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Report on the in-depth review of the national communication of Bulgaria

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Summary

1. Bulgaria ratified the Convention on 16 March 1995 and the secretariat received Bulgaria's first national communication on 11 March 1996. The in-depth review of the national communication was carried out during the period September 1996 to May 1997, including a country visit from 1 to 4 October 1996 to Sofia.

2. Although some economic reforms began in 1989, until 1991 virtually all sectors were government-controlled and, the process of liberalization and privatization has been rather slow. Since moving toward a market-based economy, Bulgaria has had to deal with the problem of overcoming a deep economic recession, which resulted in a decline in gross domestic product (GDP) of 25 per cent from 1989 to 1993. As in most of the countries with economies in transition, the economic changes have resulted in a significant decrease in the level of energy-related carbon dioxide (CO_2) emissions. Greenhouse gas (GHG) emissions in general are not expected to begin to increase in the near term, and are likely to remain substantially below the levels of Bulgaria's base year of 1988. Mostly on account of the economic decline and prevailing situation, Bulgaria is likely to meet its declared target of not exceeding base year GHG emission levels in 2000.

3. Bulgaria, referring to Article 4.6 of the Convention, has chosen 1988 as the base year rather than 1990 as recommended by the Conference of the Parties. Nonetheless, for comparison purposes emissions for 1990 are also provided in the national communication. Aggregated GHG emissions for 1988 are equivalent to 141,347 Gg of CO_2. CO_2 accounts for the largest percentage, 68.5 per cent, of total GHG emissions. CH_4 represents 24.5 per cent and N_2O only 7 per cent. Emissions of the three gases from the energy sector alone constituted 72 per cent of all GHGs, and within the energy sector, emissions from fuel combustion accounted for 92 per cent of total emissions. Preliminary estimates show that by the time of the visit aggregated GHG emissions have declined by 36 per cent compared to 1988.

4. Among the climate change measures already in place, the most important ones are based on the Environmental Protection Act which was adopted in 1991 and amended in 1992. It is a comprehensive act specifying the responsibilities of government bodies at both the national and local levels with regard to environmental protection. The Clean Air Act sets out series of ordinances to reduce emissions and to fix air pollution levels. These ordinances, some of which are still being drawn up, will address such issues as licensing, regulation of emissions from large stationary installations, and establishment of a national air quality control system.

5. The National Energy Strategy, adopted by the Government in 1995 aims to ensure the rational use of indigenous and imported energy supplies, existing energy systems and other resources in the energy sector. Bulgaria is using least-cost planning tools to set the priorities for future capacities for energy supply. The priorities set forth by these scenarios would be, first, the rehabilitation of existing utilities, then the construction of new capacities to replace the thermal power plant at Maritza (2x230 MW and desulphurization), and the completion of the nuclear

power plant in Belene (2x600 MW), whose construction was frozen in 1990 due to a lack of financial resources. With respect to the long-term potential of renewable energy in Bulgaria, the Ministry of Energy estimates a potential supply of 5 per cent from renewables (including hydropower). Although the implementation of the new energy efficiency law has been delayed, many of the existing energy efficiency regulations are considered adequate. There are presently regulations and standards relating to specific energy consumption, fuel combustion processes, electric appliances and space heating and insulation. During the review information on current standards was provided and, in particular, extensive materials were made available to the team on the existing building insulation standards. On account of the economic and social situation in Bulgaria, the team was informed that the Government had problems with liberalizing heat and electricity prices as the estimated cost to society would be too great.

6. The three scenarios used in projections were the baseline scenario, mitigation scenario and energy policy scenario. The baseline, more or less business-as-usual, scenario incorporates all policies and measures introduced before 1993. The mitigation, or energy efficiency, scenario implies macroeconomic restructuring, penetration of new energy-efficient technologies and a restructuring of the energy supply sector. Under the mitigation scenario a higher degree of foreign investment and indebtedness in the mid-term (in relation to GDP and in absolute terms) is expected owing to the import of new technologies. The energy policy scenario is consistent with the long-term goals of the Bulgarian energy sector as outlined in the National Energy Strategy. All three scenarios were projected for the period 1992-2020 for CO_2, and the baseline and mitigation scenarios were projected for N_2O, CH_4, CO, NO_x and NMVOCs. According to the results of the projections for the various scenarios, Bulgaria will meet its target of not exceeding the 1988 level of GHG emissions in 2000. However, the projections indicate a more rapid increase in emissions after 2000, and even in the case of the mitigation scenario emissions are expected to reach the level of the base year by 2020.

7. Efforts to maintain forest areas and sustain the high level of sink capacity are viewed as a vital aspect of Bulgaria's future adaptation to climate change. The Government's strategy for the forestry sector, in particular the draft Forestry Development Strategy, is designed to cultivate the forest areas in a suitable manner allowing for adaptation to and limitation of impacts of climate. However, recent legislation allows for the privatization of some state-owned forests.
Given Bulgaria's substantial area of forests, more than 3,500 million hectares, the vulnerability of forests to climate change is of great interest. Results of recent studies indicate that forest vegetation would be vulnerable to the expected changes in climate brought about by a doubling of CO_2 emission levels. The studies made show that the expected doubling of CO_2 would have a significant impact on agricultural production. The two main crops in Bulgaria, maize and wheat, would be adversely affected, with decreased yields for maize possibly as high as 30 per cent and for wheat 17 per cent.

8. Bulgaria looks favourably upon the concept of activities implemented jointly and joint implementation of commitments as an efficient mechanism for cost-effective reduction of global

emissions while facilitating the process of technology transfer to both developing countries and countries with economies in transition.

