10 July 2007

ENGLISH ONLY

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

AD HOC WORKING GROUP ON FURTHER COMMITMENTS FOR ANNEX I PARTIES UNDER THE KYOTO PROTOCOL
Fourth session
Vienna, 27–31 August 2007 and Bali, 3–11 December 2007

Item 3 of the provisional agenda
Analysis of mitigation potentials and identification of ranges of emission reduction objectives of Annex I Parties

Information and data on the mitigation potential of policies, measures and technologies

Submissions from Parties

1. At its third session, the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG) invited Annex I Parties, in a position to do so, to submit to the secretariat, by 22 June 2007, information and data on the mitigation potential of policies, measures and technologies at their disposal, with a view to providing a basis for indicative ranges of emission reduction objectives by Annex I Parties. It requested the secretariat to prepare, under the guidance of the Chair of the AWG, a technical paper that synthesizes these submissions and available information, inter alia, considering factors and criteria, relevant to the determination of the mitigation potential and to the identification of possible ranges of emission reduction objectives of Annex I Parties. The secretariat has prepared document FCCC/TP/2007/1 in response to this request.

2. The secretariat has received four such submissions. In accordance with the procedure for miscellaneous documents, these submissions are attached and reproduced[*] in the language in which they were received and without formal editing.

3. The secretariat has also received one submission from an accredited non-governmental organization. In line with established practice, the secretariat has posted this submission on the UNFCCC website <http://unfccc.int/parties_and_observers/ngo/items/3689.php>.

[*] These submissions have been electronically imported in order to make them available on electronic systems, including the World Wide Web. The secretariat has made every effort to ensure the correct reproduction of the texts as submitted.

CONTENTS

[*] This submission is supported by Croatia, The former Yugoslav Republic of Macedonia, Serbia, and Bosnia and Herzegovina.

PAPER NO. 1: GERMANY ON BEHALF OF THE EUROPEAN COMMUNITY AND ITS MEMBER STATES

This submission is supported by Croatia, former Yugoslav Republic of Macedonia, Serbia and Bosnia and Herzegovina

Subject: Information and data on mitigation potentials of policies, measures and technologies at the disposal of Annex I Parties, with a view to providing a basis for indicative ranges of emission reduction objectives by Annex I Parties.

Germany, on behalf of the European Community and its Member States, welcomes the constructive spirit of the discussions at the third meeting of the AWG in Bonn. The EU believes that the work Parties did at this meeting and the input that was received, especially from the IPCC, have provided a solid foundation from which to proceed and is encouraged that the conclusions of the AWG reflect the willingness of Annex I Parties collectively to work towards a substantial reduction of their GHG emissions. In this context it was observed that global emissions of greenhouse gases (GHGs) have to be reduced to very low levels, well below half of levels in 2000 by the middle of the twenty-first century, in order to avoid dangerous climate change. GHG emissions need to peak in the next 10 to 15 years and that this calls for GHG emission reduction commitments by Annex I Parties of between 25-40% below 1990 levels for the period beyond 2012. This is consistent with the EUs view that developed countries are required to continue to take the lead by collectively reducing their emissions of greenhouse gases in the order of 30% by 2020 compared to 1990, with a view to collectively reducing their emissions by 60 to 80% by 2050 compared to 1990. In this context, the EU is willing to commit to a reduction of 30% of greenhouse gas emissions by 2020 compared to 1990 as its contribution to a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries adequately contribute according to their responsibilities and respective capabilities.

The EU thinks that the progress made in the AWG sends a strong signal to the global community, that Annex I Parties are committed to continued leadership in our common efforts to combat climate change.

