with respect to climate change. [28]

In his opening speech to the Conference, President Putin accentuated that comprehensive scientific analysis together with legal, economic, social studies and broad support from the public would constitute the basis for establishing an integrated international framework for climate change. [20]

In May 2007, the 15th World Meteorological Congress re-elected Aleksander Bedritsky[13] as the President of the WMO Executive Council. In response to this event, Russia's Ministry of Foreign Affairs stated that the re-appointment testified to the recognition by the international meteorological community of Bedritsky's personal tribute and contribution of the Russian Federation to the international efforts on adaptation to climate change and prevention and mitigation of disasters' consequences. [26]

In 2007, Yuri A. Israel – Academician of the Russian Academy of Sciences, President of Russian Environmental Academy, Deputy Head of IPCC, Director of Russian Institute of Global Climate and Ecology represented the Russian Federation in the IPCC group [4] that was awarded the Nobel Peace Prize in 2007 for their efforts to build up and disseminate greater knowledge about man-made climate change [14]. Yuri Israel also reported during Moscow-Beijing video-conference on climate change[14] held in December 2007 that volcanic particles could help cool the Earth. According to Israel, experiments undertaken by Russian scientists showed that the world's temperature could drop 0.5 to 1 C a year if 1 million tons of volcanic particles were sprinkled across the globe from 10 to 14 km in the sky. This method was claimed to be more effective than some mechanisms stipulated in the Kyoto Protocol to mitigate global warming. [5]

In 2006, Climate Change Subgroup was set up as part of the Environment Dialogue between the RF Ministry of Natural Resources and the EC DG Environment within the framework of Russia-EU Partnership in the sphere of environmental protection [27]. The Subgroup is jointly chaired by Viktor Blinov, Head of Roshydromet Administration for Scientific Programmes, International Cooperation and Information Resources, and Artur Runge-Metzger, Head of Unit for Climate Strategy, International Negotiation and Monitoring of EU Action, DG Environment. In 2007, Subgroup held three meetings/workshops that focussed on the following issues [27]:

- adaptation and activities after 2012 (Moscow),
- regional approaches to adaptation (Nizhniy Novgorod),
- and emissions trade (Brussels).

[13] Russia's Permanent Representative in WMO, Head of Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet). Bedritskiy already acted as the WMO President during 2003-2007.
[14] The conference was part of an exchange program between Russia and China

A joint Russia-EU workshop on adaptation to climate change took place in the city of Nizhniy Novgorod in September 2007. The workshop was initiated by the Climate Change Subgroup under the Russia-EU Dialogue on Environment and was a joint effort of Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) and the EC DG Environment, with participation of the Government of Nizhnij Novgorod region and the Upper-Volga Interregional Administration on Hydrometeorology and Environmental Monitoring[15]. [21]

The workshop convened a large number of participants, including representatives of the regional administration, territorial branches of the Federal ministries and agencies, scientific and research institutions, as well as non-governmental organisations. The European side was represented by experts from the European Commission, the EC Representative office in Moscow, and scientific institutes and universities from Spain, France, Sweden and Hungary.

The Russian party presented Strategic Forecast of climate change in the Russian Federation for 2010-2015 and its impacts on Russia's economy. The Strategic Forecast was prepared and published by Roshydromet in 2006. It analyses the climate change tendencies in different regions of the Russian Federation and provides recommendations on the primary adaptation measures for different sectors of the economy (agriculture, water resources, energy and construction) and public health on the regional level. The Forecast also emphasises the necessity for the following measures:

- to consider both negative and positive consequences of climate change so that the adaptation measures help offset or strengthen the impacts;
- to conduct macroeconomic evaluation of the climate change consequences and regional adaptation measures;
- to ensure early detection and forecast;
- to prioritise adaptation measures when drafting Federal and regional development strategies.

Both the Russian and European parties acknowledged that the workshop was one of the pioneer international initiatives on the climate change adaptation that gave the participants an opportunity for expert knowledge exchange. Priority areas for further bilateral cooperation on this initiative were also determined, including [21]:

- implementation and support to research studies both on the Federal and regional levels;
- strengthening the bilateral scientific collaboration in developing adaptation measures for different sectors, including transport which so far has been given insufficient attention;
- development of the unified approaches and criteria for carrying out research works;
- risk assessment;
- awareness raising and involvement of all stakeholders, including investors, decision-makers and scientists.

In February 2007, British Council, the UK Centre for Ecology and Hydrology, and St. Peterburg's Chief Geophysical Observatory held in the city of St. Peterburg a scientific conference on the role of anthropogenic factors in climate change. Following the conference, one of the organisers of the conference Dr. Igor Shkolnik noted that while in the UK scientists and politicians agreed on the fact that anthropogenic intervention had significantly changed the environment, there was not yet such unanimity of opinion in Russia. Although, the Chief Geophysical Observatory largely supported the hypothesis that global warming had been to a great extent a result of man-made activities. [7]

An international conference on climate change adaptation and its role in sustainable development of the regions was held in the city of Murmansk on 13 May 2008. The conference was organised by UNDP and Russian Regional Environmental Centre (RusREC), with support from Roshydromet, Administration of Murmansk Region and Institute for Industrial Ecology of the North under the Kolsky Scientific Centre of the Russian Academy of Sciences. Among participants of the conference were representatives of the Ministries, Russian Academy of Sciences, Faculty of Geography of the Moscow State University, Scientific and Research Institute of Roshydromet, regional businesses, European Commission, Regional Environmental Centre for Central and Eastern Europe, and the World Bank. [22]

[15] Roshydromet's territorial body

The conference provided an opportunity for Russian and foreign scientists to present findings of the research studies on climate change impacts upon the key economic sectors of Arctic and Murmansk regions, including marine transport, coastal areas, fuel and energy sector, agriculture and water resources as well as the recreational potential, public health and lifestyle of the Indigenous Peoples of the North. There was also an opportunity for exchanging practical experience in development of the regional adaptation strategies, their funding and integration into the regional development programmes.

The conference passed a resolution that outlined necessary adaptation measures for Murmansk region, including the expansion of international cooperation in the sphere of risk assessment and adaptation, the transfer of knowledge and experience in regional adaptation measures, identification of the key sectors dependent on climate change and the most vulnerable social groups, undertaking a cost-benefit analysis of the adaptation measures and developing an adaptation strategy for the economic decision-making, enactment of relevant legislative acts and adjustment of the existing technical regulations in the light of climate change. The importance of creating sufficient incentives for scientific research on the climate change adaptation in Russia and strengthening potential of Russian experts has also been acknowledged.

The resolution also notes that development of an effective adaptation strategy is a complex task that requires concurrent actions on the different administrative levels and the maximum involvement of all stakeholders, including decision-makers, businesses, and the public. Given the active and full participation of all stakeholders, an adaptation strategy can already be adopted during this year which is extremely important taking into account the speed of climate change in the Arctic region. [22]

In September 2008, the RF Ministry of Energy set up *Steering Committee for Energy Conservation & Energy Efficiency*[16]. The Steering Committee was formed in accordance with the Ministry's Edict #75 dated 15.09.2008 and pursuant to the RF President's Act #889 dated 04.06.08 "On Improvement of Energy and Environmental Efficiency of Russian Economy", and following an instruction from the RF Government.

Ministry of Energy sees the goal of the Committee in co-coordinating activities of the Federal and regional authorities as well as businesses in implementation of the country's energy efficiency policy and fulfillment of the energy saving potential. The Steering Committee is aiming at the involvement of business sector in the energy efficiency remit, also by fostering private-state partnership. By setting up the Committee, Ministry of Energy unites the efforts of the Federal centre and regional constituents thereby strengthening a regional component of the energy efficiency policy, as well as engages with the business community to increase economic appeal of the policy.

Ministry of Energy has also drafted a conceptual basis for the Federal Task Programme (FTP) *"Improving efficiency of energy consumption in the Russian Federation"*, which is now under consideration of the relevant Ministries and agencies. The concept for the FTP hinges on the implementation of scientific and research and development works to design state-of-the-art energy efficient equipment and technologies, realisation of pilot projects, increased use of the alternative energy sources and initiation of the energy saving activities in the public sector. It is expected that the result of such activities will be a 7.65% decrease in energy intensity of the country's GDP by 2015, and saving of the fuel and energy resources in the country's energy demand will reach 100 million tonnes of fuel equivalent per year.

In addition, the Ministry will also be implementing National Project "Energy Efficient Russia".

[16] Source: http://www.minenergopress.ru/news/13557

References:

1. Artemov, N. N. (2005) *Historical experience of the USSR state policy on the natural resource use and environmental protection in the 1960 – 1980s,* Introduction to PhD Thesis. URL: http://bankrabot.com/work/work_43313.html

2. The Asahi Glass Foundation (1998) *Blue Planet Prize 1998/ Commemorative lectures. Prof. Mikhail I. Budyko.* URL: http://www.af-info.or.jp/eng/honor/98lect-e.pdf

3. The Asahi Glass Foundation. (1998) Blue Planet Prize 1998/ Commemorative lectures. Global Climate Warming and its Consequences. Prof. Mikhail I. Budyko. URL: http://www.af-info.or.jp/eng/honor/98lect-e.pdf

4. ATV (2007). *Interview with Yuri A. Israel.* Nochnoj Polet programme, 24 December 2007. URL: http://www.atv.ru/programs/fly/announces/2007/12/24/urijizrael/

5. China Daily (2007). Volcanic particles 'can help cool' Earth. 18 December 2007. URL: http://english.hanban.edu.cn/english/environment/236036.htm

6. *Doctrine on the Development of Russian Science* (1996). The State Centre for Scientific Research and Statistics. URL: http://www.csrs.ru/Public/Others/Constitution.htm

7. Dolgosheva, A. (2007). *Weather forecast for 2057.* Vedomosti of Saint-Petersburg, No 036 as of 28.02.2007. URL: http://www.spbvedomosti.ru/print.htm?id=10241155@SV_Articles

8. *Environmental Doctrine of the Russian Federation* (2002). Web-site of the Russian Transport Safety & Security Fund. URL: http://www.oftb.org/rus/problem/ecodoctrina.html

9. *Federal Law on Science and State Scientific & Technical Policy* (1996). The State Public Scientific and Technical Library of Russia. URL: http://www.gpntb.ru/win/ruszak/ip/zakon.html

10. Golitsyn, G.S., and Israel, Yu. A. (1998). *M.I. Budyko – The Blue Planet Prize Laureate.* URL: http://vivovoco.rsl.ru/VV/NEWS/PRIRODA/PR_12_98.HTM

11. Kurayev, S. N. (2004) *Some Comments on the Climate Policy in Russia*. Russian Regional Environmental Centre. URL: http://www.rusrec.ru/ru/news/168

12. *List of technologies critical for the Russian Federation* (2006). Web-site of Security Council of the Russian Federation. URL: http://www.scrf.gov.ru/

13. Ministry of Natural Resources and Environment of the Russian Federation. *Official web-site*. URL: http://www.mnr.gov.ru

14. *The Nobel Peace Prize for 2007.* Official web site of the Nobel Foundation. URL: http://nobelprize.org/nobel_prizes/peace/laureates/2007/press.html

15. *On Establishment of Interdepartmental Commission of the Russian Federation on Climate Change* (1994). The RF Government's Decree. Federal legislation web-site. URL: http://infopravo.by.ru/fed1994/ch03/akt15554.shtm