9. Climate research is focused on climate variations and its effects, creation of climate-related databases, improvement of climate and environmental monitoring and observation systems, and analysis and optimization of the use of weather and climate as natural resources. These activities include various studies and programmes, such as studies on vulnerability and adaptation, droughts in the Balkan peninsular region, sea-level rise, and application and testing of models related to climatic behaviour and effects of climate change.

I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

10. Bulgaria ratified the Convention on 16 March 1995 and the secretariat received Bulgaria's first national communication on 11 March 1996. The in-depth review of the national communication was carried out during the period September 1996 to May 1997, including a country visit from 1 to 4 October 1996 to Sofia. The review team consisted of Mr. Tibor Takács, Hungary, Mr. Wilfred D. Kipondya, Tanzania, Mr. Markus Maibach, Switzerland, and Mr. Dennis Tirpak (UNFCCC secretariat, coordinator). In the course of the visit the team met with representatives of several ministries and with members of the scientific and academic community.

11. The first national communication was prepared by Bulgaria's Interministerial Committee with the support of independent organizations and experts. The work was coordinated by the Ministry of the Environment and the research institute, Energoproekt. The communication was formally adopted by the Government in early 1996.

12. Situated in the south-east of Europe on the Balkan Peninsula, Bulgaria covers an area of 110,994 sq km. Although Bulgaria is part of the mild continental zone, in the eastern and southern areas Mediterranean climatic features are observed as a result of its location on the Black Sea and proximity to the Aegean Sea. The average temperature and amount of precipitation also varies across the country owing to the diversity of terrain altitudes in Bulgaria. As a result of the social and economic difficulties associated with the transition to a market economy, the population has been decreasing since 1988. The population was about 8.5 million in 1993.

13. Although Bulgaria began some economic reforms in 1989, until 1991 virtually all sectors were government-controlled and, in contrast to some other countries with economies in transition, the process of liberalization and privatization has been rather slow. Since moving toward a market-based economy, Bulgaria has had to deal with the problem of overcoming a deep economic recession, which resulted in a decline in Gross Domestic Product (GDP) of 25 per cent from 1989 to 1993. The decline in output was largely due to structural changes in the economy resulting from the transition process. Prior to the market reforms, the economy was

highly industrialized, dominated by processing, and mining and quarrying industries. In recent years the share of industry has declined significantly and the services sector has expanded substantially.

14. Bulgaria is highly dependent on imports for its energy needs (76 per cent of its primary energy is imported) because its national energy resource base is limited, consisting mostly of low-quality coal. Despite general price liberalization, the Government still controls energy prices, with the aim of gradually removing all subsidies in the energy sector. Nevertheless, substantial subsidization of households for heat and electricity still exists. The present pricing structure is based on various pricing zones for both industrial and public sector consumption.

15. Despite the significant decline in industrial production and industry's energy requirements as a result of the transition process, the industrial sector still remains the major consumer of primary energy and electricity. The general economic decline and structural changes brought about by the transition process have resulted in a drop in Bulgaria's total primary energy supply (TPES) and total final energy consumption (TFC). From 1989 to 1992 TPES declined by 36 per cent and TFC was down by 42 per cent. Since 1993 however, both supply and consumption have been increasing, although they are still below their 1989 levels.

16. Although oil and oil products constitute a large share of primary energy consumption, that share fell from about 40 per cent in the late 1980s to 29 per cent in 1993. The increasing presence of natural gas (17 per cent) and nuclear energy (15 per cent) in the structure of primary energy accounted for the difference while solid fuels remained relatively constant at around 33-35 per cent. Electricity is produced mostly from coal, nuclear energy and hydropower plants. Although the share of electricity produced from other sources has increased slightly, solid fuels, mostly indigenous lignite, account for more than 50 per cent of electricity production.

17. The share of solid fuels, oil and oil products, and heat in the final energy consumption has remained relatively constant, while the share of natural gas and electricity has varied. After several years of a stable or increasing share in final consumption, the share of natural gas decreased sharply in 1992 because of the slowdown in the chemical, glass and iron and steel industries, amongst others. In the past few years final consumption of electricity has remained constant or begun to increase across sectors.

18. As in most of the Central and Eastern European countries with economies in transition, the economic changes have resulted in a significant decrease in the level of energy-related carbon dioxide (CO_2) emissions. From the onset of the economic recession in 1989 until the beginning of the temporary economic recovery in 1993, energy-related CO_2 emissions decreased by 30 per cent. Despite the decrease in emissions the carbon intensity of the economy (CO_2/GDP) has remained high and relatively steady, mostly because of the high carbon content of the energy supply and energy intensity of industrial output, and the continued subsidizing of domestic energy prices. However, the economy's energy intensity is expected to decrease as a result of

ongoing structural changes and eventual higher energy prices, and the introduction of new technologies in the future.

19. As a result of the present economic situation the levels of greenhouse gas (GHG) emissions are not expected to begin to increase in the near term, and are likely to remain substantially below the levels of Bulgaria's base year of 1988. Mostly on account of the economic decline and prevailing situation, Bulgaria is likely to meet its declared target of not exceeding base year GHG emission levels in 2000.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

20. The national communication contained an inventory of anthropogenic greenhouse gas emissions and carbon dioxide sinks in Bulgaria. The development of the inventory was supported by the United States Country Studies Program. The Energoproekt research institute coordinated the involvement of several other institutions and governmental departments in the compilation of the inventory for the national communication.

21. Bulgaria has invoked Article 4.6 of the Convention which allows Parties included in Annex I and undergoing the process of transition to a market economy a certain degree of flexibility, inter alia, with regard to the historical level of anthropogenic emissions. Bulgaria, in requesting this flexibility, has chosen 1988 as the base year for the implementation of the United Nations Framework Convention on Climate Change (UNFCCC) rather than 1990 as recommended by the Conference of the Parties. Nonetheless, for comparison purposes emissions for 1990 are also provided in the national communication.

