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Report on the in-depth review of the third national communication of Japan

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

A. Introduction

1. Japan ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1993. Its first national communication (NC1) under the UNFCCC was submitted in 1994, followed by the second (NC2) in 1997. The third national communication (NC3) was submitted on 31 May 2002.[1] Japan ratified the Kyoto Protocol on 4 June 2002, as the 74th Party to the Protocol.

2. The in-depth review of the NC3 was carried out from December 2002 to July 2003 and included a country visit by a review team to Tokyo on 2–6 December 2002. The team comprised Mr. Imram Ahmad (Pakistan), Mr. Jan Pretel (Czech Republic), Mr. Sang-Yul Shim (Republic of Korea), Mr. Normand Trembley (Canada), Mr. Stéphane Willems (Organization for Economic Cooperation and Development) and Ms. June Budhooram (UNFCCC secretariat, coordinator). During the visit, the review team met with federal government officials involved in the preparation of the NC3 from the Ministry of the Environment (MOE), Ministry of Economy, Trade and Industry (METI, formerly MITI), Ministry of Land, Infrastructure and Transport, Ministry of Foreign Affairs (MOFA), Ministry of Education, Culture, Sports, Science and Technology, Ministry of Agriculture, Forestry and Fisheries (MAFF), and Japan Meteorological Agency (JMA), and with business and environmental non-governmental organizations (NGOs).

3. Preparation of the NC3 started in 2001 with collaboration among all agencies. The Global Warming Prevention Headquarters is responsible for coordinating and implementing climate change policy. The Global Environment Bureau, of the MOE, played a main role in organizing the NC3, coordinated the research efforts by various governmental agencies, and prepared the data regarding waste management. MOFA is responsible for international issues relating to climate change. The NC3 was prepared with input from METI, such as the development and use of energy resources, including research on renewables, energy conservation, economic models, and industrial processes. A steering committee was formed to oversee the preparation of the report, which was submitted for approval by the Diet (the national parliament)[2] in 2002. The team was informed that government officials, NGOs and the public consider the NC3 as the most comprehensive document on climate change in Japan, and that the NC3 is used as an important tool in policy-making.

B. National circumstances

4. Japan is an archipelago stretching approximately between latitudes 24º and 46º north, and consisting of four major islands (from north to south – Hokkaido, Honshu. Shikoku and Kyushu) and 6,800 smaller islands. The national territory is approximately 377,900 km^2, of which about 66 per cent is forested and 13 per cent is agricultural land. Because of its great span from north to south, its mountainous terrain and proximity to the Asian monsoon area, Japan has diverse and complex climatic conditions with great seasonal variation, ranging from subtropical regions around Okinawa in the south to long winters and heavy snowfalls in the north.

5. In the year 2000, Japan's population was 127 million, and the population density was approximately 340 inhabitants per square kilometre. From 1990 to 2000, gross domestic product (GDP)

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[1] The NC3 was submitted six months after the due date of 30 November 2001.

[2] Under the Japanese Constitution, the executive powers of the government are vested in the Supreme Court, the Diet and the Cabinet, which are mutually independent.

increased by 15 per cent to 481 trillion JPY.[3] Since 1997, economic performance has been declining after an upswing of the economy resulting in the effects of the "bubble economy". Domestic passenger and freight traffic grew along with economic growth, with notable increases in road traffic even though the shares of each transportation mode have remained almost constant. Since 1995, however, this growth has slowed down.

6. Primary energy production in Japan reached 105.6 million tonnes of oil equivalent (Mtoe) in 2000; per capita primary energy production was 4.13 toe, a 16 per cent increase during the last decade. Final energy consumption continued to increase considerably with the rapid growth of the Japanese economy in the recent past, and in fiscal year 1999 reached 15,565 PJ.[4] Energy consumption levelled off in the industrial sector, but has increased in the residential and commercial sector.

7. Fuel share contribution to energy supply in 2000 was as follows: oil 50.5 per cent, coal 17.9 per cent, nuclear power 16.0 per cent, gas 12.3 per cent, hydropower 1.4 per cent, combustible renewables 1.1 per cent and non-combustible renewables 0.8 per cent. In comparison with 1990, the share of oil declined whereas the shares of nuclear energy, natural gas and coal increased.

8. Japan's economic structure, natural resource base and trade pattern are the most significant factors that directly determine the development of actions and policies on climate change. In 2000 Japan was the third largest energy consumer among the developed countries after the United States of America and the Russian Federation, but it has scarce domestic energy resources. Thus, the Japanese economy is very dependent on imports of natural resources (80 per cent of its total energy supply is imported), food and other raw materials. This high level of importation also affects its trade patterns. Although the economic base continues to shift away from natural resources towards manufacturing and services, Japan still has a high level of energy-intensive industries.

9. In January 2001, Japan's national administrative system was restructured, with a view to fostering greater inter-ministerial policy coordination and cooperation. The Prime Minister's Office plus 22 ministries were transformed into a new scheme consisting of 12 ministries and the Cabinet Office, which has higher status than the ministries and agencies. A new Ministry of Environment (MOE) was also formed, superseding the Japan Environment Agency, which had been the national environmental authority since 1971.

10. Japan launched its Action Program to Arrest Global Warming in 1990. This set national targets for the reduction of greenhouse gases (GHG), including the stabilization of national and per capita emissions of carbon dioxide (CO_2) at or below 1990 levels by 2000, capping of national emissions of methane (CH_4)[5] and curbing the growth of nitrous oxide (N_2O) and other GHGs as far as possible. By signing the Kyoto Protocol, Japan made a more stringent commitment to reduce GHG emissions in the period 2008–2012 by 6 per cent relative to 1990.

11. Table 1 shows that the CO_2 intensity of the economy has decreased by 2.3 per cent as a result of fuel switching from oil to gas and nuclear power. Japan has effectively strengthened energy efficiency standards since the 1970s, particularly with the "Top Runner" programme in 1998. Although there was some decoupling of CO_2 emissions from economic growth during the decade, Japan was unable to achieve the stabilization target of the UNFCCC in 2000. Emissions were still 12.4 per cent above 1990 levels in the year 2000.

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[3] In 2000, Yen 107.84 = 1 US$.

[4] 1 petajoule (PJ) = 10^{15} joules.

[5] No deadline for this was designated.

Table 1. Main macroeconomic indicators and GHG emissions for Japan

	1990	1995	2000	Change (%) 1995/1990	Change (%) 2000/1990
Population (millions)	123.6	125.6	126.9	+1.6	+2.7
Gross domestic product GDP (billion 1995 USD)	4 936	5 292	5 681	+7.2	+15.1
Total primary energy supply (PJ)	18 374	20 842	21 969	+13.4	+19.6
Total primary energy supply (Mtoe)	438.85	497.81	524.71	+13.4	+19.6
GHG emissions (Tg CO_2 equivalent)[a]	1 185	1 321	1 332	+11.5	+12.4
GHG emissions per capita (t CO_2 equivalent)	9.6	10.5	10.5	+9.7	+9.5
GHG emissions per GDP unit (kg CO_2 equivalent per US$ of 1995)	0.2401	0.2496	0.2345	+4.0	–2.3

[a] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes.

12. The Global Warming Prevention Headquarters was established in December 1997 by order of the Cabinet to implement specific and effective measures against global warming in response to commitments under the Kyoto Protocol. The Headquarters annually reviews progress made in each sector towards the objectives set by the Government. In an attempt to strengthen efforts to reduce GHG emissions in order to meet its Kyoto target, the Headquarters initiated the preparation of the Guideline for Measures to Prevent Global Warming in June 1998. It was reviewed in order to meet the GHG reduction target under the Kyoto Protocol, and in March 2002 the New Guideline for Measures to Prevent Global Warming was approved by government.

13. The New Guideline for Measures to Prevent Global Warming is based on a three-step approach (contribution to both the environment and economy, step-by-step actions, shared responsibility and ensuring international cooperation for measures to prevent global warming). The Government of Japan will conduct an assessment of these guidelines in 2004 and 2007, to determine whether more stringent measures are needed to achieve the national GHG reduction targets.

II. GREENHOUSE GAS INVENTORY INFORMATION

A. Inventory preparation

14. The inventories presented in the NC3 were prepared using the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines) as well as country-specific methods for calculating emissions, where available. The national inventory team did not use the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Good Practice Guidelines) for the preparation of the inventory data contained in the NC3.

15. As required by the 1999 UNFCCC guidelines[6] for the preparation of national communications by Parties included in Annex I to the Convention, the NC3 summarizes anthropogenic sources (emissions) for CO_2, CH_4 and N_2O from 1990 to 1999, relevant sinks (removals) from 1990 to 1995, and hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) from 1995 to 1999, and discusses the underlying trends in emissions. Emissions for biomass and international bunker fuels were presented separately. The NC3 also included a detailed analysis of uncertainties associated with the inventory data. Most of the data on GHG inventories were prepared using data from the fiscal year, which runs from April to March. The inventory team explained that recalculations based on the calendar year are still not feasible, as this modification would require a complete change of statistical data collection in Japan, which would be less accurate.

16. During the review, the inventory team provided the review team with a completely new set of data that are fully compatible with the national GHG inventory submission for 2002. The new set of data

[6] Document FCCC/CP/1999/7.

was based on recalculation of all data series from 1990 onwards. The newly presented data for 1999, when compared to the data in the NC3, show higher values for CO_2 emissions (by 0.6 per cent) and N_2O emissions (by 105.6 per cent) and lower values for CH_4 emissions (by 16.5 per cent); there are minor differences in total emissions of fluorinated gases (HFCs, PFCs and SF_6), which were higher by 0.2 per cent. After recalculation, total GHG emissions are higher by 1.6 per cent.

17. The established Greenhouse Gas Inventory Office of Japan (GIO) under the National Institute for Environmental Studies (NIES) supported by the MOE was recently mandated to develop, monitor, analyse, compile and report GHG emissions and removals.