16. *On Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change* (2004). Federal Law. Document database on the official web-site of President of the Russian Federation. http://document.kremlin.ru/doc.asp?ID=24841&PSC=1&PT=1&Page=1

17. Petrov, M.P. (2003). *On a situation in the Russian science.* Zvezda Monthly Independent Journal, No.7, April 2003. URL: http://www.astro.spbu.ru/staff/nsot/discussion/petrov.html

18. *Principles of the Russian Federation's Policy on Scientific and Technological Development until 2010 and in the Long Term* (2002). Document database on the official web-site of President of the Russian Federation. http://www.kremlin.ru/text/docs/2002/03/94283.shtml

19. *Priority Areas for the Scientific, Technical and Technological Development in the Russian Federation* (2006). Web-site of Security Council of the Russian Federation. URL: http://www.scrf.gov.ru/

20. Putin, V.V. (2003). Opening speech to the World Conference on Climate Change. Moscow, 29 September 2003. URL: http://www.kremlin.ru/text/appears/2003/09/52992.shtml

21. Russian Regional Environmental Centre (2007). *Joint Russia-EU workshop on adaptation to climate change*. URL: http://www.rusrec.ru/en/news/1423

22. Russian Regional Environmental Centre (2008). *Outcomes of International Conference on adaptation to climate change held in Murmansk on 13 may 2008*. http://www.rusrec.ru/ru/news/1504

23. Shmygleva, A.V. (2003). *Historical aspects of the environmental policy development in Russia (XX century).* INECA Eco-bulletin No 2 (85), February 2003. URL: http://www.ineca.ru/?dr=bulletin&pg=content&number=0085008

24. Shulenina, N.V. (2003). *The environmental policy of contemporary Russia: from demands to arguments*. Bulletin of Peoples' Friendship University of Russia. Political Science Series. No 4, 2003. URL: http://www.humanities.edu.ru/db/msg/50956

25. Statement by Joke Waller-Hunter, Executive Secretary, United Nations Framework Convention on Climate Change to the World Conference on Climate Change. Moscow, 29 September 2003. URL: http://unfccc.int/files/na/application/pdf/stat_290903.pdf

26. The UN News Centre (2007). URL: http://www.un.org/russian/news/fullstorynews.asp?newsID=7620

27. Vikulova, E. (2008). *Presentation on Russia-EU Subgroup for Climate Change.* Roshydromet. 28 February 2008. URL: http://www.rusrec.ru/files/01_viculova_climate_change_subgroup_rus.ppt

28. *World Scientific Conference on Climate Change.* (2003). Database of the Resource Centre for NGOs. URL: http://db.ngo.ru/info.nsf/94edd34e5b97fbb3422566f5007c8a3f/4cb3232a9c5c7943c3256ce9001eaae5!OpenDocument

Appendix 2

Literature review for the UK
Science and policy-making in UK – examining the linkages

Policy-making is the process by which governments translate their political vision into programmes and actions to deliver 'outcomes' – desired changes in the real world. Governments are being faced with increasingly complex issues, and the global and national environment in which departmental staff and Ministers must make strategic and policy decisions is continually changing. People are becoming more demanding and their expectations of the effectiveness and impact of government policies are rising. As a result, policy makers will be increasingly challenged if policies appear not to be delivering, and an important part of the policy making process will be the willingness to continually learn and improve.

This paper examines the role of evidence, and in particular science and scientific advice, in government policy-making in the UK. It also identifies 'routes' through which the results of scientific research and expert advice reach Government policy makers, the organisations through which this occurs and the specific organisations (and individual posts) that have been established to support policy-making.

1. Modernising policy-making in the UK

In the past there has been criticism levelled at government that short-term political pressures and inertia have too often driven policy decisions. The government identified a need to improve the quality of its decision-making and the basis on which it developed its strategic approach and policies.

In 1999 the White Paper on Modernising Government[1] said that the UK Government would be *'forward looking in developing policies to deliver outcomes that matter'* and that policies would be *'shaped by the evidence rather than a response to short-term pressures'*. It committed to improving policy-making through *'the use of evidence and research so that we understand better the problems we are trying to address'*. Pilot schemes would be used to encourage and test innovations, and the importance of gathering and using feedback from those who implement and deliver policies and services was also emphasised.

In the same year, a report from the Strategic Policy Making Team (of the Cabinet Office)[2] identified a number of characteristics of 'modernised' policy; one aspect of this was that it should be 'evidence-based' (**Box 1**).

Box 1: Characteristics of 'modernised' policy

- Strategic: looks ahead; contributes to long-term goals.
- Outcome focused: aims to deliver real change.
- Joined up: works across organisational boundaries.
- **Evidence-based: based on all available best evidence.**
- Inclusive: is fair; takes account of the interests of all.
- Flexible and innovative: tackles causes, not symptoms; not afraid of experimentation
- Robust: stands the test of time; works in practice

Source: abstracted from Strategic Policy Making Team, 1999. Professional Policy Making for the Twenty First Century. London, The Cabinet Office.

In 2001, the Centre for Management and Policy Studies[3], part of the Cabinet Office, re-iterated that the advice and decisions of policy makers needed to be 'based on the best available evidence from a wide range of sources'. For this to work in practice, relevant and diverse evidence, including from specialists, businesses, charities and the voluntary and community sectors, and through public dialogue, needs to be made available to policy makers in an accessible and meaningful form. In order to ensure that key stakeholders can comment on and influence, where appropriate, policy direction

and detail, it is important that they are involved at an early stage and continue to be engaged throughout the policy development process.

Science clearly has an important role to play in informing and influencing policy decisions. However "science tends not to be involved early enough in establishing policy priorities" and "should be more engaged with establishing the government's bigger strategic questions, typically originating in Treasury or the Cabinet Office" [4]. The "long term strategies needed to address policy issues such climate change would all benefit to varying degrees from an early scientific input"[5].

This report on Better Policy Making identified an evidence-base approach to policy making as one that:

- Reviews existing research
- Commissions new research
- Consults relevant experts and/or uses internal and external consultants
- Considers a range of properly costed and appraised options.

The last ten years have seen a marked shift in not only the UK government's attitude to science but in its application by policy makers.

2. Changing attitudes to the importance and application of science by government

Changes in the government attitude towards and the drive towards making more effective use of science and scientific evidence is explored in more detail under the following headings:

- The need for science in government policy-making
- Creating a demand for science in government
- Ensuring sound science is accessible to policy makers
- Government as an 'intelligent customer' of scientific research and authoritative advice
- Science skills within government

2.1 The need for sound science in government policy-making

In the UK, findings and recommendations from the inquiries into two major crises – BSE and the Food and Mouth outbreak in 2001 – played a key role in highlighting the crucial and growing need for policy-making to be underpinned by sound evidence, including science and scientific advice. Evidence presented to the Phillips Inquiry into BSE[6], identified that:

'… because Ministers have to answer diverse questions of ever increasing sophistication while the professional and technical capability of their Department is falling,' *(as a result of the pressure on government departments to reduce administrative costs and staff numbers)* 'their need for well-marshalled external advice must continue to grow'.[7]

Later, one of the major lessons highlighted by the Anderson Lesson Learned Inquiry into the Foot and Mouth Outbreak of 2001[8] was the need to:

'Base policy decisions on best available science and ensure that the processes for providing scientific advice are widely understood and trusted.'

Ensuring that scientific research (including, for example, data collection for continuous monitoring and the establishment of trends) can deliver relevant and timely input requires a strategic direction and long term planning to prioritise and allocate appropriate levels of public funding (for staff, laboratories, major infrastructure facilities, etc). This issue was addressed in the 2004 Spending Review, the Government published the Science and Innovation Investment Framework 2004-2014[9]. This set out Government views on the long term challenges facing UK science and innovation, and its ambitions for the contribution that science and innovation will make to economic growth and public services over this decade. It also defined the needs and funding requirements that would be necessary for the research system in the UK to deliver on these expectations.

In addition to the availability of science and scientific advice, civil servants must have the means to make effective use of data and information. "Modern policy-making calls for the need to improve a Departments' capacity to make best use of evidence, and the need to improve the accessibility of the evidence available to policy-makers." At that time their findings showed that "that there is some way to go on both these issues"[10].

In November 2007, Sir David King (the then Government Chief Scientific Advisor) told us that "science and a good evidence base is integral to tackling the challenges of the 21st century, whether it's the environment, resources, food production, water resource, terrorism and wealth creation"[11]. This would need to be generated from a number of different sources and the formulation of the policy solutions would increasingly benefit from cross-departmental working.

Tackling climate change, for example, is likely to require the continuous development of more and more innovative policies, together with a growing need for multi-faceted policy solutions. Within any single government, this is likely to require resources from a number of different departments. Formulating effective policy solutions will require an integrated approach involving resources from more than one government department. There is a growing recognition that this is required but it is often acknowledged that more needs to be done.

2.2 Creating a demand for science in government

'The first step in ensuring that politicians are ready to listen, and that scientists are able to speak, is to choose the right topics' (Sir David King – valedictory speech – Nov 2007).

In its response to the House of Commons Science and Technology Committee's report on Scientific Advice, Risk and Evidence Based Policy Making, the government agreed that "there is much further still to go in ensuring that science is managed and used by Government to best effect" and that it is "committed to continuing to improve its use of scientific advice, its management of risk, and its use of evidence to support policy." **Box 2** explores further some of the key messages from this report.

In Defra there is a complete acceptance that science plays a key role at the highest level in everything they do. By contrast, Department for Culture Media and Sports (DCMS) has only recently appointed a Chief Scientific Adviser (CSA). This occurred after a review instigated by the then Office of Science and Technology. A review led by Dr Michael Dixon (Director of the Natural History Museum which receives funding via DCMS) provided recommendations as to how DCMS could make better use of scientific evidence[12]. The appointment of the Chief Scientific Advisor and creation of a scientific advisory committee took place in September 2008 and reflects how the importance of science in government has spread to those departments that do not have such a strong tradition of using scientific evidence.

Box 2: *Establishing a position for science within the Cabinet*

The key role that science can play in government was established during the UK's foot and mouth disease outbreak in 2001.

This event demonstrated that science could deliver in real time a solution to a massive national problem. The outbreak began on Feb 20, 2001 and was still climbing exponentially by March 21. The Cabinet was at a loss as to what to do. The Chief Scientific Advisor was able to produce epidemiological models that showed exactly how to turn the increase into an exponential decay. The approach was implemented because there was no other solution being offered. And the outcome followed exactly what the science predicted. This was a key demonstration of how complex scientific phenomena could be modelled in order to deliver policy-relevant information and advice that worked. The key role of science in government's emergency response has been evident since then, in the handling of similar situations.

2.3. Ensuring sound science is accessible to policy makers

Over a number of years the Government has been working to improve the internal structures and initiatives through which it advances and supports evidence-based policies, and facilitates and integrates the use of science in policy-making. The Government has recognised the importance of policy makers having access to and being able to make effective use of science and scientific advice, and several Departments host key science advisory and policy units.

The Cabinet Office plays a key role in promoting an evidence-based approach to policy making however all Secretary of State have an acknowledged shared responsibility for ensuring that the Government is using scientific advice appropriately in policy development. They are required to provide clear leadership, providing a driver for improved accountability and implementation of good practice within and across their departments.