22. Emission estimates were reported for the main greenhouse gases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and for the ozone precursors carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC). The team was informed that emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) were not reported as they were considered to be relatively small. However, estimates of emissions of chlorofluorocarbons (CFCs) and halons, gases controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer, were given, and it was noted that the decline in their consumption was due to a decrease in industrial production rather than to substitution by other gases.

23. The emissions were estimated in compliance with the Intergovernmental Panel on Climate Change (IPCC) methodology for calculation of GHG inventories, and were presented in the various sector/source categories as required by the IPCC Guidelines. However, information concerning the relevant assumptions and data used, including emissions factors and activity data, was not included in the national communication. During the in-depth review the team was provided with an annex to the national communication which included a detailed description of the methodology applied, including emission factors and activity data. The team noted the

quality of the analysis in the annex and the substantial increase in transparency of the inventory the annex provided. As well, additional documentation was provided during the review, including preliminary GHG emission inventories for the years 1991 to 1994 .

24. Emission estimates for CH_4 and N_2O in terms of CO_2 equivalent using IPCC-1994 recommended global warming potentials (GWPs) were also provided in the national communication. Taking into account the direct and indirect effects using GWPs, aggregated GHG emissions for 1988 are equivalent to 141,347 Gg of CO_2. CO_2 accounts for the largest percentage, 68.5 per cent, of total GHG emissions. CH4 represents 24.5 per cent and N_2O only 7 per cent. Emissions of the three gases from the energy sector alone constituted 72 per cent of all GHGs, and within the energy sector, emissions from fuel combustion accounted for 92 per cent of total emissions. Preliminary estimates show that aggregated GHG emissions have declined by 36 per cent since 1988.

25. CO_2 emissions from fuel combustion were calculated using the IPCC top-down and bottom-up approaches. In the case of the top-down method, IPCC default values were used, although the national experts emphasized that country-specific emission factors derived from the specific properties of fuels used in Bulgaria were available. The emission factors and heat values of the fuels recommended by IPCC were found to be lower. Non-CO_2 emissions from mobile sources were calculated according to the CORINAIR[1] methodology. The review team felt that the national team had done commendable work which had been valuable to the preparation of the national communication and emphasized the need to share their findings with the international scientific community.

26. Bulgaria's CO_2 emissions in 1988 were 96,878 Gg. Per capita CO_2 emissions were 10.8 tonnes in 1988 and 9.1 tonnes in 1990. Although lower than for many OECD countries, this level of emissions would rank Bulgaria among the countries with relatively high per capita emissions. However, as a result of the ongoing transition to a market economy and structural changes, energy-related per capita CO_2 emissions have decreased by more than 35 per cent since 1988 from 9.5 tonnes to about 6 tonnes in 1994. Estimates provided during the review indicate that between 1988 and 1994 total CO_2 emissions decreased by 40 per cent, with emissions decreasing by 41 per cent for stationary combustion, 33 per cent for mobile combustion and 50 per cent for industrial processes. Imported electricity has declined from 4146 Gwh in 1988 to 116 Gwh in 1993. If the electricity had been produced in the Bulgarian Power System, an additional 6321Gg CO_2 would have been produced and would need to be added to the 1988 emission inventory.

27. Fuel combustion accounted for the majority, 93.2 per cent, of CO_2 emissions, of which 82.1 per cent was from stationary combustion. Energy and transformation and industry were the

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[1] CORINAIR is the component dealing with air emissions inventories of the European Community CORINE (Coordinated Information System on the State of Natural Resources and the Environment).

largest emitters amongst stationary combustion sources. After stationary fuel combustion, the transport sector was the next largest contributor of CO_2 emissions, 11 per cent in 1988. The team was informed that the transport infrastructure in Bulgaria is ageing and in need of substantial renovation and development. During the review, information was provided on efforts under way to introduce new green engine technology for public transport in major cities. As emission levels in the transport sector have not declined as substantially as emissions in other sectors, and given Bulgaria's role in Europe-Asia transit, further efforts to introduce environmentally friendly technology in parallel with the development of the transport infrastructure could help to contain emission levels significantly. The national team was provided supporting materials, including energy balances, which helped to clarify some concerns about the transport sector data the review team had noted. The need to harmonize the areas of data inconsistency for the next national communication was recognized.

28. Emissions from industrial process accounted for 6 per cent of total CO_2 emissions, mostly from the production of cement, but as well from glass, steel, ammonia and soda production. CO_2 emissions from landfills were estimated at 661 Gg, less than 1 per cent of total CO_2 emissions.

29. Forest clearing and conversion is not practised in Bulgaria and the Government completely owns and manages all forests. The Government has actively promoted afforestation programmes and normalized levels of harvesting in order to increase the resource base and maintain a relatively steady increment in forest growth. In 1988 the increment in forest area amounted to 6,136 kt dry matter, thus providing a sink of 4,657 Gg of CO_2, equivalent to approximately 4.8 per cent of the total CO_2 emissions. However, the review team was informed of plans under consideration to privatize the forests in Bulgaria. The review team agreed with the national experts that privatizing the forests is likely to increase the chance that forests will be cleared for other land-use such as agriculture and animal husbandry, or other non-agricultural uses. Whatever course is taken, it is vital that sound policy measures are considered which allow for the possibility, where feasible, of maintaining and enhancing of sinks.