18. Relevant ministries verify sectoral data as part of the process of finalizing the inventories. The Ministers' Committee of Global Environment approves the inventory data before its final submission to the UNFCCC secretariat. If there are any disclosures, the MOE ensures that the necessary modifications are made to the data.

19. The MOE with other relevant ministries will also be responsible for preparing the first Japanese National Inventory Report (NIR) in 2003. The GIO will provide technical assistance in preparing the NIR. To improve quality assessment of the inventories and enhance accuracy, the MOE will prepare an audit of the GHG inventory by independent experts.

20. Between the NC2 and the NC3, actual emissions of HFCs, PFCs and SF_6 were estimated in addition to potential emissions reported earlier, including total emissions (actual and potential) expressed on a Global Warming Potential (GWP) basis. Since the submission of the NC3 to the UNFCCC secretariat, the national inventory team has applied a sectoral approach for estimating national totals of CO_2 emissions, emissions from some sources which were reported as "not estimated – NE" in the NC3 were quantified, methods for inventory data estimation were improved on the basis of the latest scientific knowledge (corrected emission factors) and all time series from 1990 to 2000 were provided in the common reporting format. This updated information was used in the analysis of inventories presented in this report.

21. The Japanese inventory team provided the UNFCCC review team with a complete table of revised emission factors, which are identical to factors submitted to the secretariat in the national GHG inventory submission for 2002.

22. Between the NC2 and the NC3,[7] CO_2 emissions for the base year 1990 were recalculated and revised downwards by 0.5 per cent, from 1,125 Tg CO_2 equivalent to 1,119 Tg CO_2 equivalent. The national inventory team explained that this is due primarily to revised emission factors and updated activity data for CH_4 and N_2O in the agriculture and industrial processes sectors, respectively. These revisions are consistent with recalculation procedures and do not affect overall GHG emission trends significantly, but shares of the main gases have changed: the share of CO_2 decreased by 0.03 per cent, the share of CH_4 decreased by 18.8 per cent, whereas the share of N_2O increased by 19.5 per cent.

23. In general, the inventory for Japan is well prepared and almost complete, and shows substantial improvements over the NC2. The review team was able to analyse trends with the additional information provided during the review, including the updated inventory series 1990–2000.

24. Because of a lack of statistical and survey data from the forestry areas, the national inventory team did not provide data for the Land-use Change and Forestry (LUCF) sector from 1996 onwards. They informed the review team that these data would be available after the new IPCC methodology for the LUCF sector is approved.

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[7] Data presented during the in-depth review.

B. Overall emission trends

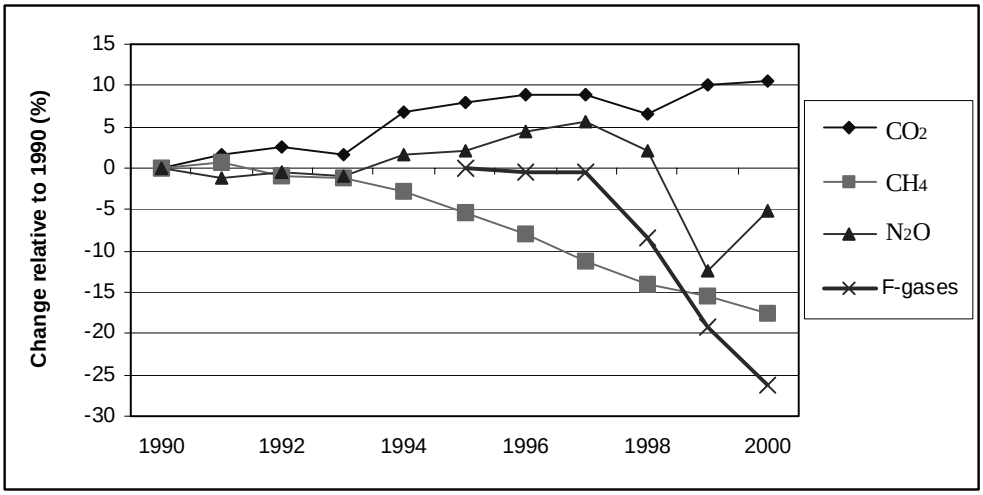
25. Trends in total GHG emissions between 1990 and 2000 are shown in table 2 and figure 1. Both are based on the new set of data which were provided to the review team during the mission. In 2000, total aggregated emissions of CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6, excluding LUCF were 12.4 per cent above the 1990 level, which does not include HFCs, PFCs, and SF_6. Emissions of CO_2 increased by 10.5 per cent, emissions of CH_4 decreased by 17.6 per cent and emissions of N_2O decreased by 5.1 per cent compared to 1990. HFC emissions decreased by 8.4 per cent and SF_6 emissions by 65.7 per cent, and PFC emissions were constant compared to 1995; total emissions of fluorinated gases (HFCs, PFCs and SF_6) decreased by 26.3 per cent in the same period. Detailed trends for fluorinated gases are shown in table 3.

Table 2. GHG emissions by gas, 1990–2000

	Tg CO_2 equivalent												
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Change (%) 1995/1990**	**Change (%) 2000/1990**
CO_2	1 119.3	1 138.5	1 148.9	1 136.4	1194.8	1208.0	1 219.4	1 219.4	1 191.7	1 232.8	1 237.1	+7.9	+10.5
CH_4	26.7	26.9	26.5	26.4	26.0	25.3	24.6	23.7	23.0	22.6	22.0	–5.5	–17.6
N_2O	38.8	38.4	38.7	38.5	39.4	39.6	40.5	41.0	39.7	34.0	36.9[8]	+2.1	–5.1
HFCs, PFCs, SF_6	NA	NA	NA	NA	NA	48.3	48.0	48.0	44.2	39.0	35.6	NA	–26.3
GHG without LUCF	1 184.9	1 203.9	1 214.1	1 201.3	1 260.1	1 321.2	1 332.7	1 332.2	1 298.5	1 328.3	1 331.6	+11.5[a]	+12.4[a]
CO_2 removals by LUCF	–83.9	–83.9	–85.6	–90.1	–93.5	–96.7	NA	NA	NA	NA	NA	+15.3	NA
GHG with LUCF	1 101.0	1 120.0	1 128.5	1 111.2	1 166.6	1 224.5	NA	NA	NA	NA	NA	+11.2[a]	NA

Note: Data were updated by the inventory team in Japan and provided during the review.
[a] Total emission in 1990 does not include emissions of F-gases.
NA = not available.

Figure 1. GHG emission trends, 1990–2000



Note: Data were updated by the inventory team in Japan and provided during the review. Figures for fluorinated gases are given as a percentage of the base year (1995).

[8] In 1999, a decomposition system was introduced in the production of adipic acid, resulting in reduction of N_2O emitted during the process. On the other hand, the rate of operation of the decomposition system has declined in 2000, thereby increasing the emission of N_2O.

26. CO_2 was the main gas contributing to the GHG total excluding LUCF in 2000 (92.9 per cent). CH_4 emissions accounted for 1.7 per cent, N_2O for 2.8 per cent, and fluorinated gases (HFCs, PFC and SF_6) in total contributed 2.7 per cent.

Table 3. Trends in emissions of fluorinated gases, 1995–2000

	Tg CO_2 equivalent						Change (%)
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2000/1995**
HFCs	20.0	19.6	19.6	19.0	19.5	18.3	–8.4
PFCs	11.5	11.3	14.0	12.4	11.1	11.5	–0.1
SF_6	16.7	17.2	14.4	12.8	8.4	5.7	–65.7

C. Trends in key emission sectors

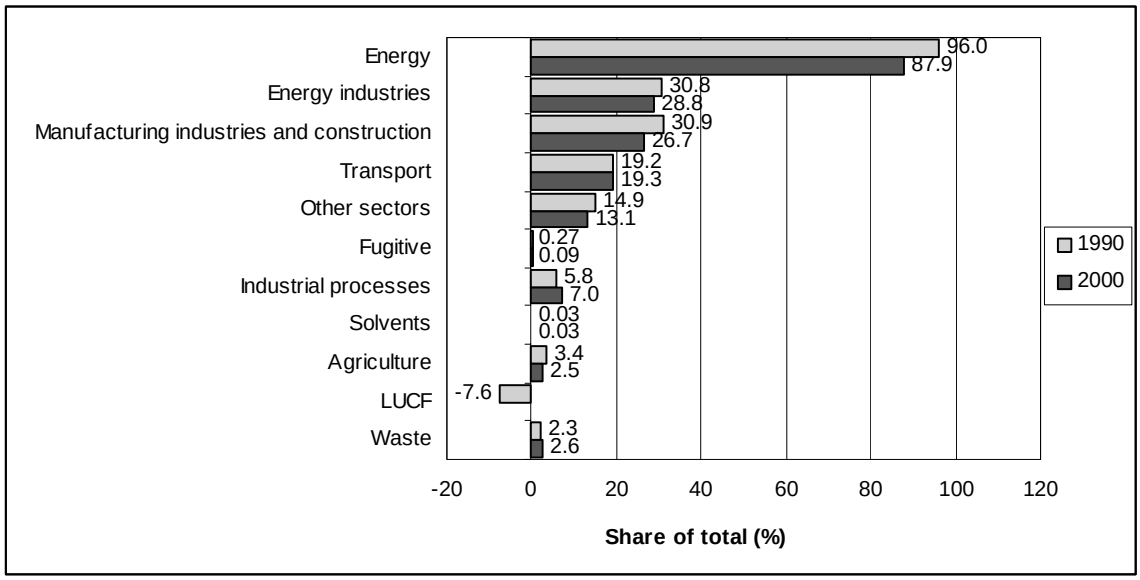
27. Between 1990 and 2000 energy was the main source of GHG emissions: in particular, electricity generation and manufacturing industries together accounted for 63.1 per cent and transport for 21.9 per cent of this sector's emissions in 2000 and 64.3 per cent and 19.9 per cent in 1990, respectively. The energy sector as a whole experienced an increase in emissions of 10.7 per cent between 1990 and 2000. Table 4 and figures 2 and 3 show the distribution of GHG emissions by major sectors.