The Government Office of Science (GO-S), located in the Department for Innovation, Universities and Skills (DIUS) (refer to Appendix 5 for details of government structure); reports to the Prime Minister and the Cabinet, and makes a major contribution to the effective use of science and evidence in policy making. The role of this office is to co-ordinate and develop good practice on how Government should seek and use scientific advice in policy making, on the presentation of that advice and on the processes used to make decisions based on it. The Government Chief Scientific Adviser (GCSA), Professor John Beddington, whose office is in DIUS, heads GO-S (see **Box 3** below).

Box 3: Role of the Government Chief Scientific Advisor (GCSA)

The GCSA has for responsibility providing the Prime Minister and Cabinet with access to quality science as well as with guidance on science policy issues. The appointed person defines the role in detail. The current GCSA is Professor John Beddington (from 1st January 2008) and was formerly Sir David King, who held the post for 7 years until the end of 2007. In addition to the GCSA, all government departments also have the opportunity to appoint a Departmental Chief Scientific Advisor (DCSA), and are encouraged to do so. Both the Government and all the Departmental CSAs are appointed from outside government to provide an independent scientific voice to ministers/policy makers.[13]

In speaking to the HoC Committee on Innovation, Universities and Skills, Sir David King emphasised:

1. the importance of the "challenge function" in the government's use of scientific evidence
2. that it is crucial for each CSA to understand how the political system works and to interact fully with the political side
3. that the CSA must maintain independence from the government, but also balance between keeping the trust of the public and keeping the trust of government ministers, PM and cabinet

In addition to the Government Chief Scientific Advisor, all departments have appointed a Departmental Chief Scientific Advisors (DCSAs) (see **Box 4** below), and all those that have a significant spend on research and development (R&D) are also required to prepare a Science and Innovation (S&I) Strategy (overseen by the DCSA). Government departments are major investors in R&D and are therefore in a strong position to "drive innovation by using science and technology to tackle policy problems", including climate change. The Science Budget of over £2.8 billion per annum is managed by DIUS and is allocated to research programmes through the seven Research Councils (see Section 3.2 below).

In order that the government's strategic thinking, policy development and investment plans are well informed by sound visions of the future and knowledge of the risks and potential of science and

technology, the government utilises 'horizon scanning'. Two cross-government units have been established specifically for this purpose:

- Foresight Programme
- Horizon Scanning Centre

> ***Box 4: Role of Departmental Chief Scientific Advisors (DCSAs)***
>
> A community of DCSAs, introduced by departments over time since 2002, supports the Government. Their principal role is to:
>
> - support the use of scientific evidence in policy-making;
> - ensure that their departments are intelligent customers for science;
> - promote and support the interests of scientists and engineers in their departments;
> - ensure the quality of the science used in their departments; and
> - explain science inside government and engage with public opinion.
>
> CSA must be able to contribute fully to strategic decision making and high level policy development within the department if their contribution is to be maximised. Departmental CSAs must be given the opportunity to play a full and active and yet independent role at board level, and be in a position to identify where their involvement is required, rather than being brought in where others have decided that there is a need for their input. DCSAs must be in a position to be fully engaged in the policy development process, not watching from the sidelines.

Both the Foresight Programme and the Horizon Scanning Centre are located within GO-S and further details of their work are provided in Section 4.1 below.

Departments are increasingly being encouraged to work together, particularly on complex issues, and to mobilise R&D to help solve public policy challenges[14]. A number of initiatives have been established to increase the availability of scientific data, advice and information resources to government departments, inform policy-making and facilitate well-informed cross-departmental work. In the area of climate change, this includes:

- Office of Climate Change (OCC)
- Committee on Climate Change (CCC).

Further details of their work are provided in Section 4.1 below.

2.4 Government as an 'intelligent customer' of scientific research and authoritative advice

There is a strong need for the civil service to maintain sufficient scientific literacy to render it effective, or 'intelligent', as a customer of science and research.

"it is only possible for Government to handle risk and science appropriately if it has a sufficiently expert and critical in-house capability to allow it to formulate the questions it needs to ask of external experts" ..... "securing scientific advice depend[s] on an in-house capability to handle it—identifying when science can contribute to policy, seeking it out from a wide range of sources and interpreting its relevance to policy"[15].

As demonstrated above the government has been striving towards increasing the use of scientific evidence in policy making. However, the extent to which individual Departments specifically make use of science varies in line with their remit, and the historical significance that has (or has not) been given to science within their policy development work. For example, Defra has a long and strong association with the use of science whereas the Department of Culture, Media and Sports has only recently appointed its first departmental Chief Scientist Advisor. Defra's science base involves

research programmes valued at around £145 million a year. The department defines the acquisition of evidence for policy in three distinct phases:

1. Hard facts (data, trends, survey information)
2. Analytical reasoning
3. Stakeholder opinion

Using the above three stages allows any weaknesses to be resolved, for example if there are weakness in the analysis then going to the stakeholders will allow an understanding of different interpretations and opinions to be considered. This type of approach assists in overcoming the situation where good information is used poorly or poor information is used well. The Science Strategy Team has explored the relationship between evidence and policy-making and published these findings in the report 'Is your evidence robust enough? Questions for policy makers and practitioners'[16]

A different but related approach has been taken through the establishment, in May 2008, of the Expert Resource Centre for Public Dialogue on Science and Innovation. This was created within the Sciencewise programme[17] and aims to help policy makers commission and use public dialogue to inform policy decisions in emerging areas of science and technology. It will utilise stakeholder consultation and dialogue to assess what the public think about an issue before policy commitments are made. This 'dialogue' (a form of evidence) can come from a large range of sources, for example from public consultation or engagement with a particular spectrum of society.

There have also been a number of recent initiatives to improve the linkages between science and policy – for example, the Council for Science and Technology have produced a report on 'How academia and government can work together'[18].

The importance of monitoring the use and impact of scientific evidence and advice in government has also been recognised. In July 2005, the House of Commons appointed a Select Committee on Environment, Food and Rural Affairs to examine the expenditure, administration and policy of Department for Environment, Food and Rural Affairs' (Defra) and its associated public bodies including the Environment Agency, Natural England and the Commission for Rural Communities. One of the key components of this review was to examine how Defra uses and applies science to underpin policy development and monitor policy impacts. More recently the House of Commons (see **Box 5** below) has also reported on the need to ensure that scientific advice is being used appropriately and to maximum effect, and that existing government guidelines are being used.

Box 5: Monitoring the use of scientific advice in government

The UK government is using increasing amounts of science. A 2007 House of Commons report[19] highlighted the need for some assurance that this is being used properly.

- Recommendation 41: quality assurance is required of the scientific information used by a government department.
- Recommendation 42: the independence from government in pilots and trials of new research/policies.
- Recommendation 46: guidance has been issued on the use of scientific analysis but there has been little monitoring of its implementation. Departmental CSAs need to be more proactive in ensuring the principles defined are adhered to.
- Recommendation 47: a formal and accountable system of monitoring the quality of scientific advice is required to improve public confidence in the way government utilises its evidence and the validity of its evidence based policies.

The Government has recognised that monitoring the use of the 'Guidelines in Scientific Analysis in Policy Making' needs further development. Monitoring is achieved via a number of routes, specifically as part of the Science Reviews, through Scientific Advisory Councils, and through annual monitoring by Departmental Chief Scientific Advisors.

2.5 Improving science skills in the Civil Service

The government recognises that the civil service staff must be equipped with relevant skills and training led to the development of specific policies and initiatives. Sir David King acknowledged that the civil service may not be as skilled as it could be in using and applying scientific information:

"*we do need to raise the bar in ensuring we have a scientifically literate civil service. They should be able to make the right decision based on the very best evidence. This does not always happen and we must not get into a situation where Civil Servants try and second guess Ministers wishes and try and fit the evidence to the answer.*"[20]

Others have also argued that the culture among Civil Service policy-makers is such that many people with scientific qualifications and experience felt it necessary to keep that background hidden so as not to prejudice their chances of advancement. In December 2007, Sir David King[21] said "when it comes to rising up through the senior Civil Service and into positions, permanent secretaries ultimately, I think the pathways to promotion are bleak for scientists…. The net result is that in the upper echelons of the Civil Service, it is a constant battle to see that wherever possible the scientific evidence is put before the policy advice system." This situation is not conducive to good scientific involvement in government policy-making. It also seemed true (according to Sir David King) that in some instances departmental Chief Scientific Advisors (CSAs) can be marginalized because the policy advisers are slightly uncomfortable dealing with science. This culture has begun to change, but only slowly.

In recognition of these additional needs, there has been a significant increase in the level of professional training provided to government officials in order to increase their awareness of the availability and use of evidence, and increase their skills in recognising, analysing, applying and presenting scientific data, advice, etc in their day-to-day decisions and in policy development. The government has produced a large number of documents to advise and support civil servants in their work (e.g. the '*Guidelines On Scientific Analysis In Policy Making*'[22] published in Oct 2005 and '*Analysis for policy: evidence-based policy in practice*'[23] which reports on the findings of an assessment of the extent to which the use and effectiveness of robust, research evidence in government decision making). The UK Civil Service also provides a public website that aims to promote strategic thinking and improve policy making and delivery across government through the provision of a wide range of evidence and policy focused resources[24].

3. Promoting and facilitating links between science and policy-making

UK government comprises of a large number of departments (over twenty) and within this structure there are also a wide range of government offices, units and publicly funded programmes (schematic diagrams of the organisational structure is presented in Appendix 5 - focusing particularly on those departments, etc that are most relevant to environment science and climate change). Although a large number of departments make use of science and other sources of evidence in their policy-making, a key department in terms of providing the practical links, including the flow of research funding, that underpin science and scientific advice is the Department of Innovation, Universities and Skills (DIUS).

3.1 Department for Innovation, Universities & Skills (DIUS)

The overall aim and mission of DIUS is "to build a dynamic, knowledge based economy - the new Department will draw together the nation's strengths in colleges, research, science and universities" - it provides a strategy for how science can improve the social and economic position of the UK. The report 'A vision for Science and Society: a consultation on developing a new strategy for the UK', July 2008[25] provides a clear outline of the overall Departments thinking around the delivery of its stated goals.

One of the key focus areas is the development of knowledge that will benefit overall UK economic development. DIUS has six Department Strategic Objectives of which DSO6 - to foster better use of science in government – is of particular relevance to the promotion and facilitation of links between science and policy making. DIUS also has as one of its objectives to make the UK a centre for world-class science.

As indicated above, the office of the Government Chief Scientific Advisor (GCSA), Professor John Beddington, is located within DIUS. The GCSA has responsibility for providing the Prime Minister and Cabinet with quality science as well as guidance on science policy issues.

Annually £2.8 billion is invested to help deliver the government's objectives of science and innovation. DIUS oversees the allocation and overall management of funding assistance to seven major research councils. The ministerial team residing under DIUS[26] has four members and of these Lord Paul Drayson is responsible for the research councils and most of science/technology councils and boards[27].