30. Waste management is the main source of CH_4 emissions, accounting for approximately half of emissions. In 1988 emissions from the waste management sector were 732 Gg, of which the vast majority were from landfills. Emissions from the agricultural sector accounted for only 21.7 per cent and fugitive fuel emissions were responsible for 22.3 per cent. Within the fugitive fuel emission sources, the share of coal was only 8 per cent, since more than 77 per cent of the coal is extracted from open cast mines, which has emissions per unit of production 15 times less than underground mines. Total CH_4 emissions were 24 per cent lower in 1994 than in 1998; most noticeable were decreases in emissions from fuel combustion (industry) and agriculture of 76 per cent and 60 per cent, respectively.

31. The main sources of N_2O emissions in Bulgaria are the application of mineral fertilizers, production of nitric acid and fuel combustion. In 1988 fertilizers accounted for the largest share of N_2O emissions, followed by nitric acid production. However, owing to the economic crisis and structural changes in the agricultural sector, application of fertilizers has decreased

significantly, and production of nitric acid has become the leading source of N_2O emissions in recent years. From 1988 to 1994 N_2O emissions decreased by 42 per cent, with emissions from the production of nitric acid down 44 per cent and from fertilizer use down 81 per cent.

32. Emission estimates for the ozone precursor gases, CO, NO_x and NMVOC, were also provided in the national communication. While stationary combustion was the leading source of emissions of NO_x, the transport sector accounted for 53.9 per cent and 49 per cent of CO and NMVOC emissions respectively in the base year. Other sources of CO emissions were stationary combustion and burning of agricultural residues. Solvent use was the other major source of NMVOC emissions.

33. In accordance with the IPCC Guidelines, emissions from international bunkers were reported separately and not included in total national emissions. CO_2 emissions from aviation bunkers were estimated at 162.4 Gg for the base year. No emissions estimates were available for marine bunkers and estimates for gases other than CO_2 were not reported.

34. During the in-depth review, the team was provided with the results of the comparison of the IPCC top-down and the applied bottom-up methods of estimating CO_2 emissions from fuel combustion. For the base year the difference was only 0.44 per cent and up through 1992 did not exceed 3.5 per cent which is within acceptable limits. However, in 1993 and 1994 the differences were 6.7 per cent and 6.4 per cent respectively. These differences were most likely due to the inability of official statistics to follow the real fuel trade, especially exports during the embargo against the former Federal Republic of Yugoslavia. Such problems may as well concern the uncertainties of the reported emissions data. Bulgaria did not provide estimates of uncertainties in its national communication. However, during the in-depth review, the national experts stated that uncertainties of the reported results in general were low, noting however that the shortcomings of official statistics may have resulted in higher levels of uncertainty for some specific activity data.

35. The supporting materials provided during the in-depth review also contained activity data, although in the case of the energy sector, only aggregated data were presented for the period 1985-1994. The accuracy of these data for the last two years may need further verification, since the trends of primary energy consumption and energy end-use appear contradictory. Although the information provided during the review increased the transparency of the inventory, the review team suggested that in the future the main activity data, emission factors and other data assumptions be provided in the national communication.

III. POLICIES AND MEASURES

36. The national communication included a descriptive analysis of implemented and planned policies and measures for the reduction of greenhouse gas emissions. Most of the strategies and mitigation measures outlined in the communication are still in various stages of planning and

only a few have been fully implemented. However, within the mitigation scenario for long-term projections in the communication, a series of potential mitigation measures with detailed calculations on their costs and effects is presented. The team suggested that these calculations could serve as a basis for additional estimations of the effects of measures in Bulgaria's second national communication.

37. As Bulgaria is a country with an economy in transition with limited financial resources, the criterion of cost-effectiveness when choosing appropriate mitigation measures is of high priority. The energy and industrial sectors are viewed as the most important sectors with respect to mitigation measures as they account for more than 93 per cent of CO_2 emissions. Most utilities in Bulgaria use rather energy-inefficient techniques and therefore have been identified as one of the leading potentials for significant energy savings.

38. During the review additional information was provided on the status of implementation of various policies and measures. It was noted that no specific additional measures had yet been adopted. Specifically in the energy sector, the planned structural changes consequent upon the new laws on privatization and on energy efficiency were still under discussion. Details on the specific content and expected effects of these laws could not be provided.

39. Among the measures already adopted, the most important ones are based on the Environmental Protection Act which was adopted in 1991 and amended in 1992. It is a comprehensive act specifying the responsibilities of government bodies at both the national and local levels with regard to environmental protection. This act also established the financial mechanism, the National Environment Fund, for funding of environment-oriented activities and projects in various sectors of the economy. The National Environment Fund is financed from part of the import tax on vehicles 10 or more years old, 5 per cent of the revenues from privatization of state enterprises, 70 per cent of revenues collected for violations of environmental standards, administrative fees collected by the Ministry of the Environment and from state budgets for environmental programmes. This diversified method of funding has helped to secure a steady means of financing environmental protection and the amount of resources the fund has raised has actually substantially increased since its introduction in 1993 from 106 million leva to 1,252 million leva in 1996. A board of directors chaired by the Minister for the Environment manages the fund, and determines the fund's policies with respect to activities funded, specifically the setting the criteria (e.g. cost-effectiveness, relative environmental effect) for the allocation of funds. The fund provides resources to municipalities and companies by way of grants and preferential loans for activities such as acquisition of assets and payment of services related to environmental protection and assessment, development and maintenance of environmental monitoring and control systems, scientific research, participation in environment-related conferences and workshops, and educational and public awareness activities.

40. The Clean Air Act sets out series of ordinances to reduce emissions and to fix air pollution levels. These ordinances, some of which are still being drawn up, will address such issues as

licensing, regulation of emissions from large stationary installations, and establishment of a national air quality control system. Although the act specifically targets emissions of the indirect greenhouse gases sulphur dioxide (SO_2) and nitrogen oxides, an effect is expected on the levels of carbon dioxide and methane emissions as well. Present regulations that contribute to the reduction of greenhouse gases are the additional import duties on used automobiles introduced in 1995, lower levels of excise tax on unleaded gasoline, and tax concessions for the import of environmentally friendly equipment (95 million leva worth of equipment was imported in 1994 using such concessions).