Table 4. GHG emissions by sector and sub-sector, 1990–2000

	Tg CO_2 equivalent											Change (%)
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2000/1990**
Energy	1 057	1 074	1 083	1 070	1 125	1 137	1 149	1 149	1 125	1 168	1 170	10.7
Energy industries	*339*	*342*	*350*	*332*	*369*	*360*	*361*	*357*	*350*	*372*	*384*	*13.1*
Manufacturing and construction	*340*	*339*	*329*	*333*	*342*	*347*	*354*	*355*	*345*	*361*	*355*	*4.4*
Transport	*211*	*221*	*226*	*228*	*239*	*246*	*253*	*258*	*258*	*262*	*256*	*21.6*
Other sectors	*158*	*165*	*170*	*169*	*167*	*177*	*174*	*172*	*167*	*167*	*169*	*6.8*
Fugitive emissions	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*–61.0*
Industrial processes	64.2	65.1	65.6	64.8	66.7	115	115	114	104	92.5	93.0	45.0
Solvents	0.29	0.36	0.41	0.41	0.44	0.44	0.42	0.40	0.38	0.36	0.34	18.8
Agriculture	37.6	37.5	37.4	37.3	36.8	35.9	35.0	34.2	33.7	33.2	33.0	–12.1
CO_2 removals by LUCF	–83.9	–83.8	–85.6	–90.1	–93.5	–96.7	NA	NA	NA	NA	NA	NA
Waste	25.7	26.4	28.0	28.4	31.3	32.5	33.3	34.5	34.8	34.5	34.7	35.2

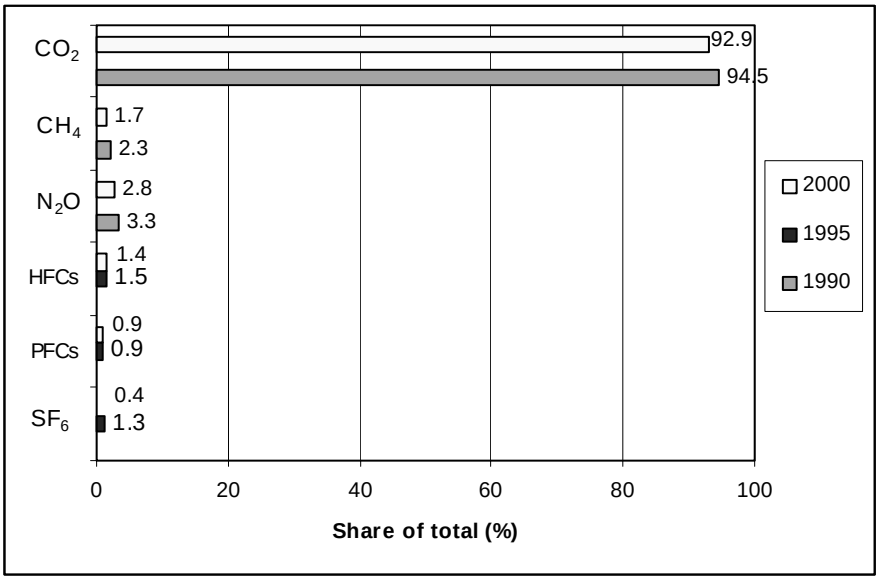
Note: Based on GHG inventory submission 2002.
F-gases are included in "Industrial processes" from 1995 to 2000; they are not included before 1995.
Small discrepancies in totals are due to rounding.
NA = not available.

Figure 2. Shares of GHG emissions by sector, 1990 and 2000



Note: Data on LUCF for 2000 are not available.

Figure 3. Shares of GHG emissions by gas, 1990, 1995 and 2000



Note: Data on HFCs, PFCs and SF_6 for 1990 are not available.

28. There are three notable trends in sectoral performance and GHG emissions over the decade: substantial increases in GHG emissions from transport and waste; moderate increases in the energy, manufacturing and construction and residential/commercial/institutional (RCI) sectors; and a decline in agricultural and fugitive emissions. No estimate for the LUCF sector is available.

29. ***Substantial increases in GHG emissions from transport and waste.*** Between 1990 and 2000, emissions from the transport sector increased by 21.6 per cent. However, between 1999 and 2000 emissions decreased by 2.1 per cent and stabilization or a continuing decline is expected in future. The inventory team explained that the growth in GHG emissions from transport was due to increased traffic

demand, an increase in passenger–kilometres transported and an increase in car sizes over the decade. Emissions from the waste sector increased by 35.2 per cent between 1990 and 2000. National experts explained that this was a direct result of more waste being incinerated, especially plastics (80 per cent of municipal solid waste is incinerated in Japan). The emissions from waste management were stable from 1997 to 2000.

30. ***Moderate increases in the energy, manufacturing industry and RCI sectors.*** Emissions from the energy and manufacturing sectors together grew by 8.8 per cent between 1990 and 2000. Emissions from the RCI sector increased by 6.8 per cent. Together, the energy and manufacturing sectors contributed 55.5 per cent to total GHG emissions in 2000, but the RCI sector is responsible for only 12.7 per cent of total GHG emissions. These moderate increases were a consequence of growth in energy demand, and also of an increase in the number and average size of households, increased floor space area per household and an improvement in living standards in Japan.

31. ***Decline in agriculture and fugitive emissions.*** Emissions from the agriculture sector declined by 12.1 per cent between 1990 and 2000. National experts attributed this reduction to a decrease of land area under rice cultivation. Fugitive emissions were responsible for only 0.1 per cent of total GHG emissions in 2000, and they decreased by 61.0 per cent between 1990 and 2000 as a result of technological improvements in gas distribution.

III. POLICIES AND MEASURES

32. In order to prepare for the implementation of the Kyoto Protocol, Japan has strengthened its overall framework for climate change policy. The Law Concerning the Promotion of the Measures to Cope with Global Warming, enforced in April 1999, defines the respective roles of the Government, local public organizations, businesses and citizens in developing and implementing plans to reduce GHG emissions. The Diet revised this law in May 2002, at the same time that it approved the ratification of the Kyoto Protocol. A new Climate Change Policy Programme (called “New Guideline for Measures to Prevent Global Warming” in the NC3) was also drawn up by various ministries, discussed in several advisory councils and adopted in March 2002 by the Global Warming Prevention Headquarters, which consists of cabinet ministers in charge of climate policy (see para. 12). Under the revised Law, a “Kyoto Protocol Target Achievement Plan”, based on the above programme, will be adopted when the Kyoto Protocol enters into force.

33. The Climate Change Policy Programme addresses the policies which contribute to both the environment and the economy, the step-by-step approach, actions by all sectors and international cooperation. Through the contribution of the environment and the economy, the Japanese Government strives to ensure that policies and measures have both climate and non-climate benefits. The step-by-step approach specifies how the plan will be monitored over time. To make sure Japan stays on track to meet its Kyoto commitment, a revision of the plan is foreseen in 2004 and 2007, based on yearly reviews of the performance of policies and measures already implemented. “Actions by all sectors” reflects the increased involvement of all actors – national, regional, local governments, businesses, NGOs, as well as citizens – in GHG mitigation. Finally, through international cooperation, the goal is to ensure that all countries join in the international efforts to combat climate change.

34. The Climate Change Policy Programme defines several subsidiary targets within the overall 6 per cent target:

(a) To return CO_2 emissions from the energy source to their 1990 level within the first commitment period;

(b) To reduce CO_2 emissions from non-energy sources, CH_4 and N_2O by 0.5 per cent of total GHG emissions in the base year within the first commitment period;

(c) To achieve a further 2 per cent reduction as compared to the total GHG emissions in the base year within the first commitment period by innovative technological development and promotion of further activities involving various sectors and the public such as implementation of a national campaign to create a lifestyle suited to the global environment era, strengthening the basis for promoting regional measures, promotion of measures implemented by individual families, and promotion of awareness campaigns for global warming activities;

(d) To contain the growth of fluorinated gases to 2 per cent of the total GHG emissions in the base year within the first commitment period;

(e) To ensure removals of about 13 million tonnes of carbon through sink activities in Japan, corresponding to about 3.9 per cent of the total GHG emissions in the base year.

35. This leaves about 1.6 per cent of the total GHG emissions in the base year to be addressed by other means, including the possible use of the Kyoto Mechanisms. However, the Japanese Government has not yet decided how much emissions reduction it would like to achieve through these mechanisms.

36. The Climate Change Policy Programme includes a comprehensive set of policies and measures, covering all sectors. It includes both a set of current measures and a set of additional measures needed to achieve the 6 per cent target. The description of more than 100 policies and measures provides clear evidence of the increased level of effort put into climate change mitigation. However, the NC3 provides little information on the details or effects of implementation, for example on the scale of investments or funding, status of implementation, or past performance of measures, because the NC3 was submitted just after the decision of the Climate Change Policy Programme. The strengthened policy framework, including the step-by-step approach, should allow Japan to closely monitor the performance of measures, in order to stay on track for compliance with the Kyoto Protocol.

37. Some substantial reporting improvements have been made compared to the NC2. In particular, there is detailed quantitative information on the expected effects of policies and measures, individually or in combination, in 2010 as compared to the base year. This allows for a better understanding of the priorities of climate change policy. Some further improvements could greatly enhance Japan's compliance with current reporting guidelines, including: and reporting of measures by sectors, subdivided by gas (as opposed to a reporting by policy objectives); detailed description of policies and measures (as shown in section V.D and in table 1 of the guidelines); and reporting on policies and practices which discourage activities leading to greater levels of anthropogenic GHG emissions.