3.2 Funding science – the role of the UK Research Councils

Research Councils UK is a strategic partnership and represents the seven councils, which are:

- Arts and Humanities Research Council (AHRC)
- Biotechnology & Biological Science research Council (BBSRC);
- Engineering & Physical Sciences Research Council (EPSRC);
- Economic & Social Research Council (ESRC);
- Medical Research Council (MRC);
- Natural Environment Research Council (NERC);
- Science and Technology Facilities Council (STFC)

Research Councils UK has a ring fenced budget of approximately £2.8 billion per annum, which will be increasing to £3.4 billion by 2010[28]. This investment is split between the seven research councils. The government has overall control of the level of funding allocated to each research council but not how this money is then allocated to individual projects.

Projects undertaken by the research councils are aligned under four major programmes:

- Energy
- Living with Environmental Change
- Global Threats to Security
- Ageing: Long Life, Health and Wellbeing.

The Comprehensive Spending Review outlined by the Treasury also influences the spending allocations for science and research; this review identified the following key themes that represent strategic challenges for the UK:

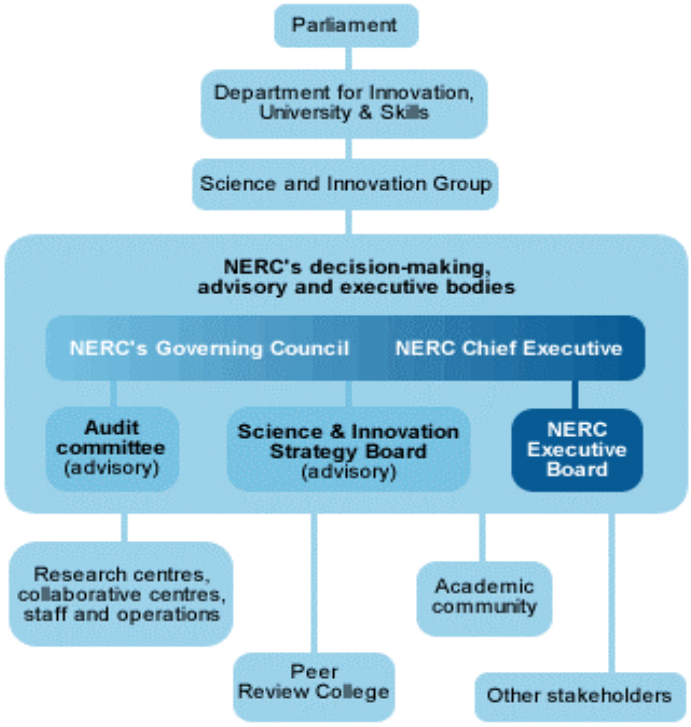
- Rapid increase in old age of the UK population
- Increasing cross border competition, balance of economic activity shifting to emerging markets such as China and India
- Acceleration in the pace of innovation and technological diffusion
- Continued global uncertainty surrounding international terrorism and conflicts
- Increased pressure on natural resources from growing economies and populations combined with a sustained demand for fossil fuels.

One of the key research councils involved in environmental science and work on climate change is the Natural Environment Research Council (NERC) - all the research councils use similar structures and processes to allocate and manage their funding and research programme. NERC is used here as an example.

NERC has recently undertaken a wide consultation of its stakeholders to develop its strategy for 2007-12. This strategy outlines a number of objectives that funding must meet such as the continued development of UK and international environmental science, and future skills development.

Figure 1 shows the organisational structure of NERC in relation to the government and the overarching Science and Innovation Group.

Figure 1: Organisational structure of NERC



(Source: NERC)

A key body in defining the strategy for NERC is the Science & Innovation Strategy Board (SISB); its remit includes:

- Development of NERC's integrated science strategy
- Advise on the balance of science in the portfolio
- Advise on the strategic funding of new programmes and initiatives
- Assess and advise on UK science activities and achievements.

Three funding streams deliver the strategy:

- National capability
- Research programmes
- Responsive mode – the encouragement of 'new' academic research.

The National Capability Advisory Group (NCAG) is a sub-group of the SISB, and is responsible for considering and advising on NERC's long term national capability needs. This style of structure therefore represents one that is significantly detached from short term government policy.

To complement the work of the research councils, there are also a wide range of institutions, processes and communication mechanisms that have been established to promote and facilitate the links between science (and scientist) and policy-making (government). These are both formal mechanisms and roles (with a specific and defined responsibility in this regard) and more informal networking arrangements. Although the former is usually associated with government, there are also a number of key non-governmental institutions, such as the Royal Society, that make an important contribution (see Section 4.2 below).

4. Evidence gathering, expert advice and communications

Effective linkages between science and policy-making rely on the flow free of information and advice (evidence), in a form that can be understood by both parties. There is also increasing recognition that policy development processes need to include and engage within wider stakeholders, including the general public. Appendix 5 – second figure – provides an illustration of how science and policy interacts as a result of the connections (both formal and informal) between a wide range of different organisations and bodies. The following examples illustrate this diversity.

4.1 Within government

As mentioned previously, the scientific advisory structure was established by the UK government to ensure that policy-makers had access to the best available evidence to support strategic decisions and the development and implementation of policies by all departments. The major drive towards the evidence-based approach relies on key role played by Government Chief Scientific Advisor and the Departmental Chief Scientific Advisors in bridging the gap between science and policy, and ensuring that ministers are well advised.

There are also a number of UK government programmes and offices whose primary objectives and function are to make connections between science and policy, these include:

- **Foresight Programme**[29]
  Based in the Government Office for Science within the Department for Innovation, Universities and Skills, this programme aims to inject long term planning into cross-departmental challenges faced by the UK – 'visions of the future using robust science'. These are intended to be used by policy makers to help the development of strategies and policies that take account of potential risks and opportunities posed by science and technology. Foresight also aims to improve the use of science and technology within Government and by society and by looking "beyond normal planning horizons to identify potential opportunities from new science and technologies and actions to help realise those opportunities". An example of how work under the Foresight Programme on future flooding prevention and coastal protection informed long term strategic planning and government spending plans in provided in ***Box 6*** *below.*

> ***Box 6: An example of the impact of the UK Government's Foresight programme***
>
> Translating scientific outcomes into policy can be difficult as Ministers change on shorter timescales than the research is produced. Work under the Foresight Programme feeds directly into government policy and in this way is able to inform strategic planning at an early enough stage to enable the government to commit budget over the long term.
>
> <u>Flood and coastal defence</u>
> Following the publication of the Foresight research on future flooding, the amount of government spending on flood and coastal defence management in the Environment Agency increased from £300 million per year to £600 million per year. It currently stands at £700 million per year with a commitment for further increases. This is exactly what the Foresight work recommended. Building the necessary improvements throughout the UK's flood defence schemes will take time, but the UK is now the first country in the world to be dealing with climate change impacts in such a thorough and consistent way.

- **Horizon Scanning Centre**[30]
  Horizon scanning is considered to be an important means of ensuring that strategic decisions are informed and challenged by the analysis of possible futures. Working

alongside the Foresight Programme in the Government Office for Science, the Horizon Scanning Centre was established as a result of a commitment made by the Government in its Science and Innovation Investment Framework 2004-2014. Outputs are strongly informed by science and existing work from Government, the private sector and elsewhere, and feed directly into decision-making in government departments and into cross-government priority-setting and strategy formation. The Centre also works to identify "the implications of emerging science and technology and enable others to act on them", and "spread good practice in departmental horizon scanning".

- **Office of Climate Change (OCC)**[31]
  Set up in September 2006, the OCC is a cross-sectoral, non-departmental body on Climate Change. Climate change is a cross-cutting issue and OCC is a shared resource across all government departments (working primarily with Defra, BERR, FCO, DfID, DfT and CLG). It aims to improve climate change policy and its delivery by providing independent support and challenge, and support Ministers to "develop future UK strategy and policy on domestic and international climate change". The OCC essentially functions as an internal consultancy group on key climate change issues and policy development for the Government. The recently appointed Committee on Climate Change is also located within OCC.

- **Committee on Climate Change (CCC)**[32]
  CCC is an independent statutory non-departmental public body that will play a key role in the UK's effort to tackle climate change. The Committee will draw on existing knowledge and information on climate science and technological developments, together with economics, business competitiveness and financial management, and will undertake its own analysis. It will provide independent, expert advice to Ministers on the five-year carbon budgets needed to achieve the 2020 and 2050 targets and to fulfill the UK's international obligations. It may also provided ad hoc advice to Ministers on climate change matters, and the creation of a low carbon economy.

- **Prime Minister's Strategy Unit**[33]
  The Prime Minister's Strategy Unit undertakes strategic and policy reviews, and has also undertaken occasional Strategic Audits of the challenges facing the UK.

DIUS also has a departmental focus on improving the way scientific information is communicated, through engaging all levels of society. *Sciencewise* (Section 2.4), a programme supported by DIUS, was established as the practical means through which to improve UK policy-making by embedding public dialogue into policy development, implementation and outcome monitoring.

4.2 External sources of expert scientific advice

Alongside the governmental processes and advisory structure, there are also a number of external bodies that are highly respected sources of scientific advice, challenge and debate on public policy areas and major issues facing the government (and in the international arena). These organisations include:

Royal Society[34]

The Royal Society is the National Academy of Science of the UK and Commonwealth. It is an independent charitable body that provides support to leading young scientists, engineers and technologists. The Society deliberately maintains a variety of funding to ensure its independence is not influenced by a single funder; 68.2% of its annual budget is provides from a Parliamentary Grant in Aid, assigned for specific projects and programmes. The society also aims to ensure the uptake of science into business and policy.

One of their latest strategic priorities is 'Influence - policymaking with the best scientific advice'. This programme is intended as a focus for the work of the Royal Society in influencing and connecting science, policy and government. In order to expand the reach of their science advisory work 'to ensure that policies on key issues are influenced by the best independent science', they are creating

an International Science Policy Centre that will 'enable national and international decision makers to take full account of the best scientific advice available'. The Centre will bring together economists, social scientists, scientists and engineers from a range of specialisms, and its work will concentrate on the following themes:

- Climate change, environment and energy
- New and emerging technologies
- Biosciences and health
- Innovation and scientific infrastructure
- International security

Over the last ten years a key approach of the Society has been to incorporate dialogue into policy studies. This has occurred as a part of projects by involving public groups, NGOs and other stakeholders in shaping the recommendations made to government. Another example of how science and policy are being practically linked is the scheme to pair Members of Parliament with a Scientist, and for each to spend time observing the others work.

Chatham House[35]

Chatham House is the historical home and recognised identity of the Royal Institute of International Affairs (RIIA). Established in the 1920s the Institute aims to be a source of independent analysis, informed debate and influential ideas on how to build a prosperous and secure world for all'. Its members include a mix of policy makers, politicians, researchers and business. The Chatham House Rule - a provision of free speech and confidentiality at meetings that still exists today - originated here. Chatham House undertakes independent research across a number of areas including energy, environment, international economics and regional studies. The independence is maintained through diverse sources of funding including via members, subscriptions and donations. Chatham House regularly publishes its research as well as hosting high profile speakers, often from UK government. It provides a location and context for interactions and the diffusion of ideas to freely take place, and thereby offers a valuable route through which UK science and policy can be indirectly influenced.