41. The National Energy Strategy, adopted by the Government in 1995 aims to ensure the rational use of indigenous and imported energy supplies, existing energy systems and other resources in the energy sector. As Bulgaria is heavily dependent on imported energy resources, energy efficiency plays a vital role in their National Energy Strategy. Under the guidance of the Committee on Energy, a subsidiary body of the Council of Ministers, in 1995 a new energy efficiency law was drafted, but at the time of the review was still awaiting final adoption by parliament. The new law focuses on improved energy efficiency standards and mandatory energy audits, outlines the rights and responsibilities of the various state bodies, defines the means for economic intervention and involvement of consumers in improvement of energy efficiency, and establishes a state fund to finance energy efficiency related projects. The review team was informed of the political controversy over the adoption of this law and of the unlikeliness that the law would be adopted any time soon, mostly because of the debate concerning appropriate financial instruments.

42. Although the implementation of the new energy efficiency law has been delayed, many of the existing energy efficiency regulations are considered adequate. There are presently regulations and standards relating to specific energy consumption, fuel combustion processes, electric appliances and space heating and insulation. As a result of the delays in the introduction of the new energy efficiency law, these regulations have not been updated in recent years. However, during the review information on current standards was provided and, in particular, extensive materials were made available to the team on the existing building insulation standards. These standards are considered to be quite sufficient and are comparable with similar standards of the European Union (EU). However, only a small percentage of buildings, including newly constructed ones, meet these standards. The indifference to application of the standards is due to a lack of supervision. Under the new energy efficiency law a more stringent system of monitoring (improvements in the area of licensing, and energy audits and assessments) is proposed which would lead to greater enforcement of the present and any additional regulations. Furthermore, with the help of the European Community's THERMIE programme or other EU programmes, Bulgaria hopes to begin work on projects for the plastering of panel buildings, the dominant style of building in cities and most in need of repair, with a double layer of plaster thereby increasing the heat insulation and renovating the buildings' exteriors.

43. Mainly with the help of foreign resources and assistance, Bulgaria is engaged in a significant number of specific energy efficiency projects and programmes. One important

national project is the improvement of the provision of natural gas to households with the assistance of the Netherlands. It is estimated that 1.2 million (2 million optimistically) households could be supplied with natural gas by the year 2020. Under the European Community's PHARE programme, a total of 6.5 million leva has been invested in energy efficiency related projects, mainly for demonstration projects in the residential, and to some extent industrial sectors. The review team gained the impression that these projects are of major importance in demonstrating the investment potential, especially to foreign investors.

44. On account of the economic and social situation in Bulgaria, the team was informed that the Government had problems with liberalizing heat and electricity prices as the estimated cost to society would be too great. During the review, it was clear to the review team that, despite this stance, the Government was quite aware of the potential vicious cycle that could develop with regard to its future energy policy - without market-based energy prices, there are only limited incentives for energy-efficient supply or demand-side management. On the other hand, there is at present a lack of financial resources to improve the performance of existing utilities. To overcome this problem, Bulgaria is following a step-by-step approach, encompassing the liberalization of energy markets, improvement of the conditions of private electricity producers' access to national grids and increasing incentives to attract foreign capital. A new energy law, under consideration by Parliament, is a first step towards the liberalization of the energy market and will change the institutional framework of ownership with respect to producers. The law will provide for the regulation of natural monopolies in the energy sector, allocate energy sector activities on a concession or licensing basis, and establish a regulatory commission to deal with long-term policy, energy prices and energy-related technology policies. As a result of the Government's approach and the new energy law, it is expected that within the electricity production sector new small producers will invest in energy- efficient equipment.

45. Bulgaria is using least-cost planning tools to set the priorities for future capacities for energy supply. The review team was informed that new electricity scenarios had been devised by the national electricity company, but not yet approved by the Government. The priorities set forth by these scenarios would be, first, the rehabilitation of existing utilities, then the construction of new capacities to replace the thermal power plant at Maritza (2x230 MW and desulphurization), and the completion of the nuclear power plant in Belene (2x600 MW), whose construction was frozen in 1990 due to a lack of financial resources, is under consideration. With respect to the long-term potential of renewable energy in Bulgaria, the Ministry of Energy estimates a potential supply of 5 per cent from renewables (including hydropower). A separate study elaborated by the country study estimates a slightly higher potential of 31.8 TWh by 2020, approximately 7 per cent of national energy demand. The areas which have been identified as having the greatest potential for use of renewables are the high mountain regions along the Black Sea for wind-driven technologies, the southern and eastern regions for passive solar heating and the northern and north-eastern regions for utilization of biomass.

46. Since the onset of the transition to a market economy, the transport sector has become an issue of growing national importance. The team was informed, that in the road transport sector

significant growth is visible owing to the fact that imports, especially of older model vehicles, have increased dramatically in recent years. This is true for both passenger vehicles and light and heavy duty vehicles. As a result of this situation, the market share of the national railways, especially in the freight sector, has dropped.

47. The review team was informed of a number of environmentally oriented actions which are undertaken by the Ministry of Transport and funded by the National Environment Fund or through foreign assistance. Most of these actions are aimed at decreasing the air pollution caused by trucks and buses. Although the Government plans to adopt the European emission standards (EURO I and EURO II), at the time of the review a specific time-frame for adoption of these standards could not be given. Other measures include import taxes and purchase duties on automobiles corresponding to European levels, subsidies to city public transport and limitation of private automobile traffic in city centres, mandatory maintenance and vehicle inspections, and subsidies to rail transport to increase its competitiveness vis-a-vis road transport.