A. Energy

38. Of the six GHGs under the Kyoto Protocol, CO_2 poses the largest challenge to Japan. Comprising about 93 per cent of total GHG emissions in 2000, it increased by 10.5 per cent between 1990 and 2000. The country faces difficulties in reducing CO_2 emissions from energy use as it has already achieved major efficiency improvements in most energy-consuming sectors and also, in the interest of energy security, would like to ensure a diverse supply of energy. Nevertheless, reducing CO_2 emissions through energy-related policies and measures (excluding transport) is expected to represent about 61 per cent of the quantified emission mitigation effort, as presented in the NC3 (about 370 Mt CO_2 equivalent, not counting emission reductions from the nuclear energy programme). This includes other energy measures presented separately in the NC3 (see sections I and J). No policies or measures in the energy sector that are aimed at reducing emissions of CH_4 or N_2O are described in the NC3.

39. The bulk of CO_2 emission reductions in the energy sector (excluding measures presented in sections I and J) is expected to stem from energy conservation measures in the industrial sector (about 63 Mt) and in the commercial and residential sector (about 83 Mt). Most of the policies and measures on the demand side were already part of the "Guideline for Measures to Prevent Global Warming" adopted in 1998 ("old guideline"). However, an additional set of policies and measures targeting energy conservation in these sectors was included in the new guideline adopted in 2002. Additional measures on the energy supply side were also included in this latest programme, which would reduce emissions by another 52 Mt.

40. Among measures for the industrial sector in the "Climate Change Policy Programme" , the main energy conservation measure is the Keidanren Voluntary Action Plan (VAP), established in 1997 by the Japanese Federation of Economic Organizations (Keidanren). It aims to reduce CO_2 emissions in 2010 to no more than those of 1990 through energy conservation measures. Currently, energy efficiency in industry has reached the highest level in the world, as the result of continued energy conservation after oil crises. The plan is, however, ambitious, as it would reduce emissions by about 42 Mt in 2010 compared to "business as usual". Although the Japanese Government does not participate in the VAP itself, it is trying to increase its effectiveness through additional measures, such as financial support for measures included in the VAP and factory checks based on the Law Concerning the Rational Use of Energy. The priority of these factory checks is to target industries that have not established action plans, or those whose progress in terms of energy conservation lags behind what is stated in their action plan.

41. According to Keidanren, CO_2 emissions in 2001 from participating industries, provided by yearly reports to the public, were 3.2 per cent below 1990 levels. The reports were reviewed by the government and the relevant advisory councils in order to enhance reliability and transparency. In addition, in July 2002 Keidanren set up an evaluation committee for the VAP to check data reliability and improve transparency for third parties. Although the emissions of the participating industries cover approximately 80.1 per cent of the total amount of CO_2 emitted by the country's industrial and energy-converting sectors in 1990, Keidanren made efforts to expand the coverage of participating industries.

42. In the residential and commercial sector, the main policies and measures focus on improving the energy efficiency of equipment and appliances as well as of housing and buildings. The centrepiece of Japan's appliance and equipment efficiency programme is the regulatory approach called "Top Runner", adopted in 1998 through the revision of the Law on the Rational Use of Energy. This system sets the targets for the weighted-average energy efficiency of each manufacturer or importer's shipments in predefined product categories to the level of the most efficient model in each category currently on the market. As a result, today's best model defines tomorrow's standards. The latest Climate Change Policy Programme has extended this approach to new equipment. Altogether, this ambitious policy is meant to reduce CO_2 emissions by 33.3 Mt by 2010. Measures with a smaller emission reduction potential include financial assistance and labelling systems for the development and dissemination of energy-efficient products.

43. As far as housing and commercial buildings are concerned, the construction guidelines/standards (under the Law on the Rational Use of Energy) were revised and strengthened in March 1999. These measures, together with complementary measures such as financial incentives, are meant to reduce CO_2 emissions by 35.6 Mt in 2010. A new measure, included in the latest Climate Change Policy Programme, is the promotion of energy management systems, which are meant to reduce CO_2 emissions by a further 10.6 Mt in 2010. Financial incentives have been or will be established for both residential and commercial buildings, and, in addition, a regulatory approach for large-scale office buildings, similar to that applying to large-scale factories, was adopted.

44. On the supply side, the main policies so far implemented to reduce CO_2 emissions are the promotion of renewable energies, fuel switching to natural gas and the promotion of nuclear power. The promotion of renewable energies is meant to reduce CO_2 emissions by 34 Mt in 2010, and fuel switching to natural gas would bring another reduction of 18 Mt by 2010. The current objective for nuclear power is to increase nuclear electricity generation by 30 per cent in 2010 compared to 2000. Most measures to promote renewable energies and fuel switching to natural gas have so far relied on subsidies and financial support programmes. Other recent measures focus on expanding new markets for renewable energy, in particular through the adoption of the Law on the Promotion of the Use of New Energy by Electric Power Suppliers, which will be implemented in April 2003. Development of photovoltaic power generation, generation using biomass and waste, and wind power generation is to be promoted in particular.[9] After a series of incidents that risked undermining the Japanese nuclear programme, the emphasis of new measures in this area is in providing information and education on nuclear power to regain the trust of Japanese citizens.

45. It is unclear at this stage whether current measures on the energy supply side will be successful in reaching the above emission reduction targets or whether other measures will be needed, in particular if nuclear electricity generation cannot be increased according to current objectives. The Japanese Government is currently considering new measures, such as taxes on coal, which may be introduced in the near future.

B. Transport

46. Reducing CO_2 emissions in the transport sector is expected to represent about 12 per cent (or about 45 Mt CO_2) of the quantified emission mitigation effort, as presented in the NC3. About 41 per cent of this reduction should be reached through a package of measures aiming at promoting highly fuel-efficient and low-emission vehicles (including clean energy vehicles). In addition to the adoption of the "Top Runner" approach for vehicles in 1998, recent measures (included in the Climate Change Policy Programme of March 2002) include tax measures (green automobile taxation) and financial support for technological development and dissemination of low-emission vehicles. The remaining emission reduction should be reached through more than 50 measures aiming at improving driving style and traffic flow, as well as promoting less energy-consuming modes of transport. Success in reducing emissions in this sector will depend on the details of implementation, as "soft" measures have so far not proved to be successful in curbing the increasing trend of CO_2 emissions in this sector in industrialized countries.

C. Industry

47. Process-related CO_2 emissions from the industrial sector in Japan accounted for 4.3 per cent of the total CO_2 emissions in 2000 compared to a level of 5.1 per cent (56.6 Mt CO_2 equivalent) in 1990, which represents a reduction of 6.1 per cent to 53.2 Mt CO_2 equivalent. This reduction in emissions from non-energy sources was mainly due to an 8.1 per cent decrease in the limestone consumption used in cement production in 2000 compared to 1990. It is uncertain whether a similar reduction is possible in the future.

48. N_2O emissions from industrial processes have followed the same trend, but the reduction was much greater. The emissions fell from 23.9 to 13.6 Gg in 2000, a reduction of 43.2 per cent. It should be noted that the emissions increased from 1990 to 1997 and then reduced from 24.8 to 13.6 Gg between 1998 and 2000. The reason for this drastic reduction was the introduction in a specific production unit,

[9] The NC3 provided the following targets for electricity generation from renewables in 2010: 4.82 TWh for photovoltaics, 4.17 TWh for waste, 3 TWh for wind, and 0.33 TWh for biomass.

through a voluntary plan, of a decomposition system for N_2O emitted in the production of adipic acid. The review team was informed that there is only one factory which produces adipic acid in Japan.

49. Japan has been successful in implementing effective measures that have led to the reduction of 26.3 per cent in fluorinated gases during the period 1995–2000, comprising a reduction of 8.4 per cent for HFCs, 0.1 per cent for PFCs and 66 per cent for SF_6.

50. With the requirement of the Montreal Protocol to eliminate ozone-depleting substances, Japan will have to make considerable efforts in order to minimize the growth of HFC, PFC and SF_6 emissions. Japan's objective is to reduce these emissions by approximately 34 Mt from "business as usual": to 73 Mt compared to 107 Mt. Current measures have focused on promoting the implementation of voluntary action plans by industries – in April 1998 industrial sectors established plans based on the "Guidelines for Measures to Limit Emissions of HFCs, PFCS, and SF_6 by Industry" issued by METI – as well as on the development of alternative substances and development of technologies to recover and destroy HFCs.

51. Japan will also implement additional measures to ensure that the set target will be reached. Research and development (R&D) of alternative substances will focus specifically on new substitutes for refrigerants, cleaners and foaming agents, and substitute gases and systems for the etching gas (PFC) used in the production of electronic devices. Japan has also put in place laws that require the recovery of HFC refrigerants from equipment: the Law for Recycling of Specified Kinds of Home Appliances, and the Law for Ensuring the Implementation of Recovery and Destruction of Fluorocarbons Concerning Specific Products. The review team felt that the measures taken so far seem appropriate. However, Japan's capacity to meet its set target will depend on the positive outcome of the measures that are contemplated.

D. Agriculture

52. The agriculture sector continues to play an important role in the overall Japanese economy and in the reduction of GHG emissions. Agricultural land covers approximately 13.1 per cent of Japanese territory. However, since the late 1980s, development of farmland has been reduced, with a trend for farmland to be left uncultivated, so the total area used for agricultural purposes has decreased.

53. This sector contributed to 63 per cent of the total emissions of CH_4 in 2000. However, overall GHG emissions from the sector were reduced by 12.1 per cent compared po 1990. It sloul` also$be noted that N_2O emissions dropped by 12.9 per cent between 1990 and 2000. The key elements that have influenced the reductions of CH_4 emissions are mainly related to the decrease in agricultural activities overall, and rice production in particular. It should also be noted that efforts have been made to improve management of farmland and livestock. Future reductions in CH_4 and N_2O emissions are expected from a range of measures, including improved farmland management, the development of emission reduction technologies such as livestock feeding management skills, and the promotion of appropriate use of animal manure and other technologies to reduce emissions of N_2O from this sector.