It was noted that there is significant mitigation potential in a broad range of sectors and regions that can be realised at moderate cost, a substantial part even at low or negative cost. In this respect, the IPCC's Fourth Assessment Report provides a significant input to the work of the AWG. Inter alia, the IPCC's Workgroup III reported that the macro-economic costs of GHG stabilisation at levels consistent with the 2°C limit are estimated to be equivalent to a reduction of the average annual GDP growth rates of less than 0.12%. However, these costs are lower in overall economic terms if an active climate protection policy stimulates technological change to a greater extent, for example by investing revenues from a carbon tax directly in the development of climate friendly or low carbon energies or technologies and near-term benefits on health of measures to reduce air pollution are taken into account, alongside other co-benefits such as increased energy security. The IPCC also confirmed that mitigation opportunities with net negative costs have the potential to reduce emissions by around 6 Gt CO_2-eq per year by 2030, i.e. about 10% of the projected global emissions by that time. Furthermore, the outcome of the meeting of the AWG in Bonn confirms the EUs view that there already exists a wide base of relevant information from other organisations on the mitigation potential in parties and across sectors. The EU welcomes the request to the secretariat to prepare a technical paper that synthesises available information relevant to the determination of the mitigation potential and to the identification of possible ranges of emission reduction objectives of Annex I.

The EU has already taken the opportunity to provide information about the underpinning work that it has done, both in its submissions earlier this year (FCCC/KP/AWG/2007/MISC.1 and Add.1) and in its presentation to the Roundtable at the third session of the AWG. The EU will continue to share information with other parties on mitigation potentials both to prepare this and subsequent stages of the work plan, in order to facilitate the work of the Group. More detailed background information on the analysis that is underpinning recent EU policy decisions can be found at the European Commission website under
http://europa.eu/press_room/presspacks/energy/index_en.htm.

Responding to the wish of other Parties to better understand the analytical approach and work that is underpinning recent policy decisions by the EU, we will organise a side event at the Vienna intersessional meeting in August 2007 to present and explain our analysis.

The EU would also like to draw attention to work done by, inter alia, the organisations listed in its submission incorporated in document FCCC/KP/AWG/2007/MISC.2 and Add.1. Further relevant information could also be drawn from ongoing discussions on mitigation potentials in a range of fora, for example the proceedings of the Low Carbon Society conference which has been held in London in June.

PAPER NO. 2: JAPAN

Japan's submission on information and data on the mitigation potential of policies

This submission presents information and data on the mitigation potential of policies, measures and technologies at the disposal of Annex I Parties, with a view to providing a basis for indicative ranges of emission reduction objectives by Annex I Parties.

1. General Remarks

- Japan has proposed a long-term target of reducing global emissions by half from the current level by 2050 as a common goal for the entire world and the recent G8 Summit Declaration expresses the leaders will seriously consider the decisions which include this proposal.
- In order to design a concrete framework for addressing global warming beyond 2012, the following "3 Principles" are necessary:
  - All major emitters must participate, thus moving beyond the Kyoto Protocol, leading to global reduction of emissions.
  - The framework must be flexible and diverse, taking into consideration the circumstances of each country.
  - The framework must achieve compatibility between environmental protection and economic growth by utilizing energy conservation and other technologies.
- In establishing an effective international framework in accordance with these "3 Principles" based on a common long-term target, consideration should be given to the following:
  - From the viewpoint of equity, attention and appreciation should be drawn to preceding efforts for energy-saving in each country's activities.
  - Irrespective of any changes in the situation of the world economy and the national economies, a real progress in GHG emissions reduction matters. Therefore, it is also necessary to measure such reduction with the level of energy efficiency. Efficiency is a useful indicator for the realization of sustainable and maximum emission reductions while considering sectoral international competitiveness.
  - Levels of reduction in the required commitment of the subsequent framework should be in a way not to bring about substantial differences in required reduction efforts among commitment takers, from the viewpoint of equity. The most cost-effective emission reduction with limited resources is possible through putting those resources into sectors where reduction potential is large and therefore reduction cost is low, taking into consideration relative comparison on the sectoral efficiency levels.
  - Sectoral approach is necessary to address global emission increases caused by cross-country transfer of emission source.
- A detailed analysis for each sector is therefore necessary and indispensable in the analysis of mitigation potential. On the other hand, neither efficiency by sector nor the actual circumstances of each country have been given adequate consideration in setting the levels of the emissions reduction obligations of the Annex I countries under the Kyoto Protocol. For example, in the 3rd Assessment Report of the IPCC, which analyzed emissions reduction targets in the Kyoto Protocol, Japan's marginal abatement cost (median value of 9 models: 330.5) is 1.6-1.9 times higher than those of other developed countries (178-211). In analyzing reduction potential, the difference in the mitigation cost between regions should be considered from a viewpoint of equity.