48. Although a portion of the revenues from the existing tax schemes in the transport sector is earmarked for the Environmental Trust Fund, the majority of the revenues from vehicle import taxes and excise duties on gasoline and diesel are appropriated for improvements to the road network. In addition to import taxes and fuel excise duties, a substantial amount of revenue is generated by taxing transit freight road traffic. The improvement of the existing road network has the highest priority in Bulgaria's national transportation policy. The present network is in a rather poor condition, but it is estimated that ongoing improvements are already lowering user costs and saving energy. In the mid-term, the Government is planning to liberalize the road sector by licensing private construction and maintenance companies to operate new sections of the network, allowing for tolling systems to finance these sections, as is already the case in other Eastern European countries.

49. Opportunities for emission reductions are ample in the industrial sector on account of the high level of energy intensity in the sector. During the review several potential measures across various industries were presented, although the actual state of implementation was not clear. Examples of potential technologies and applications for increased capacity and more efficient use of inputs were given for a variety of industries including, the iron and steel, non-ferrous metallurgy, chemical, and building materials and construction industries. It is estimated that implementation of such measures and technologies could lead to energy savings of 44 PJ by the year 2000 and increase to a level of 159 PJ in the period from 2016-2020. Implementation of such measures is heavily dependent on the availability of resources, and therefore the Government strongly supports efforts to increase foreign investment. The Government is also actively encouraging voluntary programmes in industry to improve energy efficiency with a corresponding reduction of greenhouse gas emissions.

50. Bulgaria has a very long tradition of protecting its forests. As a result, forest area has increased steadily over the last few decades (7 per cent since 1965) and forest growth rates have been increasing since 1990 as a result of lower than planned forest cut. Efforts to maintain forest

areas and sustain the high level of sink capacity are viewed as a vital aspect of Bulgaria's future adaptation to climate change. The Government's strategy for the forestry sector, in particular the draft Forestry Development Strategy, is designed to cultivate the forest areas in a suitable manner allowing for adaptation to and limitation of impacts of climate. However, recent legislation allows for the privatization of some state-owned forests. The possible diverging interests between the privatization of state forest and the national forest strategies is recognized. It is clear that future policies will have to support incentives for a sustainable cultivation of forests, including adoption of new varieties of trees (especially for substitution of coniferous areas) and afforestation of wasteland areas.

51. The agricultural sector, as other sectors, is in a dynamic phase of transition. Although specific measurers have not been taken yet and effects and projections of potential measures are not very clear, it is expected that the modernization and privatization of the sector will be done in conjunction with the use of more environmentally friendly technology that will contribute to the reduction of CH_4 and N_2O emissions. The greatest potential for emissions reduction is envisaged to come from the increased use of manure from cattle as fertilizer. The Government is also in favour of the use of new fertilizer techniques which are more adapted to soil quality and the improvement of irrigation systems with the aim of improving water quality. Although the collection of methane for biogas is limited, two such facilities have been installed as part of a demonstration project. The Government hopes to continue, with international assistance, adopting international methods where possible in order to increase the overall productivity and environmental soundness of the agricultural sector.

52. The review team was informed that 77 percent of municipal solid waste is collected and disposed in municipal landfills. According to national statistics there are over 2000 disposal sites. Approximately 682 of these are organized and serve 78 percent of the population. The remaining 1400 are small, unorganized sites that serve 22 percent of the population. Waste disposal is responsible for about 50 per cent of methane emissions. A national strategy has been drawn up which sets the priorities for minimizing waste by adopting new technologies, improving recycling systems, and improving end-treatment by managing disposal sites and optimizing the collection system. Incineration plants have not been taken into consideration since they are considered too costly at present. This strategy is outlined in current draft legislation designed by the Ministry of the Environment. The review team was informed that there was no clear indication of when the legislation would be adopted as it is not an immediate priority of the Government. With respect to industrial waste a new regulation has come into force requiring industrial companies to build their own waste treatment facilities.

IV. PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

53. The communication contains a fairly detailed description of projection results and methodologies. The emphasis was on energy production and energy-intensive sectors but, some limited analysis of the non-energy sectors was also provided. The macro- and socio-economic

analysis and projections were developed by the Institute of Economics and the projections of final energy demand by the Institute of Nuclear Research and Nuclear Energy, both institutes of the Bulgarian Academy of Science. The research institute Energoproekt did the projections on long-term development of the energy sector and experts of Energoproekt also estimated GHG emissions in cooperation with the Institute of Meteorology and Hydrology of the Bulgarian Academy of Science.

54. The experts from the various institutes provided the review team with additional materials and reports, which outlined the development of the different projection scenarios. The methodologies and results were explained in a transparent manner, and the assumptions for the various parameters and variables were considered plausible. The team recognized the difficulty of projecting certain aspects of the economy given the degree of uncertainty introduced by continuing structural changes throughout the economy and other socio-economic developments. Despite these difficulties, the analysis was found to be rather thorough and informative, and the team expressed its appreciation for the substantial efforts devoted to the development of scenarios and projections.

55. The three scenarios developed were the baseline scenario, mitigation scenario and energy policy scenario. The baseline, more or less business-as-usual, scenario incorporates all policies and measures introduced before 1993. The mitigation, or energy efficiency, scenario implies macroeconomic restructuring, penetration of new energy-efficient technologies and a restructuring of the energy supply sector. Under the mitigation scenario a higher degree of foreign investment and indebtedness in the mid-term (in relation to GDP and in absolute terms) is expected owing to the import of new technologies. The energy policy scenario is consistent with the long-term goals of the Bulgarian energy sector as outlined in the National Energy Strategy. All three scenarios were projected for the period 1992-2020 for CO_2, and the baseline and mitigation scenarios were projected for N_2O, CH_4, CO, NO_x and NMVOCs. The projections were done at the sectoral and subsectoral level, providing a clear understanding of the influence of sectors vis-a-vis overall emissions, and economic and energy demand developments.