54. The review team was informed that farming activities and livestock numbers are expected to continue to decline in the future. Special emphasis will be given to promoting the reduction of CO_2 from farmland soil by supplying organic substances through compost deoxidization and green manure cultivation, as well as improved management of grassland. Efforts will continue to be made to maintain the negative trend of CH_4 emissions, through the implementation of new measures such as the establishment of technologies for livestock feeding management and improvements in farmland management.

E. Land-use change and forestry

55. Japan has a long tradition of sustainable use of forests. The present system of forest ownership was established during the Meiji period (more than 100 years ago). Around 60 per cent of forest area is privately owned, the large majority of plots being very small (less than 5 hectares); 10 per cent belongs to prefectures and municipalities, and about 30 per cent (representing 20 per cent of the total area of the country) is national forest. The national government is responsible for the management of national forests but all other forests are managed by prefecture and local government authorities, private citizens, companies and other non-governmental entities.

56. Forests already cover 66 per cent of the national territory, or roughly 25 million hectares, so there is almost no scope to increase the coverage. Under the Kyoto Protocol, Japan has been permitted to remove through forest management 3.9 per cent of its total GHG emissions in the base year (47.67 Tg CO_2 equivalent). The review team was informed that Japan does not have enough afforestation and/or reforestation sites that could contribute to the enhancement of CO_2 removal. Therefore, the approach taken by Japan focuses on the management of its existing forest for CO_2 removal.

57. National forest experts expressed their concern that there is a risk that the removals could fall below the upper limit if the forest management, timber supply and utilization were to remain at current levels. Japan has therefore recognized the importance of steadily and comprehensively implementing forest management, timber supply, and efficient utilization through the Basic Plan on Forest and Forestry which was introduced by a cabinet decision, in October 2001, based on the Basic Law on Forest and Forestry.

58. The Basic Plan sets targets to fulfil the multiple functions that forests have, including targets pertaining to the supply and utilization of forestry products. The measures to be implemented will focus mainly on sound forest management, including protected forest, the promotion of forest-related activities in which private citizens can participate and the utilization of timber and wood biomass.

F. Waste management

59. Japan faces substantial challenges related to waste. However, there has been a noticeable decrease in CH_4 emissions, a reduction of 9.2 per cent between 1990 and 1999 compared with an increase of 55.5 per cent for CO_2 and 41.6 per cent for N_2O from waste incineration during the same period.

60. The focus is, and will continue to be, on waste management and reducing the emissions of CH_4 and CO_2 from the treatment of waste, by reducing incineration of plastic waste and biodegradable landfill. The approach favoured by Japan will address the reduction of waste generation, the promotion of reuse and recycling, and the reduction of waste landfill.

61. The review team noted that the potential to reduce CH_4 is well exploited and there should be further reductions in the future. However, there is also a risk that the implementation of the measures to reduce direct landfill disposal of waste could lead to an increase of emissions of CO_2 and N_2O from incineration of waste that cannot be disposed of by other means. Nevertheless, GHG emissions of CO_2 and N_2O from incineration are less than the CH_4 emitted from direct landfill disposal for the same amount of waste, indicating that the reduction in direct landfill disposal would reduce the GHG emission.

G. Development of innovative technology and further extensive efforts by the public

62. Japan has made substantial efforts in promoting measures related to innovative technological development beyond the current technological standards such as ultra-efficient photovoltaic power,

hydrogen production technology, technologies to improve energy use efficiency (e.g. ultra-steels and super-heat-resistant materials), and technology relating to energy conservation in the energy use sector (technologies using supercritical fluids as an innovative environmental energy technology).

63. The review team was informed that METI has in the past played an active role as the leading organization in conducting R&D in a number of key areas, and is expected to continue to do so in the foreseeable future.

64. The review team was also informed that, through development of innovative technology and further extensive efforts such as the creation of a lifestyle suited to the global warming era, Japan is aiming for a 2 per cent emission reduction in total GHG emissions compared to 1990. The review team is of the view that in order to meet this target, Japan will need to be highly successful in delivering its measures, current and additional.

65. However, Japan has identified a number of additional measures that should assist in reaching its target, by strengthening the promotion of innovative technological development. In industries that consume large quantities of energy, the main focus is on the storage of energy and the reduction of losses during electricity distribution, improvement of the energy efficiency of products (electronic and transport equipment) and of processes.

66. The review team felt that given the level of uncertainty attached with R&D and related technologies, the total impacts of measures are difficult to estimate at this moment.

67. Japan strongly believes that specific initiatives (awareness campaigns and the provision of information to seek better understanding, action and cooperation) have to be put in place in order to involve various sectors and the general public.

68. A number of valuable measures have been undertaken previously under the leadership of MOE. These measures include various awareness campaigns carried out by the Japan Centre for Climate Change Actions, Prefectural Centres for Climate Change Actions and global warming prevention activities advisors, and through implementation of national resource and energy conservation campaigns in accordance with the Law for the Promotion of Measures to Cope With Global Warming.

69. However, Japan is of the view that additional measures have to be implemented in order to maintain the involvement of various sectors and the public. A series of measures have been identified for implementation by the general public, by companies and government and local authorities, and these measures should reduce emissions by 1.8 per cent (22.1 Mt CO_2 equivalent compared to emissions in 1990).

70. The review team is of the view that it is difficult to measure success with respect to public awareness, including the potential GHG reduction. The review team is of the opinion that the figure of a 1.8 per cent reduction in GHG emissions through a change in public behaviour may be prudent; however, the effectiveness of such an instrument needs to be assessed.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

71. The projections in the NC3 are based on the new climate change policies contained in the new Guideline for Measures to Prevent Global Warming established in March 2002. Many government institutions and NGOs as well as private experts are involved in the formulation of the Climate Change Policy Programme at relevant stages of the decision-making process. Every ministry concerned with sectoral emissions is responsible for drafting the mix of policies and measures, and preparing the associated projections and the total effect of policies and measures in that particular sector. These

ministry-level drafts are adjusted where appropriate, and merged into a single report for the deliberation of the Joint Council, which is composed of eight advisory councils such as the Central Environmental Council and the Industrial Structure Council. The members of the Joint Council are from various different sectors including academia, industry, the private sector, NGOs, and central and local government. At the final stage of the decision-making process is the Global Warming Prevention Headquarters, which consists of the Prime Minister as chief, and the Chief Cabinet Secretary as a Deputy-Chief, Minister of the Environment, and Minister of Economy, Trade and Industry, Minister of the Environment as a Deputy-Chief, approves the projected data presented in the NC3.

72. Various approaches to projections and the total effect of policies and measures are employed, depending on the characteristics of the sector and greenhouse gas, the availability of information, and state of GHG estimation techniques.

73. Projections of CO_2 emissions from energy sources are primarily based on a general equilibrium model – the KEO model (invented by Keio University and METI) – which is integrated with an energy conservation factor model and an electric power sector composition model. The validity of the integrated KEO model is tested using a regression analysis model. The national projection team responsible for CO_2 emissions from energy sources informed the review team that the integrated KEO model generates economic indicators, e.g. GDP, energy consumption, and the effects of specific policy measures such as a carbon tax. During the review, the national projections team pointed out that the regression analysis model employed in the NC2 was also used to estimate CO_2 emissions from energy sources for the "without measures" projection of the NC3.

74. A bottom-up approach and expert judgement are utilized to project CO_2 emissions from non-energy sources, CH_4 and N_2O. Activity levels and emission intensities are forecast, where appropriate, to project emissions of these GHGs using bottom-up models. National experts extrapolated emissions levels from 1999 up to 2010 for those cases where either there was no significant change in emission levels during the 1990s, or information was limited.[10] An example of this type of expert judgement is the estimation of CH_4 emissions from carbon black production in 2010.

75. Both a bottom-up and a top-down model are used to project emissions of fluorinated gases where industry-submitted data are widely available.

76. The net CO_2 removals of the LUCF sector are projected by forecasting the net growth of forests based on the Basic Plan on Forest and Forestry and applying a national conversion factor. The NC3 states that further examination of this method will be required when the IPCC Good Practice Guidelines are available.

77. Projections of CO_2 emissions from international aviation bunker fuel sold in Japan are based on a trend analysis of activity levels, passengers travelled and freight transported, and the average values of the transport distances and CO_2 emissions per revenue tonne–kilometre. CO_2 emissions from international marine bunker fuel are not estimated, since no correlation has been identified between major economic indicators and the sales volume of marine bunker fuel.

78. The NC3 considers three GHG emission projections scenarios: "without measures", "with measures" and "with additional measures". It presents emission projections for each scenario by sector and by gas, but only for the year 2010. The NC3 does not present information for 2005, 2015, and 2020 as suggested by the UNFCCC reporting guidelines.

[10] Emission data and projections are presented in the NC3 using the fiscal year April to March.

A. Case definitions and key assumptions

79. The "with measures" scenario projects future emissions taking into account the implementation of policies and measures defined under the 1998 ("old") Guideline for Measures to Prevent Global Warming. The "with additional measures" scenario includes policies outlined in the 2002 ("new") Guideline for Measures to Prevent Global Warming, which is planned for implementation after an assessment of current policy abatement performance in 2004. These planned policies and measures are described in detail in the guideline. The "without measures" scenario does not include any of the policies contained in the old or the new guidelines. The 1999 inventory was used to prepare the projections presented in NC3, as this was the latest year available at the time of its preparation.