4. Concluding remarks

There are a wide diversity of formal and informal channels in the UK that provide links between science and policy. They enable a flow and exchange of information, expertise, and advice and as such form the basis for informed challenge, debate and influence. Formal structures have been established to ensure that policy makers have access to expert scientific advice and that they are able to understand, analyse and apply this information and data. There is also an increasing involvement of the general public in the policy-making processes, and in monitoring of impact of policy implementation. Specific mechanisms and programmes have also been established to promote and facilitate dialogue between and amongst scientists, members of the public and those in a position to influence policy. The allocation of funding for scientific research is open and transparent and, although government is a major source of these budgets and sets the thematic areas in line with the strategic issues facing the UK, the decisions on which specific projects and programmes are supported are taken independently. Key centres of scientific expertise and advice such as the Royal Society also retain their independence, particularly from government policy makers, by maintaining a diversity of funding sources.

A clear trend is seen towards cross-departmental initiatives, e.g. the Office of Climate Change. There is a growing recognition that solutions to complex issues such as environmental degradation and climate change require expertise from a range of disciplines, and that effective and sustainable solutions will only be found through information sharing and dialogue. The importance of international collaboration is also evident in the work of both government and non-governmental organisations.

---

[1] Cabinet Office (1999) 'Modernising Government White Paper', Cm 4310, The Stationery Office. Available online at: http://archive.cabinetoffice.gov.uk/moderngov/download/modgov.pdf

[2] Strategic Policy Making Team, 1999. 'Professional Policy Making for the Twenty First Century'. The Cabinet Office, London available online at: http://www.ruru.ac.uk/PDFs/Rhetoric%20to%20reality%20NF.pdf

[3] http://www.nationalschool.gov.uk/policyhub/docs/betterpolicymaking.pdf

[4] Evidence presented by Environment Research Funders' Forum to the House of Commons Science & Technology Committee on Scientific Advice, Risk and Evidence Based Policy Making, October 2006
[5] Response from the HoC S&T Committee to the above point (footnote 3)
[6] Para 4.60 at http://www.bseinquiry.gov.uk/report/volume15/chaptea5.htm#56902
[7] Integrating professional advice into policy making
http://www.bseinquiry.gov.uk/report/volume15/chaptea5.htm#56902
[8] Anderson report on Foot and Mouth Disease 2001: Lessons to be Learned Inquiry Report, House of Commons, July 2002. Full report is available online at:
http://archive.cabinetoffice.gov.uk/fmd/fmd_report/report/index.htm
[9] The "Science & innovation investment framework 2004-2014" is available online at: http://www.hm-treasury.gov.uk/spending_review/spend_sr04/associated_documents/spending_sr04_science.cfm
[10] Bullock, H., Mountford, J. and Stanley, R. (2001). Better Policy Making, prepared by the Centre for Management and Policy Studies can be viewed on-line at:
http://www.nationalschool.gov.uk/policyhub/docs/betterpolicymaking.pdf

[11] Sir David King in his valedictory speech, The Royal Society, 27 November 2007
[12] DCMS (2008) http://www.culture.gov.uk/reference_library/publications/5477.aspx
[13] Inferred from SDK's evidence on 5 Dec 2007. Is there a clear description of the role on Department websites?
[14] DTI's Five Year Plan 2004 on-line at: http://www.dti.gov.uk/files/file12618.pdf#page=20
[15] Evidence presented by Environment Research Funders' Forum to the House of Commons Science & Technology Committee on Scientific Advice, Risk and Evidence Based Policy Making, October 2006
[16] Shaxson, Louise, 2005. Is your evidence robust enough? Questions for policy makers and practitioners, in Evidence & Policy: A Journal of Research, Debate and Practice, Volume 1, Number 1, January 2005 , pp. 101-112(12). Publisher: Policy Press. Available on line at:
http://www.ingentaconnect.com/content/tpp/ep/2005/00000001/00000001/art00006;jsessionid=321qb704u8hd1.victoria
[17] Information on the Sciencewise Expert Resource Centre for Public Dialogue in Science and Innovation (ERC) is available online at:
http://www.dius.gov.uk/policy/science_society/sciencewise.html
[18] http://www2.cst.gov.uk/cst/reports/files/academia-government.pdf
[19] House of Commons (2007). Scientific Advice, Risk and Evidence Based Policy-Making: Government Response to the Committee's Seventh Report of Session 2005–06, HC307.
http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/307/307.pdf
[20] Sir David King in his valedictory speech, The Royal Society, 27 November 2007
[21] In evidence given to the House of Commons Select Committee on Innovation, Universities and Skills, 5 December, 2007
[22] The Government Chief Scientific Adviser's Guidelines on Scientific Analysis In Policy Making (2005) can be viewed on-line at: http://www.berr.gov.uk/files/file9767.pdf
[23] http://www.gsr.gov.uk/downloads/resources/pu256_160407.pdf
[24] http://www.nationalschool.gov.uk/policyhub/
[25] http://www.dius.gov.uk/consultations/documents/A_Vision_for_Science_and_Society.pdf
[26] http://www.dius.gov.uk/ministerialteam/index.html
[27] http://www.dius.gov.uk/ministerialteam/ianpearson.html
[28] The Allocations of the Science Budget, 2008/09 to 2010/11, Published in December 2007. Available online at: http://www.dius.gov.uk/publications/URN07114.pdf
[29] Foresight programme website at http://www.foresight.gov.uk
[30] Information on the work of the Horizon Scanning Centre, and current and past projects, is available online at: http://www.foresight.gov.uk/Horizon%20Scanning%20Centre/index.asp
[31] http://www.occ.gov.uk/about/index.htm
[32] http://www.defra.gov.uk/environment/climatechange/uk/legislation/committee/index.htm
[33] Prime Ministers Strategy Unit http://www.strategy.gov.uk/
[34] An overview of the work of the Royal Society is available from their comprehensive website at:
http://royalsociety.org
[35] More details on the work of Chatham House are available online: http://www.chathamhouse.org.uk/

Appendix 3

Schematic diagrams ('maps') showing science-policy linkages – Russia

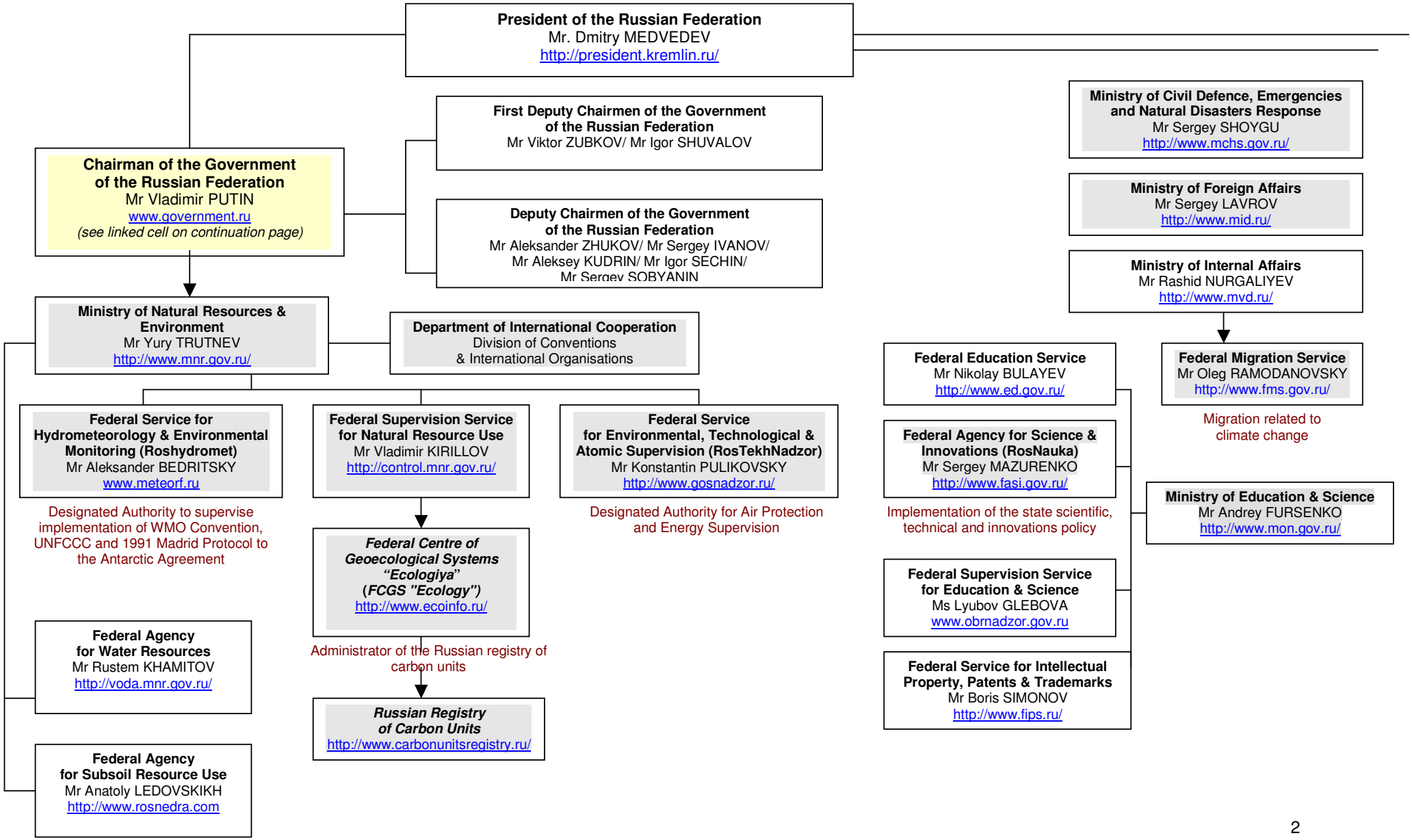
1) Russia's Federal Executive Bodies (new structure) as of September 2008 (2 sheets)