56. The macroeconomic projections anticipate an increase in GDP of at least 3.4 times between 1992 and 2020. In particular, in comparison to 1992, the outputs of the transport and services sectors are expected to double by 2005 and 2010 respectively, while output by 2020 is expected to be 5.8 and 4 times higher. As present demographic trends are projected to continue, the population of the country will be decreasing throughout the period in question. For the projections of primary and final energy demands in the baseline and mitigation scenarios a bottom-up methodology was used. An econometric approach was applied for energy demand projections for the energy policy scenario. The results of the energy demand projections associate the highest increases with the baseline scenario and lowest with the mitigation scenario, while the energy policy scenario falls roughly in between the two, although with respect to growth rate and structure of consumption it is more similar to the baseline scenario.

57. According to the results of the projections for the various scenarios, Bulgaria will meet its target of not exceeding the 1988 level of GHG emissions in 2000. However, the projections indicate a more rapid increase in emissions after 2000, and even in the case of the mitigation scenario emissions are expected to reach the level of the base year by 2020.

58. In 2000 CO_2 emissions are projected to be below the level of 1988 for all scenarios - 29 per cent, 36 per cent and 27 per cent lower for the baseline, mitigation and energy policy scenarios. By 2020 however, CO_2 emissions for the baseline and energy policy scenario are expected to be more than 35 per cent higher than in the base year. Under the projected mitigation scenario, the implementation of measures in all sectors, as outlined in the scenario, would possibly lead to long-term stabilization of CO_2 emissions, as emissions in 2020 are projected to be roughly equivalent to those in 1988. The scenario's projections indicated that the expected structural changes to the economy and GDP would lead to reduced energy intensity, even in the case of the baseline scenario.

59. The projected growth in CO_2 emissions across the sectors varied to some degree. In comparison to 1992, the base year for projections analysis, each scenario's emissions from transport were projected to grow by more than 225 per cent by 2020, and under the baseline and mitigation scenarios by more than 75 per cent by 2000. Emissions from stationary fuel combustion were projected to grow more slowly, with emission growth in 2000 ranging from 26 per cent for the mitigation scenario to 92 per cent growth for the energy policy scenario. Within stationary fuel combustion, only emissions from industry were projected to increase by 2000, with the exception of slight increases from the commercial and residential sectors under the energy policy scenario.

60. The growth in CO_2 emissions from industrial processes was projected to be significant as compared to other sectors. In all three scenarios, emissions were expected to increase by more than 200 per cent by 2020, although in the short term, until 2000, under the mitigation scenario emissions would increase by less than 10 per cent. Although emissions from the production of iron and steel and inorganic chemicals were projected to increase substantially, emissions from the production of cement were expected to increase the most amongst industrial processes.

61. Three separate scenarios were developed to assess the development of sink capacity: a scenario considering the transformation of coniferous to deciduous forests, a scenario based on the expansion of forest vegetation area and a mixed scenario which is a combination of the first two. Efforts to improve forest management practices and afforestation as described in the mixed scenario are projected to result in the highest level of forest sink capacity. In this case the quantity of the absorbed CO_2 in 2020-2025 would be increased by 23 per cent as compared to 1990.

62. The projections of emissions of gases other than CO_2 were limited since the projections mainly targeted energy intensive sectors. Emissions of CH_4 are projected to increase after 2000 mainly on account of coal mining, oil and gas extraction, and mobile combustion. The

projections, excluding emissions from waste, indicate that CH_4 emissions should increase by 40-100 per cent as compared to 1992 by the year 2020. Mostly owing to process emissions, the amount of N_2O emissions is expected to increase by 72-125 per cent by 2020. N_2O emissions from fuel combustion are expected to grow in a similar fashion to those of CO_2. Emissions of N_2O from the agricultural sector were not included in the projections analysis. Projections were also provided for the precursor gases CO, NO_x, and NMVOCs, where emissions followed patterns similar to those of the other gases. The range of projected emissions growth by 2020 varied from 131-200 per cent for CO, to 67-139 per cent for NO_x and 224-322 per cent for NMVOCs.

63. The projections analysis also included estimates of the effects of different GHG mitigation options. The main supply- and demand-side measures in the energy sector were evaluated in terms of costs and CO_2 reduction potential. Sub-scenarios within the energy supply sector were developed to assess the emissions reduction potential of individual measures. As the economy is presently in a transition to lower levels of energy intensity, in the medium term it is expected that demand-side measures would be more effective, while in the longer term supply-side measures would provide more emissions reduction potential. Analysis was also conducted on which measures would be efficient even in the absence of reduction of CO_2 emissions. The review team highlighted the importance of continued analysis of the effects of mitigation options with respect to projections, but also urged greater harmony with the analysis of policies and measures in the next communication, that is, greater clarity needs to be provided about incompatibilities between basic data and projections. Also, future national communications will need to begin to assess the effects of various policies and measures on GHG emissions.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION

64. A detailed assessment of Bulgaria's vulnerability to climate change and possible adaptation strategies was provided in the national communication. In addition to the information in the communication, further materials were provided during the review, in particular, results from studies on the expected impacts in the forestry and agricultural sectors which were undertaken in conjunction with Bulgaria's participation in the United States Country Studies Program.