80. Key variables projected to affect macroeconomic growth are population, exchange rate, world oil price, consumption of liquid natural gas and steam coal, rice cultivation acreage, production of domestic livestock, waste treated, energy consumption and forested area. Population is forecast to be 127.6 million in 2010, similar to the figure used in the NC2. The price of crude oil is estimated at US$ 30 per barrel in 2010, equal to the price assumed in the NC2. There is no significant difference between the NC2 and the NC3 in the assumptions made on rice cultivation acreage, incinerated waste and forest area for 2010. However, there are considerable differences between the NC2 and the NC3 in the values estimated for 2010 of milk cows, beef cattle, hogs, and landfilled organic waste. The review team noted that it was difficult to understand the changes to the underlying assumptions between the NC2 and the NC3 and recommend to the national team that, for transparency and comparability of projections data for Japan as well as for country comparisons, the format of table 2 on page 91 of the reporting guidelines should be used to report information about the key underlying assumptions.

81. Unlike the NC2, the NC3 does not assume an annual growth rate of GDP for most sectors of the economy. This situation is due primarily to a change in the model used for projections of the energy sector from a regression analysis method in the NC2 to the integrated KEO model in the NC3, which generates GDP endogenously. However, it was not clear to the review team whether consistency is maintained in applying the same GDP assumptions for 2010 for the GHG estimates across all sectors.

82. For the energy sector[11] it is assumed that deregulation of the energy industry sector will have some impact on environmental protection, economic efficiency and energy security. In particular, fuel switching from coal to natural gas in the electric power generation sector is expected to be difficult in the deregulated energy market unless appropriate measures such as economic disincentives are introduced to discourage the use of coal.

B. Methodologies and coverage of projections

83. The NC3 employs various models such as the integrated KEO model, regression analysis, trend analysis, top-down model, bottom-up model and expert judgement. The NC3 briefly covers the structure and characteristics of the methods utilized, other than the integrated KEO model used for projections of CO_2 emissions from energy sources. The review team is of the opinion the use of the KEO model to project CO_2 emissions from energy sources (instead of a system of about 200 regression equations in the NC2) makes the projections more robust. At the same time, the review team believes that a sophisticated, integrated model such as the KEO model deserves more elaboration in the NC3 in terms of its structure,

[11] The review team noted that there were differences in the conversion factors (petajoules to tonnes of oil equivalent) used for the energy sector for 1990, 1999 and 2010. This difference was noted when comparing the assumed figures of primary energy consumption in table 4.9 on page 147 of the NC3 with the energy consumption data in a paper presented during review, "*Comprehensive review of Japanese energy policy*" (JEP). The review team suggested that this data be verified to ensure consistency between the energy data and the projected GHG emissions.

purposes, strengths and weaknesses, in order to understand the robustness of the model and the projected data.

84. The integrated KEO model is composed of three sub-models: the KEO sub-model developed at Keio University, an energy conservation factor sub-model and an electric power composition sub-model which decides on electric power generation capacity and operation. The review team was informed that the KEO sub-model deals with approximately 500 sectors of the economy and commodities, and that a dynamic general equilibrium sub-model generates the long-term outlook for economic variables such as GDP, prices, energy consumption and GHG emissions. The national projections team in charge of the sub-model has consolidated an impressive database, utilizing the input–output table of the economy and parameters derived from extensive analyses of regressions. Since the original KEO model was developed to forecast the future economy of Japan, it has been adapted and upgraded to include the two sub-models for projecting GHG emissions.

85. The energy conservation factor sub-model captures the long-term effects of individual policies and measures for energy conservation through its interaction with the other sub-models. The energy conservation factor sub-model is structured to relate energy conservation levels to relevant prices and other quantity levels. Because of its nature as a general equilibrium model, the integrated KEO model does not eliminate the overlap effects of various policies and measures, nor does it evaluate their synergy effects. The electric power composition sub-model, together with other sectoral sub-models, evaluates fuel switching possibilities and nuclear power options. The review team noted that in the current projections methodology presented in the NC3, the projection of GHG emissions from the transport sector is integrated with that of the energy sector to ensure the consistency in the projection of the transport and the other energy sectors. It is recommended to explain in the NC how emissions from the transport sector are projected, and use relevant projection/assumption data in order to guide the policy-making process.

86. When projected data using the integrated KEO model were compared to actual historical data for the time series 1990–1999, the model predictions had a margin of error of less than 1 per cent. The review team noted that it is not easy to conduct sensitivity analyses for the projected emissions data, as the model determined GDP levels endogenously. However, the review team expects that variations in some variables exogenous to the integrated KEO model will have an impact on GDP, and this type of sensitivity analysis could be performed for major exogenous variables such as world energy prices, population, exchange rate and even substitutability between energy inputs and capital goods. The review team believes that sensitivity analyses such as these are essential to investigate how sensitive the mix and intensities of policies and measures in Japan are to changes in key assumptions.

87. The review team believes that more attention needs to be given to how the results of the integrated KEO model can be utilized. The model endogenously forecasts activity variables of economic sectors, e.g. the value added and employment level of each sector. In principle, activity variables projected from the integrated KEO model can be used to crosscheck those that projection teams assume or estimate, in order to forecast GHGs other than CO_2 emissions from energy sources.

88. Projections in the NC3 are consistent with the classification of measures in chapter III of the NC3 for the energy sector; measures for non-energy sources, CH_4 and N_2O; and measures for fluorinated gases. Except for projections of CO_2 emissions from energy sources, the national teams projected GHG emissions by sector and by gas. CO_2 emissions from energy sources are provided only for a national total, although the UNFCCC reporting guidelines[12] require Parties to project emissions by sector and by gas.

[12] See paragraphs 34 and 35 on page 88 of the UNFCCC reporting guidelines.

89. The projections of the NC3 are prepared only for 2010, whereas the reporting guidelines require inclusion of projections for the years 2005, 2010, 2015 and 2020. In accordance with the reporting guidelines (paragraph 36 on page 88), the NC3 projects and reports CO_2 emissions from international bunker fuel separately, but only for international aviation bunker fuel sold in Japan. The NC3 includes the emission projections of fluorinated gases, which were not included in the NC2.

C. Projected emission trends

90. Table 5 presents the projected reduction in GHG emissions that is expected from specific policies, and table 6 presents the major assumptions and their differences between the NC3 and the NC2. For CO_2 emission projections from international bunker fuel in the NC3 the GDP growth rate is assumed to be 1.8–2.2 per cent, whereas projections of the NC2 assume the average GDP growth rate per annum at 3 per cent for the period 1996–2000 and 2.3 per cent for the period 2001–2010.[13] Domestic livestock for 2010 is forecast at 10–27 per cent higher in the NC2 than in the NC3. Landfilled waste (organic or biodegradable) for 2010 is expected to be 31 per cent higher in the NC2 than in the NC3. Past estimates of land-filled and incinerated waste for 1990 are reported to be 113 per cent and 34 per cent higher, respectively, in the NC2 than in the NC3 as a result of a change in emission factors.

Table 5. Past emission trends and future outlook

	Mt CO_2 equivalent					
	CO_2 from energy	CO_2 from non-energy + CH_4 + N_2O	Fluorinated gases	Reduction from innovative technology and extensive public efforts	Sinks	Total
Base year						
NC3	1 053	128	48			**1 229**
Revised inventory data	1047	138	48			**1233**
NC2	1 053	137[a]	NA			**NA**
Year 1999 (actual)						
NC3	1 148	127	39			**1 314**
Revised inventory data	1 157	132	39			**1 328**
Year 2010						
NC3						
Without measures	1 272[b]	140	107			**1 519**
With measures	1 126	122	73	–4		**1 317**
With additional measures	1 052	122	73	–26	–48	**1 173**
NC2	1 272	153[c]	NA	NA	NA	**NA**

Note: NA = "not available".

[a] Calculated from page 29 of the NC2, based on GWP: 21 for CH_4, and 310 for N_2O.

[b] Not reported in the NC3, but based on information during the IDR meetings, and caution needed for use as indicated in the text.

[c] Calculated from pp. 93-98 of the NC2.

[13] See page 18 of FCCC/IDR.2/JPN.

Table 6. Major assumptions and GHG emission projections in the NC2 and NC3

	1990			2010		
	NC2	NC3	Change (%)	NC2	NC3	Change (%)
Assumptions						
Milk cows (10 000 head)	207	207	0.0	198	180	–9.1
Beef cattle (10 000 head)	280	280	0.0	433	317	–26.8
Hogs (10 000 head)	1 134	1 134	0.0	1 031	929	–9.9
Landfilled waste (10 000 tonnes)	5 360	2 511	–53.2	1 436	1 098	–23.5
Incinerated waste (waste oil, waste plastic: 10 000 tonnes)	7 805	5 833	–25.3	9 118	9 125	+0.1
GHG emissions						
CO_2 from non-energy + CH_4+ N_2O (Mt CO_2)	138	128	–7.2	153	140[a]	–8.5
				153	122[b]	–20.3

[a] "Without measures" projection.
[b] "With measures" projection.

91. The national total GHG emissions in 2010 for the "with measures" scenario are projected at 1,317 million tonnes of CO_2 equivalent (Mt CO_2 equivalent), 7.2 per cent higher than the base year total emissions (1,229 Mt CO_2 equivalent). In 2010, CO_2 emissions from energy sources for the "with measures" scenario are forecast to be 6.9 per cent higher than the base year level, the sub-total of three gases (CO_2 emissions of the non-energy sector, CH_4 and N_2O) 4.8 per cent lower, and fluorinated gases 51 per cent higher. Because energy efficiency is high, additional emission reductions through energy policies and measures are expected to be more difficult and costly. An increase in energy sector emissions is expected from energy-using lifestyle changes, an increase in passenger car ownership and the slower expansion rate of non-fossil energy sources (nuclear power). National experts informed the review team that an improvement of waste treatment and the manufacture of synthetic fibre materials will lead to a reduction in emissions. Fluorinated gases as substitutes for ozone-depleting substances are forecast to increase inevitably, even with policies and measures such as the VAP and R&D of alternative substances.