2) Russia's Representative and Legislative Bodies as of July 2008

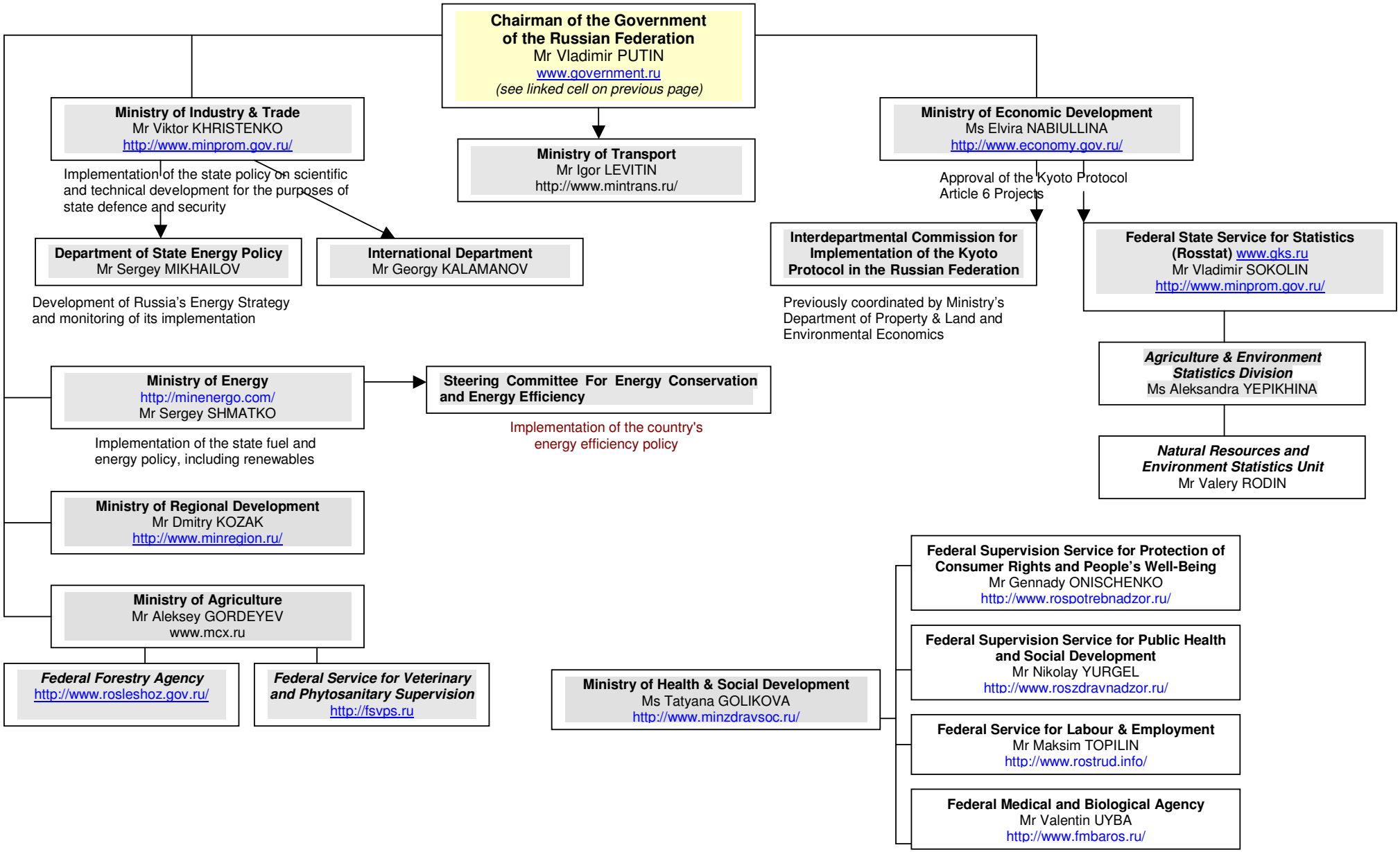
3) Russian Academy of Sciences (RAS)

- **Introduction**
- **Structure of the Russian Academy of Sciences**
- **Funding sources for RAS activities**
- **Linkages within the Fundamental Scientific Research Programme of State Academies of Sciences 2008-2012**

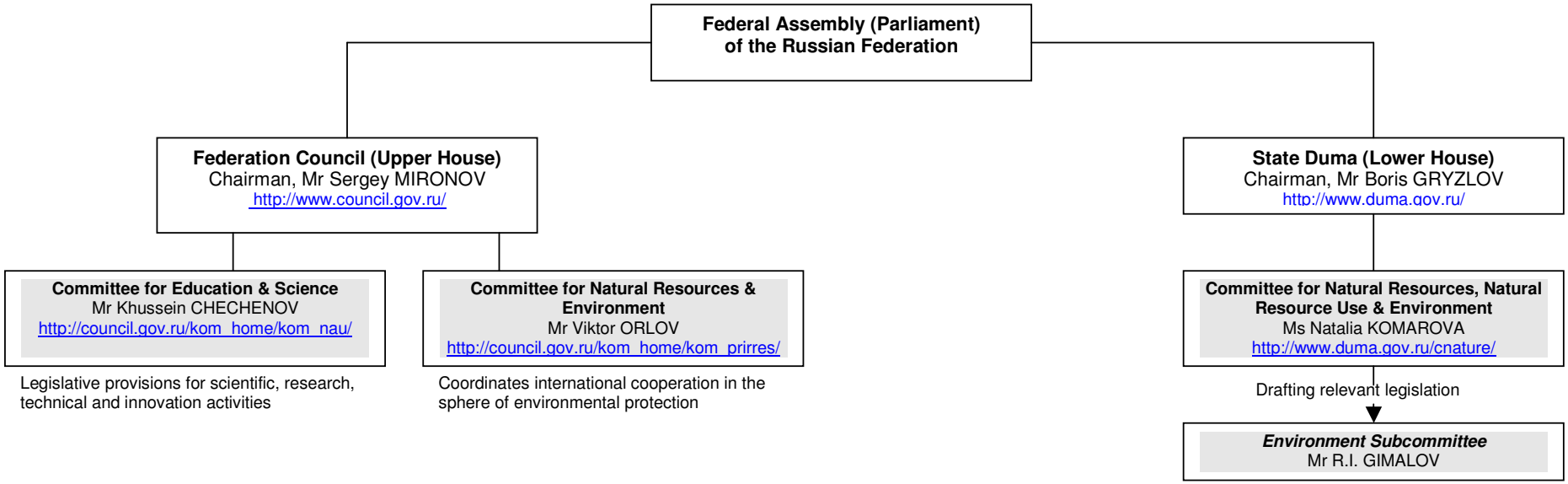
RUSSIA'S FEDERAL EXECUTIVE BODIES (NEW STRUCTURE) AS AT SEPTEMBER 2008



RUSSIA'S FEDERAL EXECUTIVE BODIES (NEW STRUCTURE) AS AT SEPTEMBER 2008 – CONTINUED



RUSSIA'S REPRESENTATIVE AND LEGISLATIVE BODIES AS AT 1 JULY 2008



RUSSIAN ACADEMY OF SCIENCES (RAS)

RAS is the governing body for science in Russia. It is an official self-governed non-profit institution with its own Charter (Statute). Mission of the RAS is *organisation and implementation of fundamental scientific research in the interest of the country's technological, economic, social and spiritual development* as well as *raising the public profile of science*.

The RAS pursues, *inter alia*, the following goals:

- Analysis of world's scientific findings and achievements;
- Participation in the development and implementation of the state scientific-and-technological and environmental policies;
- Strengthening links between science and industries and development of the science-driven sectors of the national economy;
- Determining framework and priority areas of the fundamental research.

The **RAS Fundamental Scientific Research Programme for 2007-2011**[1] lists the main areas of fundamental research, including studies related to *evolution of the natural environment and climate under the influence of natural and anthropogenic factors; scientific basis for sustainable resource use; and traditional and alternative energy sources*.

The RAS acknowledges the fact that the country's leaders continue to pay increased attention to science. Fundamental science is recognised among the highest priorities of the state, according to the "*Policy Framework for the Development of Science and Technologies in the Russian Federation until and post 2010*" adopted by the President in 2002.

Over the period of 2001-2007, RAS was actively interacting with the governmental bodies. The Academy submitted in the range of 4,300 documents on draft Federal laws, Presidential edicts and Government's resolutions. A number of expert reviews conducted by the RAS have also increased. Scientists are now invited to review draft legislation passed by the State Duma of the Federal Assembly, the environmental aspects of projects (e.g. the *East Siberia – Pacific oil pipeline, international maritime canal «Eurasia»*), as well as regional programmes of socio-economic development for Siberia, Urals and Far East. Scientific advice and counsel of the Academy is now actively sought while making decisions on the various aspects and issues that are of importance to the country.

In a meeting of **Science, Technology & Education Council**[2] in November 2007, Vladimir PUTIN – the then President of the Russian Federation – emphasised the importance of the **State Programme for Fundamental Scientific Research for 2008–2012** that had been largely initiated by the RAS. The President reconfirmed the fact that science would be receiving stable and steady earmarked funding over the next five years. In 2007, the total budget allocated to science exceeded 200 billion Rubles which was 5 times the scientific budget in 2000. By 2010, the total scientific budget will be doubled and will amount to 400 billion Rubles.

The President also noted that the priority development of fundamental science is becoming a pre-requisite for modernisation of the Russian economy. The basis that fundamental science will establish in the next few years will be instrumental not only in the successful development of strategic and military sectors, but also of the country's public policy. A profound analysis of the development of modern

---

[1] Approved by the President of RAS, Academic Yuri S. Ossipov, in January 2007.
Source: http://www.ras.ru/presidium/documents/directionsp.aspx?ID=82e3f4da-25be-4724-849b-602263d4ae72

[2] **Science, Technology & Education Council to the RF President** advises the President on priority areas of the state research-and-development policy, innovations and educational policy and their implementation. It regularly informs the President about the current situation in the sphere of science, technology and education, both in Russia and abroad. The Council conducts expert reviews and prepares recommendations on draft Federal laws and other legislative acts on related subjects. It advises the President on the interaction between Russian Academy of Sciences, its scientific and educational institutions and foreign/ international scientific organisations, with the aim of coordinating the activities of joint projects. Among members of the Council are Rectors and professors of State Universities, research and scientific centres and institutes, members and academics of the RAS,
Source: http://www.kremlin.ru/state_subj/group39628.shtml,
http://document.kremlin.ru/doc.asp?ID=47801&PSC=1&PT=1&Page=1

Russian society is needed, that would take into account current global trends and their influence on the country.

In summer 2006, the Russian Academy of Sciences actively participated in the preparation of the *G8 Summit* that was held in Saint Petersburg as part of Russia's Presidency. Among the issues that were considered at the St. Petersburg's summit were global energy security, climate change and health care.