65. Data from various global circulation models (GCMs) were used to simulate climatic scenarios in conducting the vulnerability assessment of Bulgaria. Results of the assessment indicate, under the assumption of continuously increasing concentrations of greenhouse gases, an increase in average annual temperatures and greater variability in precipitation. Specific scenarios for the years 2006 and 2036 indicated temperatures 1.2 °C and 2.1 °C higher than in recent (1951-1980) years. The variability of precipitation will increase, with rising levels of precipitation in the winters and lower levels in the warmer seasons. The ongoing studies on expected climatic changes include analysis of the drought phenomenon in the Balkan peninsular regions, effects of sea-level rise along the Black Sea, regional climate change variations and tendencies in hydrological resources in Bulgaria.

66. Given Bulgaria's substantial area of forests, more than 3,500 million hectares, the vulnerability of forests to climate change is of great interest. Results of recent studies indicate that forest vegetation would be vulnerable to the expected changes in climate brought about by a doubling of CO_2 emission levels. The changing climatic conditions predicted would have the largest effect on the lowest forest vegetation zone (below 800 m) in which the majority (61 per cent) of forests are located. In particular, climatic changes would result in shifts in the North from cool temperate moist forest to warm temperate dry forest; in the south warm temperate forest would remain to the most extent, except in the most temperate regions where subtropical dry forest would begin to appear. Although the impact on forests in higher climatic zones is expected to be less adverse, these areas would experience shifts from cool temperate wet forest to warm temperate moist forest.

67. The studies made show that the expected doubling of CO_2 would have a significant impact on agricultural production. The two main crops in Bulgaria, maize and wheat, would be adversely affected, with decreased yields for maize possibly as high as 30 per cent and for wheat 17 per cent. The changes would impact the germination dates and effective growing periods and result in the need for adjustment to, or introduction of, new agricultural management practices such as planting dates, application of fertilizers, irrigation, zoning of crops, and the introduction of hybrids suited to the new climatic conditions.

68. Although no information was provided on adaptation measures now being implemented, the detailed analysis of expected impacts on the forest and agricultural sectors included possible adaptation strategies. The proposed adaptation strategy for forest areas is quite diversified on account of the differing effects expected between the lower and higher area vegetation. The diversified strategy outlined includes application of afforestation programmes according to levels of aridity in specific regions, both the extension and limitation of specific forest characteristics and species across the vegetation spectrum, use of forest shelter belts, use of new technologies in the area of soil preparation and cutting, and development of systems for dealing with fires, pests and disease. Possible adaptation measures for the agricultural sector include zoning of crop production, changes in hybrids and cultivation techniques, introduction of new hybrids and new crops, changes in management practices and systems for pest and disease control, and increased monitoring of land-use and efforts for national and international research.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

69. Some funding has been provided for projects under the European Community's PHARE and THERMIE programmes for support of activities in the energy sector, such as feasibility studies, projects for improved energy efficiency, and promotion of new technologies and renewable energy sources. Projects in the energy sector have also been carried out in collaboration with the European Bank for Reconstruction and Development.

70. Recognizing the large potential positive effect of energy-saving technologies on Bulgaria's energy intensity and GHG emissions, the Government has expressed its continued interest in improving access to such technologies. The team was informed of some projects which have been undertaken in cooperation with external participants, but the need for further international cooperation in the promotion of technological innovations and the dissemination of these technologies to developing countries and countries with economies in transition was emphasized.

Activities Implemented Jointly/Joint Implementation

71. Bulgaria looks favourably upon the concept of activities implemented jointly and joint implementation of commitments as an efficient mechanism for cost-effective reduction of global emissions while facilitating the process of technology transfer to both developing countries and countries with economies in transition. Under the Ministry of the Environment the Project Preparation Unit, established to ensure the fulfillment of commitments under the Convention, is widening its activities in the area of GHG reduction projects. Numerous potential projects have been identified in both the energy and non-energy sectors, including projects for the upgrading of public transport, reconstruction of district heating boilers and cogeneration plants, and implementation of demand-side management programmes. The team was informed that the interest expressed by Annex II Parties in the projects proposed has been very limited as of the date of the review.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

72. During the review some of the activities in the area of climate change research were elaborated on in support of the limited description given in the national communication. In Bulgaria climate research has traditionally been a major area of interest to the scientific community and in recent years research in the field of climate change has grown substantially. The Institute of Meteorology and Hydrology of the Bulgarian Academy of Science has taken the lead in climate change research and is coordinator of the National Climate Programme (NCP) which was developed in 1992. Other institutes involved in the NCP are the Institute of Forestry and the Institute of Geography of the Bulgarian Academy of Science, and the Nikola Pushkarov Institute of Soil Science and Agroecology.

73. The main objectives of the NCP are research on climate variations and its effects, creation of climate-related databases, improvement of climate and environmental monitoring and observation systems, and analysis and optimization of the use of weather and climate as natural resources. These objectives are implemented through various studies and programmes, including studies on vulnerability and adaptation, droughts in the Balkan peninsular region, sea-level rise, and application and testing of models related to climatic behaviour and effects of climate change.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

74. Activities in the area of education and public awareness, although under way, are limited, partly because financial resources are limited. However, at the time of the review, the team was informed that the results of research and work undertaken with respect to Bulgaria's participation in the United States Country Studies Program and preparation of Bulgaria's first national communication under the UNFCCC have been disseminated through seminars and publication in scientific journals. Furthermore, in an effort to reach the wider public, publications in national magazines and newspapers, as well as a series of reports and television and radio programmes are envisaged.

75. Although there are approximately 200 non-governmental organizations working in the area of the environment, only a few are directly involved in climate change. The few concerned are working in cooperation with the Government through the dissemination of information and participation in seminars organized by the Government, industry and the scientific community. The review team, in acknowledging the efforts and activities under way, emphasized the importance of further public awareness and involvement in the area of climate change.

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