92. For the "with additional measures" scenario, total GHG emissions in 2010 are projected at 1,173 Mt CO_2 equivalent, 4.6 per cent lower than the base year level, but still 1.6 per cent higher than the Kyoto target (1,155 Mt CO_2 equivalent) and with LUCF. Additional policies and measures are focused on the energy sector, intensified R&D activities and the expansion of sink capacity. Planned policies and measures in the energy sector include further promotion of energy conservation, further promotion of new and renewable energy, and fuel switching in the electricity generation sector. The review team believes that if all of these additional policies are implemented successfully from 2002 onwards, CO_2 emissions of the energy sector in 2010 are anticipated to be the same as the base year level.

93. Based on the revised inventory data, the national GHG emissions in the base year are recalculated at 1,233 Mt CO_2 equivalent, which is close to negligible when compared to the data in the NC3. It is interesting to note that the sub-total of three emission gases (CO_2 emissions from non-energy sources, CH_4 and N_2O) in the revised data is almost the same as in the NC2.

94. Japan needs to achieve an emission level of 1,155 Mt CO_2 equivalent in 2008–2012, if it is to achieve its 6 per cent reduction in GHG emissions compared to 1990 under the Kyoto Protocol. The implemented and adopted policies and measures alone under the "with measures" scenario do not appear to be sufficient to meet this target. The planned policies and measures aim to reduce GHG emissions to 1,173 Mt CO_2 equivalent, still more than the Kyoto target but 11 per cent less than the projected emissions of the "with measures case" (1,320 Mt CO_2 equivalent). Of the total planned CO_2 emissions reduction, i.e. 144 Mt CO_2 equivalent, 51 per cent are planned to be achieved by strengthened energy conservation and electricity generation policies, 33 per cent by the further enhancement of sinks based on the Basic Plan on Forest and Forestry, and 16 per cent by innovative technology R&D and the extensive

use of public efforts. It is expected that the remaining gap of 1.6 per cent (20 Mt) will be filled, possibly through the use of flexibility mechanisms.

D. Overall evaluation of GHG emission projections

95. Since the NC2, the national projection teams, especially the energy teams, have developed and used rigorous and sophisticated approaches, e.g. the integrated KEO model, to model projections and the total effect of policies and measures. The review team believes that the integrated KEO model, a general equilibrium model, is robust in that it replicates the past trends of major economic variables with a narrow margin of error. The model can capture the effect on GHG emissions of individual policies and measures, and generate activity indicators, e.g. sectoral values added, which can be used as key assumptions in the bottom-up approaches. This feature needs to be taken into account in the decision-making process for NCs as well as the Climate Change Policy Programme. In this context, the roles of the principal institutions at the decision-making level as well as at the working level are crucial for the enhancement of consistency and transparency.

96. The review team noted several other improvements since the NC2. For instance, the NC3 includes projections for fluorinated gases, and includes all three projection scenarios. The projections section of the NC3 deals with most of the policies and measures, of which there are more than 100, whereas the NC2 dealt with a very limited number of policies and measures. On the other hand, there was no concrete description of details on major assumptions and methodologies in the NC3 (for example, for projecting GHG emissions from transport), there were no sensitivity analyses, no comparative analysis between the NC2 and the NC3 (as required by paragraph 45 of the UNFCCC guidelines), and a limited coverage of projection years.

97. Additional (planned) measures are anticipated to reduce GHG emissions to 1,173 Mt CO_2 equivalent from the forecast emissions with measures (1,320 Mt CO_2 equivalent). Of the total emissions cut by additional measures, 144 Mt CO_2 equivalent, 51 per cent are planned to be achieved by energy policies and measures, 33 per cent by enhanced sinks, and 16 per cent by innovative technology R&D and public efforts.

98. The planned measures are assessed to be not enough to meet the national Kyoto target of emissions (1,155 Mt CO_2 equivalent) in the period 2008–2012. A gap of 1.6 per cent still remains to be filled, and the use of flexibility mechanisms is expected to be a potential measure. The national government is committed to preparing the requisite national systems for the use of these mechanisms, which it considers to be supplemental to domestic actions. In addition, the government has developed an evaluation and feedback process for the achievement of the Kyoto target. Based on the new guideline, the government has planned to evaluate the effectiveness of individual policies and measures in 2004 and again in 2007, just before the beginning of the first commitment period. The results of the evaluations will be fed back into the new guideline.

V. VULNERABILITY AND ADAPTATION

99. The information contained in the NC3 meets the reporting guidelines. The review team felt that the issues were addressed comprehensively, and extensive use was made of the internationally available literature on impact assessment and adaptation. In Japan, the MOE collates research on vulnerability, impact assessment and adaptation, and produces a comprehensive report. National experts informed the review team that the IPCC Guidelines on vulnerability and adaptation were used in preparing the NC3. The review team was informed that an English version of the work entitled *Impact of Climate Change in Japan* would be available later this year. This document (produced in Japanese) is a major compendium of research information in the area of vulnerability, impact assessment and adaptation.

100. The review team was informed that there is strong emphasis on research in this area, given the unique national circumstances of Japan, and that the results of such activities will feed into the policy-making process. The national experts pointed out that linking research strengths into the policy-making process in Japan is an important goal.

101. In terms of institutional arrangements, it was observed that there is a strong institutional collaboration among the various agencies of government, such as MOE, METI, the Ministry of Land, Infrastructure and Transport (MLIT) and MOFA, and the strong institutional role of MOE in coordinating the research efforts was very much in evidence. The review team encouraged the national team to emphasize and elaborate on these linkages, as well as the active collaboration among the various organs of state and civil society, in future NCs.

102. The potential impact of global warming on Japan's climate is evaluated using 11 coupled atmosphere–ocean general equilibrium models. It was observed that considerable research, institutional and policy advances have been made since the NC2 in quantifying climate change impacts and identifying adaptation measures. The NC3 provides comprehensive coverage of climate change impacts in various areas and sectors vulnerable to climate change. These areas include mainly negative effects on agriculture, forestry and fisheries, in particular on rice and wheat productivity, on the growth rate of trees due to dehydration, and on the population of sardines. Given that Japan is an island nation with long coastlines, there is considerable government concern about the possible effects of rising sea levels and extreme weather events, such as frequent storm surges, on Japan's natural environment and socioeconomic systems.

103. It was also noted in the NC3 that the two main sectors where adaptation is a priority are agriculture and coastal zone management. The review team felt that future NCs could build on work already done on economic analysis of impacts at sector level, as well as on assessment of proposed adaptation measures.

104. The review team also felt that perhaps some of the model adaptation projects could be listed in future NCs, as useful work that has not been adequately promoted in the NC3 has been done in the area of climate change impacts and adaptation although the guideline did not indicate it. This could be an area worth elaborating in future NCs, as such details add strength to the information contained in the document and capture some of the important work being done in the country for a wider audience.

VI. FINANCIAL RESOURCES AND TECHNOLOGY TRANSFER

105. The information on financial resources and technology transfer contained in the NC3 not only meets the reporting requirements but is also a distinct improvement over the NC2 in reporting. There has been extensive use of tables, as required by the guidelines. In accordance with the guidelines, Japan completed table 6.1 in communicating information on "new and additional" financial resources. In Japan, the Official Development Assistance (ODA) Charter adopted by the Cabinet in 1992 spells out the philosophy and principles of Japan's ODA, which includes "environmental conservation" as a basic philosophy underlying Japanese aid. In 1999, another document titled "Japan's Medium Term Policy on ODA", also listed environmental conservation as a priority task. The review team was given extensive tables, charts and explanations on Japan's continued commitment and endeavours in the area of financial resources and technology transfer. Japan provides considerable financial resources to developing countries, including climate-related funding, although from the latter half of the 1990s to the beginning of the 2000s the volume of ODA decreased generally as a result of the severe economic recession.

106. The review team was informed that Japanese bilateral aid policy for developing country cooperation is based on the principle of "consistency with the sustainable development priorities of the

country". The Japan International Cooperation Agency (JICA), a Japanese executing agency responsible for technical cooperation with other countries, has formulated environmental guidelines for specific fields of international projects. For example, the "Environmental Guidelines for Social and Economic Infrastructure Development Projects" are extensively employed in the evaluation and appraisal of aid programmes and projects. The Japan Bank for International Cooperation (JBIC), which is the executing agency of yen loans, has implemented environmental considerations based on the environmental consideration guidelines established in 1995 and 1999 by its predecessors, namely the Overseas Economic Cooperation Fund (OECF) and the Japan Export Import Bank (JEXIM). These guidelines specify screening criteria for projects, obligate the implementation of environmental assessments as needed, and also establish a checklist for the major sectors. As of December 2001, the bank is preparing consolidated guidelines that include greater consideration of the environment, taking into account international trends and external opinions.

107. The "Kyoto Initiative", developed in 1997 by MOFA, is a major instrument in Japanese assistance to countries that are particularly vulnerable to the adverse effects of climate change, and focuses on assisting developing countries to combat global warming. The initiative is based on the principles of global human security, ownership and partnership and sustainable development. Japan further invests considerable sums in capacity-building programmes and, through a programme that started in 1998, has trained more than 4,600 people from developing countries in fields related to global warming. The terms of Japanese ODA loans are favourable, with low interest and long repayment periods.

108. The tables in the NC3 provide details on Japanese assistance to developing countries in the area of mitigation and adaptation. The review team was further informed that the ratio of mitigation to adaptation is generally about 3.5 to 1 and is likely to change from year to year. ODA loans amounting to US$ 2.302 billion were provided in 1999 alone.

109. The review team was informed that Japan funds an average of 846 projects per year. However, detailed classification into various sub-categories such as "renewable" has not been undertaken because of the overlapping nature of development projects, which makes classification very subjective. This could be an area worth elaborating, as it could potentially take advantage of the substantial Japanese contribution towards climate change funding.