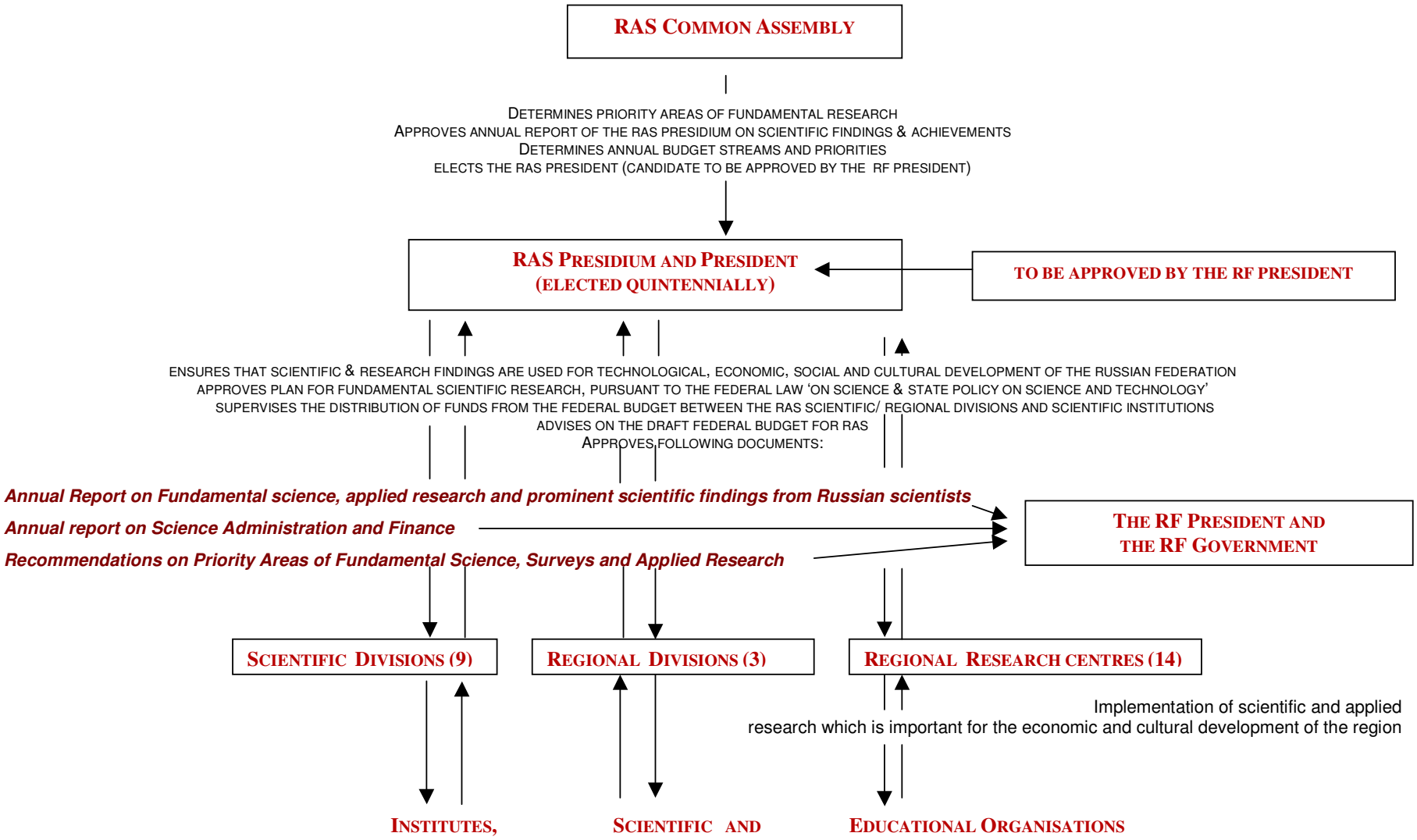
Prior to the 2006 Summit, RAS had initiated and made considerable contribution to the organisation of *Energy Forum* in Moscow which was attended by Ministers of Energy and heads of major energy companies from different countries. In April 2006, Moscow hosted a two-day meeting that convened Presidents of the Science Academies of the G8 states, as well as Brazil, China, India and South Africa. The meeting had been jointly initiated by RAS, the UK's Royal Society and the U.S. National Academy of Sciences in the light of the forthcoming G8 Summit in Saint Petersburg.

Among the issues that the Presidents of Science Academies discussed at the meeting were sustainability and security of major energy systems and advanced methods of diagnosis and therapy of flu-type diseases, including the avian flu. Within two weeks following the meeting, the scientists passed a memorandum that was subsequently included in the G8 Summit agenda. Nikolai Platte – the then Vice-President of RAS – announced at the final press-conference that it had been the first time when leading scientists from the 12 countries had come together in order to discuss problems that concerned the entire global society.

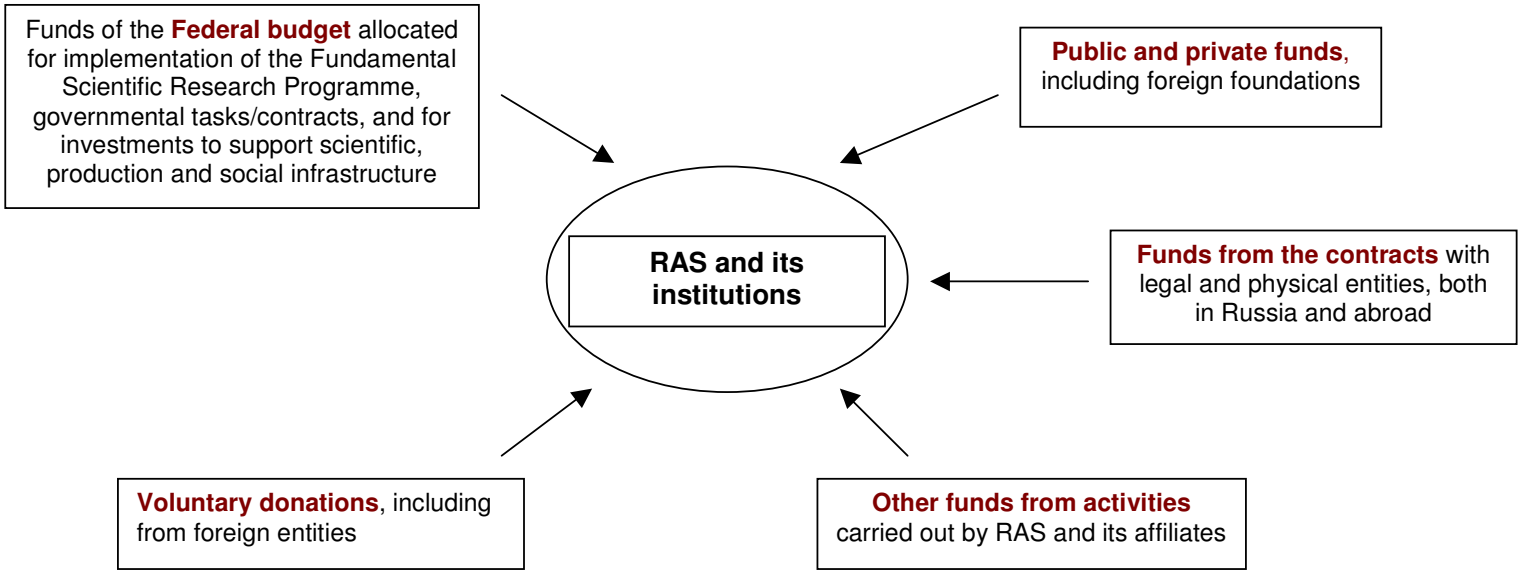
Based on Russia's initiative, the 2006 G8 Summit eventually produced the so-called *St. Petersburg's Global Energy Security Action Plan*. This framework defines energy security as encompassing "all links of the technological chain, from the exploration of energy resources, to energy production, to the transportation of energy products." According to Vladimir Fortov – Academic, Secretary of Energy Division of the Russian Academy of Sciences, the importance of this initiative cannot be overestimated. President Putin suggested that the issue of energy security be discussed at the G8 Summit in St. Petersburg not only due to economic aspects of the situation, but also given the uneven distribution of energy supply and energy consumption on the planet. Diversification of energy supply and the search for alternative energy sources were thus among the issues on the Summit's agenda. Being a major energy supplier/producer/exporter and, at the same time, possessing high scientific potential and technical expertise, Russia proposed to the Summit a set of measures to overcome economic and technological barriers to improving efficiency of traditional energy resources and developing alternative energy.

In 2008, RAS and its institutions actively participated in the preparation of Russia's official position at the G8 Summit in Japan, also including on the issue of climate change.

STRUCTURE OF THE RUSSIAN ACADEMY OF SCIENCES (RAS)

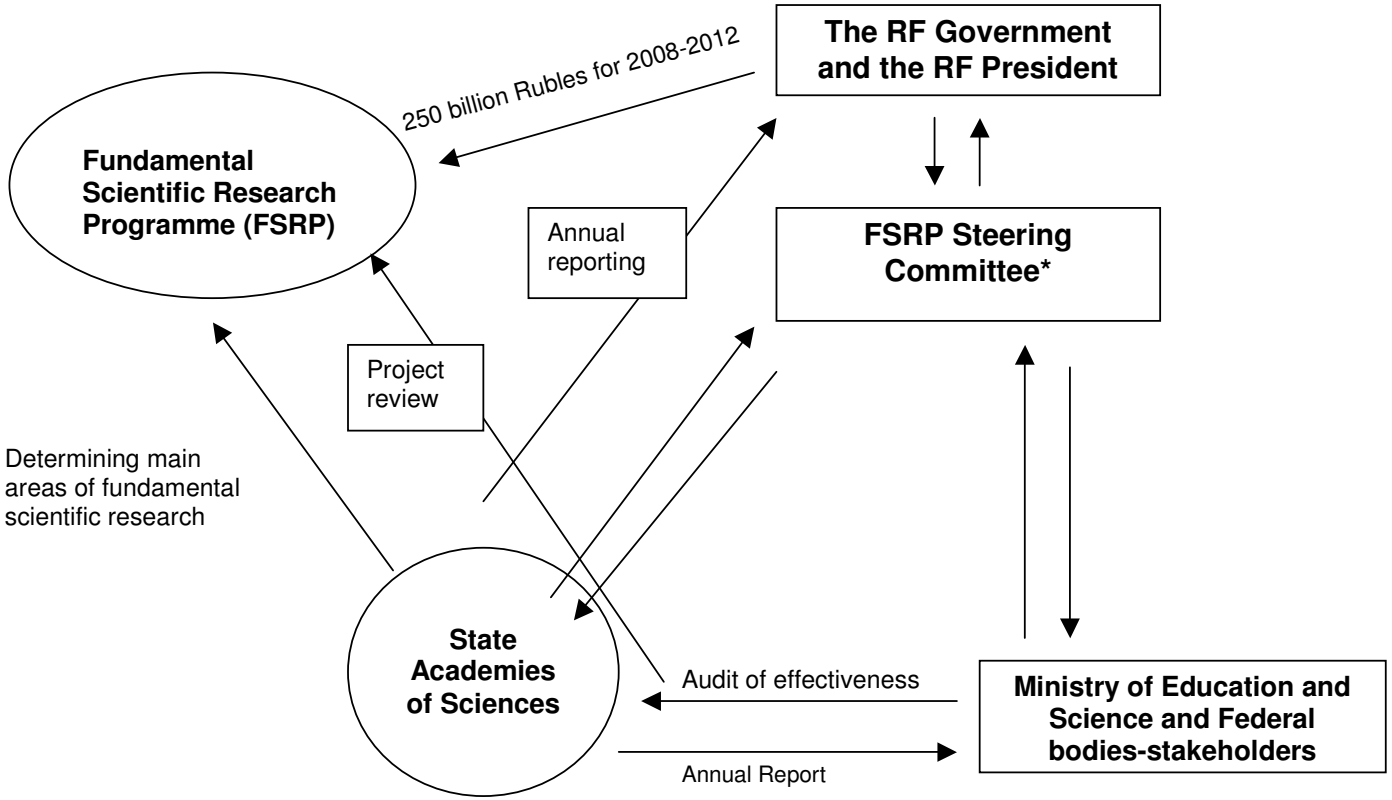


FUNDING SOURCES FOR RAS ACTIVITIES



Fundamental Scientific Research Programme of Russian State Academies of Sciences for 2008-2012

(Approved by the RF Government Decree #233-p dated 27.02. 2008, pursuant to the RF Federal Law "*On Science and State Policy for Science and Technology*" and the RF President's Address to the RF Federal Assembly for 2007)



The **FSRP Steering Committee** consists of members of **RAS and state representatives of the Federal bodies**. Chair of the Steering Committee – President of RAS (Mr. Yuri Ossipov). Members of the Committee: Rector of Moscow State University (Mr. Viktor Sadovnichy); Heads of the Siberian, Ural and Far East Divisions of RAS; Deputy Minister for Industry and Trade (Mr. Yuri Borissov), Deputy Minister for Education and Science (Mr. Vladimir Fridlyanov), Deputy Head of the RF Government Administration (Mr. Vladimir Shamakhov), Deputy Head of Federal Space Agency (Roskosmos) (Mr. Sergey Ponomarev), Director General of the State Corporation for Nuclear Energy 'RosAtom' (Mr. Sergey Kiriyenko), Deputy Director General of State Corporation for Nano Technologies 'RosNano' (Mr. Andrey Malyshev).

Appendix 4

RUSSIAN FOUNDATION FOR BASIC RESEARCH (RFBR)

The **Russian Foundation for Basic (Fundamental) Research** (*РФФИ/ RFBR*) was founded in 1992 pursuant to the RF President's Decree #426 and following the initiative that had been instigated by prominent Russian scientists. RFBR is a self-governed non-profit Federal body under the jurisdiction of the RF Government that is aimed at supporting fundamental science and research on the basis of competitive bidding and ***is intended to build a new type of relationships between scientists and the state***.

Setting up RFBR signified the establishment of a conceptually new form of organisation for the Russian science which affords scientists broader opportunities for creative self-expression, enables them to independently determine a research subject, to set up research teams to allocate funds to the most promising works. Since June 2008, the RFBR is chaired by Academic V. Panchenko.

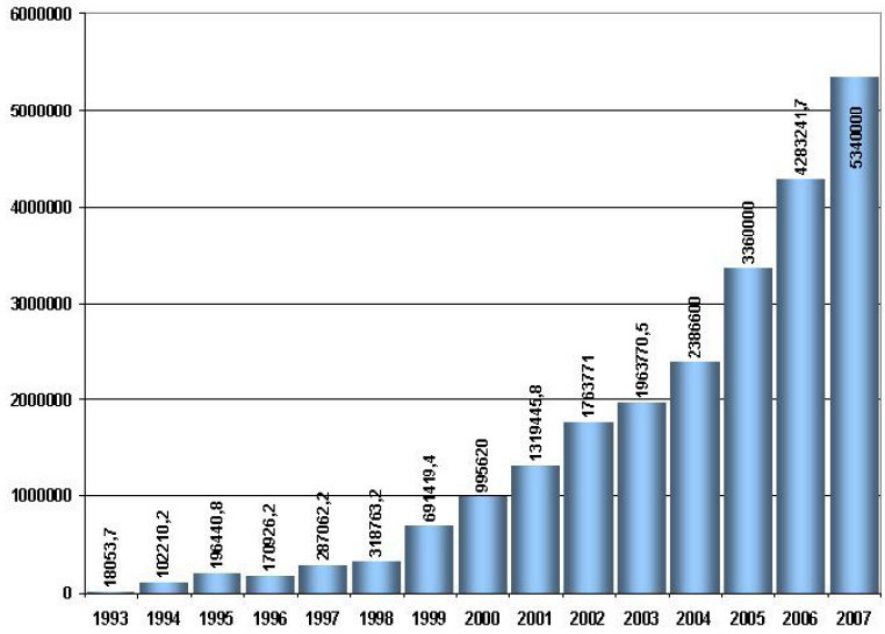
Earmarked funding is provided directly to a scientific team implementing a project, rather than to an entire organisation or institution to which the team belongs. Over a period from 1992 to 2006, RFBR held 14 tender rounds for all thematic areas in natural sciences and the humanities. During 1993-2004, RFBR supported over 4,500 scientific conferences and workshops in Russia. Grants from RFBR enabled nearly 13,000 Russian scientists to travel abroad and to participate in international conferences. By 2005, the RFBR held 11 international tenders.

The RFBR funding is based upon:

- Federal allocations, which account for 6% of the total budget for civil science
- Voluntary donations, including from foreign parties.

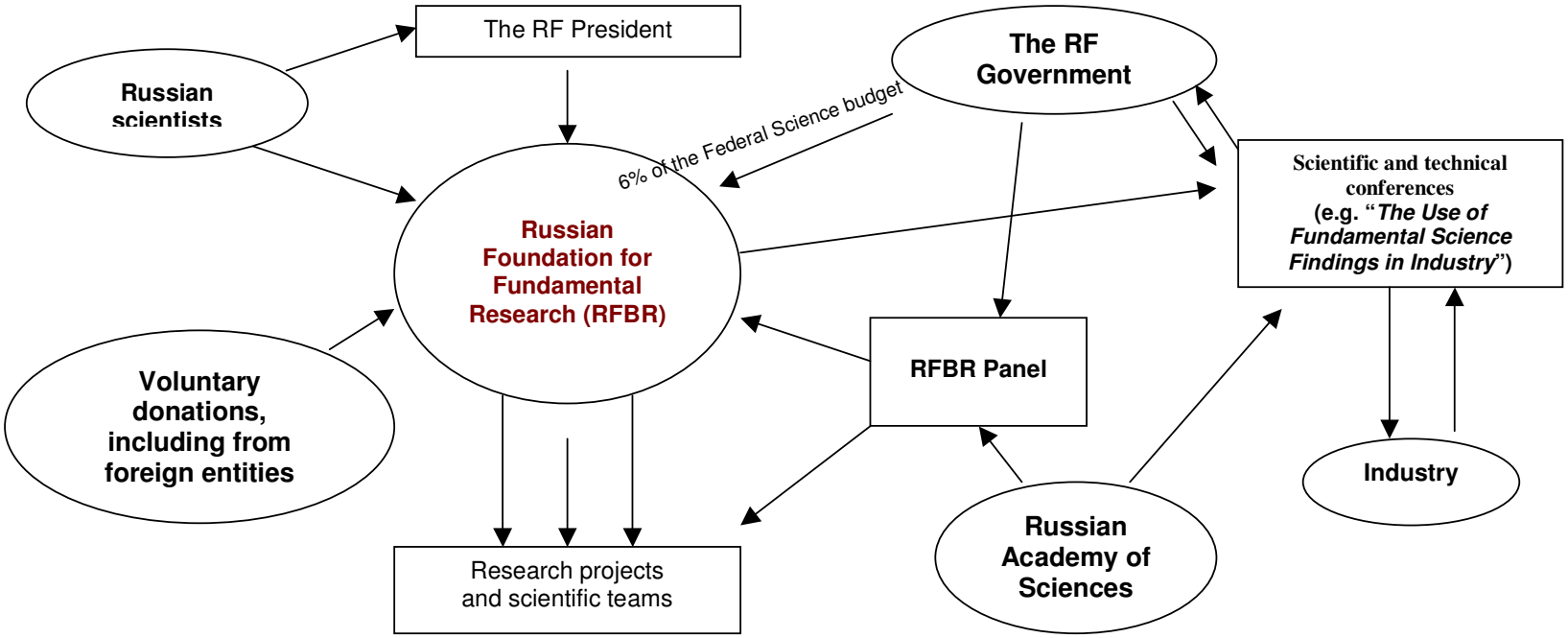
Transparency is an overarching principle of the RFBR: all information on tenders, bidding and funding is available in the public domain (http://www.rfbr.ru). Funds are allocated on the non-commercial and non-repayable basis. A prerequisite for awarding a grant from RFBR is scientists' commitment to subsequently publish and disseminate their research findings.

Federal funding of the RFBR, 1993-2007, Thousand Rubles



Source: http://www.rfbr.ru/pics/22135ref/file.pdf

THE RFBR INTERACTIVE DIAGRAM



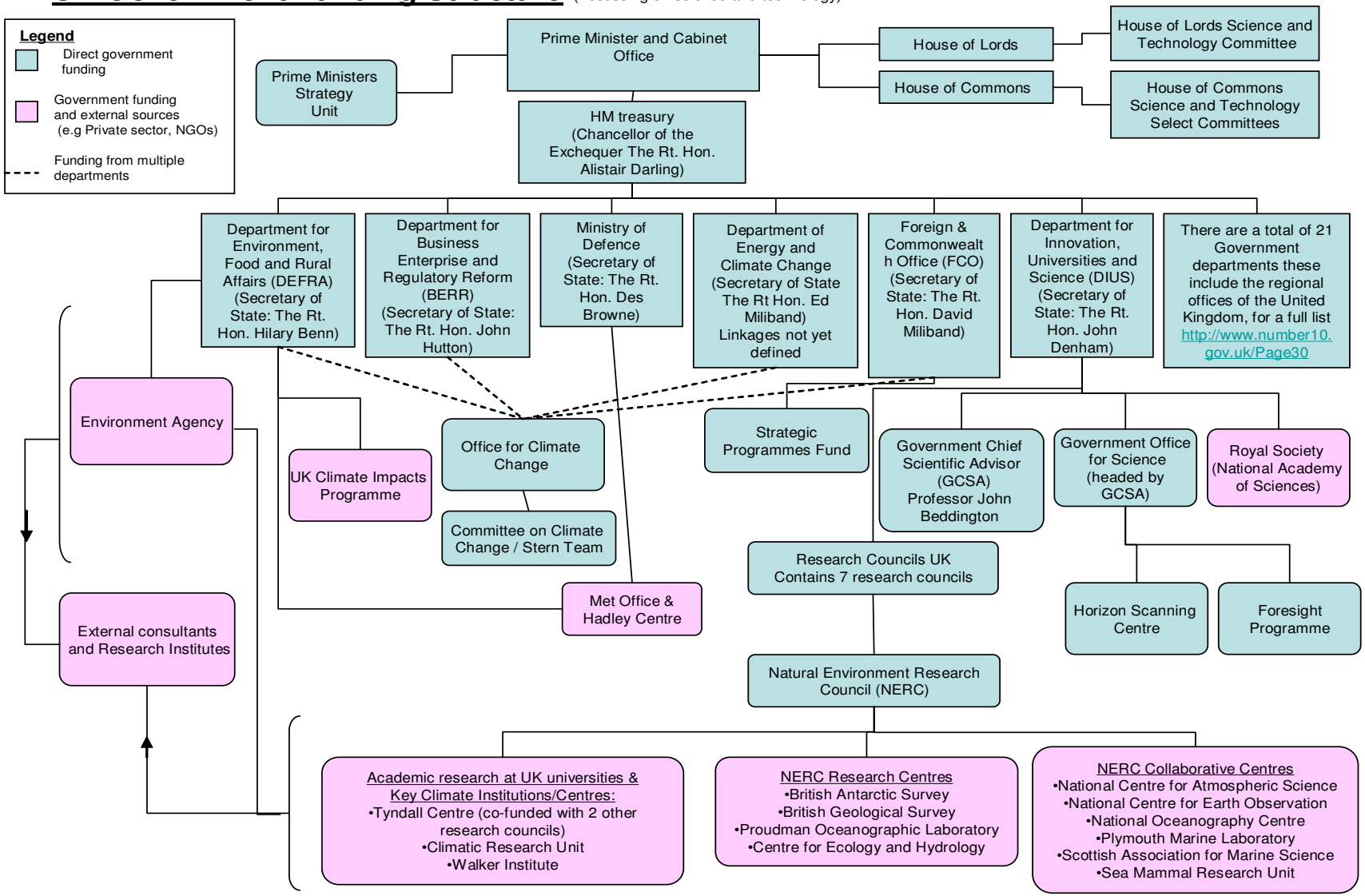
Appendix 5

Schematic diagrams (‘maps’) showing science-policy linkages – UK

1) UK Government structure focusing on funding routes for science and technology, and in particular climate science

2) UK climate change policy and science influences (information flows)

UK Government Funding Structure (Focussing on science and technology)



Schematic diagram of the layers of major influencers in UK climate change policy and science