110. In terms of multilateral funding, Japan remains a major donor to international organizations such as the World Bank, the Asian Development Bank, the United Nations Development Programme, the Global Environment Facility (GEF) and the United Nations Environment Programme. Japan is one of the largest contributors to the GEF and contributed US$ 422.7 million to the third GEF replenishment. Japan has also been a major contributor to the Intergovernmental Panel on Climate Change (IPCC) and supports the IPCC task force on inventories established in 1999.

111. The NC3 provides extensive coverage of Japanese efforts to transfer technology to developing countries. The review team was informed of initiatives by NEDO, a Japanese organization which funds companies that are interested in investing in technology transfer activities. The review team was informed of some of the projects that were being implemented by NEDO in partnership with companies and local hosts in developing countries. It was noted that the transfer of technology to developing countries remained a key challenge, as in Japan most technology is in private hands.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

112. The NC3 complies with reporting requirements and provides extensive details, including tables, on Japanese efforts in research and systematic observation. The Council of Ministers for global

environmental conservation, decides on a comprehensive programme for promotion of global environmental research, monitoring and technological development each year. This programme identifies key priority areas for Japan's contribution to international initiatives.

113. Japan's Basic Science and Technology Plan, of which there is now a second version, generally established the environment as one of its four priority areas. Major funding initiatives, such as the Global Environmental Research Fund, which promotes all types of scientific and international research on global environmental conservation, and the Fund for Global Environmental Conservation Tests and Studies, established in 2001, promote major studies on global warming. In addition, there are two other government budget lines that fund related research and government subsidies for scientific research.

114. The review team was given details of the innovative coordination mechanism between key research institutes/departments and relevant ministries and industry, which is initiated by the "Global Warming Restate Initiative" included in the promotion strategy of environmental science decided by the Council for Science and Technology Policy, Cabinet Office. The strong role and efforts of the JMA, the Ministry of Education, Culture, Sports, Science and Technology and MOE aim to enhance Japan's ability to respond effectively to both domestic and international efforts in the area of research and systematic observation. Five-year targets for modelling and impacts have been established in the Global Warming Research Initiative.

115. The JMA has undertaken important research on the development of the Global Climate Model and regional climate model around Japan, through the implementation of the project " Study of the Prediction of Regional Climate Changes Over Japan due to Global Warming (2000–2004)". In terms of international efforts the JMA participates in World Climate Research Programme activities and JMA experts participate in the Working Group on Coupled Modelling and the Working Group on Seasonal to Interannual Prediction (WGSIP). Additionally, Japanese experts have participated in the IPCC third assessment report (TAR), and Japan participates in the International Geosphere–Biosphere Programme (IGBP) and the International Human Dimensions Programme of global environmental change (IHDP). Japan is leading efforts in the Asia–Pacific region in studying global environmental change.

116. The NC3 lists a rich compendium of research being undertaken in Japan on climatic processes, modelling and prediction study, an impact study on climate change, and R&D on mitigation and adaption technologies. The research projects include a study to monitor and predict El Niño/La Niña events and warm pools in the western Pacific; an assessment of impacts on the generation of GHGs; and the amount removed from the terrestrial ecosystem as a result of changes in land use in tropical Asia.

117. The area of systematic observation is also governed largely by the Basic Science and Technology Plan. High-quality climate observations are made by a network of more than 150 meteorological stations in Japan. Detailed tables on atmospheric and oceanographic observations, including observations and concentrations of greenhouse gases, have been reported. The national experts informed the review team that they are in the process of preparing Japan's GCOS report, without specifying any timeline.

VIII. EDUCATION AND PUBLIC AWARENESS

118. The NC3 reports on these issues comprehensively and meets the reporting requirements. It lists both the activities being undertaken domestically and Japan's participation in international efforts. The review team was provided with detailed explanations and literature on the innovative approaches coordinated by MOE, Ministry of Education, Culture, Sports, Science and Technology, etc., to promoting climate change education and awareness in Japan. The basic philosophy behind Japanese efforts in the area is based on the principle of energy conservation. The efforts are directed towards homes, schools and society at large. The prefectures, the major local government unit in Japan, promote energy

conservation efforts in their respective jurisdictions, while the central government sets the overall macropolicy framework.

119. The basic law concerning the promotion of measures to cope with global warming was enacted in 1999 and sets the direction and focus of major education and public awareness efforts. At the local government level, two such efforts – the Prefecture Centres for Climate Change Actions and the Global Warming Prevention Regional Council – stand out, in view of their focus on promoting public awareness on climate change issues among local communities. Additionally, the prefectural governors have designated global warming prevention advisors to assist the prefectures with such efforts.

120. Environmental education remains a major cornerstone of governmental policy. An innovative policy, Measures for Environmental Education and Study, targets schools, homes and social education. Besides enriching the curriculum with natural science and other contents, there is an institutionalized effort towards mainstreaming other environmental education programmes such as GLOBE into the education and awareness strategy. Modular projects such as Green Education, Junior Eco Club and the Junior Park Ranger project have been initiated. The review team was provided with details of how such schemes contribute to climate change education in Japan.

121. The NC3 lists specific measures that are being undertaken in Japan to raise awareness. Notable among these efforts is the "*Wa-no-kurashi*" initiative; this Japanese term means promoting a lifestyle that emphasizes simplicity, quality and sustainability. A handbook of the same name has been produced and around 40,000 copies are to be distributed among key sections of the population as a first step. It sets out four key themes relevant to the climate change issue. Other materials include a DVD on global warming.

122. At present no detailed analysis has yet been undertaken of the effectiveness of such measures in terms of actual reduction in emissions. However, the Japanese people are extremely environmentally conscious and care a lot about their environment. The review team was interested to learn about some of the economic incentives that accompany such awareness-raising campaigns. The review team was of the opinion that it is important to study the effectiveness of these campaigns, as this will not only benefit the Japanese government but also provide useful information for other countries that have similar national circumstances. Additionally, important information concerning the role of such efforts towards a reduction in emissions can be gauged.

IX. CONCLUSIONS

123. Japan's NC3 is well prepared and conforms to the UNFCCC guidelines for the most part. In comparison with the NC2 there have been notable improvements, such as more comprehensive reporting of inventory data and trends, inclusion of fluorinated gases and a more extensive chapter on impacts and adaptation. The review team identified some areas for further improvement, such as presenting data for sinks between 1996 and 2000 and providing details of the methodology used for projections, especially the methodology and assumptions regarding future GHG emissions trends from transport.

124. In 2000, total aggregated GHG emissions excluding LUCF increased by 12.4 per cent compared to 1990 levels, which does not include HFCs, PFCs and SF_6. Although there was some decoupling of CO_2 emissions and economic growth during the decade, Japan was unable to achieve the UNFCCC stabilization target in 2000. This increase was mainly due to emissions of CO_2 which rose by 10.5 per cent between 1990 and 2000. However, aggressive policies in agriculture and in industry resulted in a decrease of CH_4 emissions by 17.6 per cent compared to 1990, a decrease in N_2O emissions by 5.1 per cent compared to 1990 and a decrease in HFC emissions by 8.4 per cent over 1995 levels. Japan has also been successful in reducing SF_6 emissions from industry (by about 66 per cent to the 1995 level).

125. Recognizing that efforts need to be strengthened in order to meet its Kyoto target of a 6 per cent reduction in GHG emission levels between 2008 and 2012 compared to 1990, the Japanese Government revised its main national GHG mitigation programme (The New Climate Change Policy Programme) in 2002 to include more stringent regulations in the area of fuel switching, waste, efficient use of energy and development of renewable energy sources. Climate policies in Japan are well coordinated and regularly reviewed. The national government has also established a well-organized institutional framework under which all central and regional governments concerned, as well as NGOs, participate in preparing the new guidelines, which will undergo assessment and review in 2004 and 2007.

126. According to information received during the review, to meet its Kyoto target Japan must reduce emissions in 2008–2012 by 166 Mt CO_2 equivalent, the difference between the reductions gained from implemented and adopted policies under the "with measures" scenario and the Kyoto level. Of the planned CO_2 emissions reduction of 144 Mt CO_2 equivalent, 51 per cent is planned to be achieved by energy policies and measures, 33 per cent by enhanced sinks, and 16 per cent by innovative technology R&D and public efforts. The remaining gap of 1.6 per cent (20 Mt CO_2 equivalent) will be filled using flexibility mechanisms.

127. The NC3 cited possibly negative climate change impacts on agriculture, in particular on rice and wheat productivity, and for coastal areas as a consequence of rising sea levels and extreme weather events such as frequent storms. In forestry and fisheries, impacts are possibly mixed, varying from positive effects of a longer growing period on certain trees to negative effects of higher temperatures on sardine populations.

128. Japan undertakes high-quality climate observations through a network of more than 150 meteorological stations. In 2003 a major compendium of research information in the area of vulnerability, impact assessment and adaptation entitled *Impact of Climate Change in Japan*, already available in Japanese, will be published in English.

129. Japan provides considerable financial resources to developing countries, including climate-related funding, although from the latter half of the 1990s to the beginning of the 2000s the volume of ODA decreased generally as a result of the severe economic recession . In 2002, however, Japan contributed an increased amount to the third replenishment of the GEF, and ODA loans amounting to more than US$ 2302 million in 1999.

130. Education and public awareness continue to play an important role in changing the behaviour of the public to ensure reductions in per capita GHG emission levels. To this end, targeted education related to climate change continues to be a priority for the government as well as for the NGOs. The budget for education and public awareness concerning climate change increased nearly ten-fold between 1990 and 2000 from JPY 340 million in 1990 to around JPY 3 billion in 2000. A large part of the budget was targeted at programmes and facilities for preparing high-quality software, and training of staff for the efficient delivery of climate information and education. These programmes have been well coordinated and funded, but there has been no assessment of their effectiveness.

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