- Therefore, the analysis of reduction potential should be based on the power source structure and indicators of “Efficiency” and “Activity” by key sectors. In addition, it is also necessary to consider constraint factors such as macro trend indicators for environment, economy, society, etc. of each country, as well as mitigation cost and information such as timing of modernization of large-scale facilities.

2. Analytical Framework

- Broadly categorized, the following two approaches are conceivable when analyzing reduction potential.
  - Approach based on efficiency analysis
    - This is a method in which “greenhouse gas emissions (mainly energy-related CO_2)” is factorized into “emissions efficiency (CO_2 emissions efficiency or energy efficiency)” and “activity by key sectors”, and reduction potential is quantified by considering the possibility of future improvement in emissions efficiency and activity, respectively.
  - Approach based on diffusion rate of Best Available Technology (BAT)
    - This is a method in which the applicable technologies with the highest efficiency (Best Available Technology: BAT） are designated by key sectors, and the emissions reduction effect as of assuming utmost popularization of those technologies is quantified as the reduction potential.
- In general, it is desirable to apply the former, “Approach based on efficiency analysis.” However, due to technical problems such as poor data availability, etc., “Approach based on diffusion rate of BAT,” may be more appropriate in some sectors.

2.1 Approach based on efficiency analysis

- In order to analyze GHG reduction potential while reflecting the actual circumstances of each country, a detailed sectoral analysis in accordance with the following policy is important (see table on p. 4).
  - The amount of GHG emissions can be factorized into “emissions efficiency (unit CO_2 emissions or energy efficiency)” and “activity (physical data such as production, etc.)” (Emissions reductions can be achieved by reducing activity, improving emissions efficiency, or a combination of the two.) It should be recognized that the natures of these two factors are completely different, as discussed below. Analyzing these respective factors makes it possible to analyze reduction potential in greater detail.
  - “Efficiency” changes depending on indicators such as development/popularization of technology, ingenuity and effort in the operational aspect, the cost of capital investment, etc. Reducing emissions by improving efficiency to an extent that does not hinder economic development makes it possible to satisfy both environmental mitigation and sustainable development.
  - “Activity” depends on the current status and trend in economic activity, and changes as a result of indicators such as regulatory action, etc. If emissions reductions are achieved by an extreme reduction in activity, there is a possibility of substantially affecting economic activity and the lifestyles of the country’s citizens.

【Conditions to be considered】

- The following indicators should be considered when analyzing mitigation potential.
  - Macro indicators
    - Environment: GHG emissions (current condition and rate of increase)

- ✧ Economy: GDP (current condition and growth rate), share of GDP by sector (by primary, secondary, and tertiary industry)
- ✧ Society: Population (current condition and rate of increase), climate condition, land area.

➢ Cost:: The range of improvements in efficiency is limited by costs related to the implementation of countermeasures. The effect of co-benefit which offset the mitigation cost should be taken in account. Furthermore, in an actual society, in addition to the cost to the society as a whole, the cost borne by each company implementing countermeasures should also be considered.

➢ Timing of implementation: When the perspective for technological development is considered, the applicable technological options will vary greatly depending on the timing of implementation of the countermeasures. In promoting efficiency in large-scale facilities such as power plants, manufacturing plants, and the like, the timing of equipment replacement becomes an important element.

○ Regarding the information that are necessary in the analysis described above, data and analyses possessed by international organizations can be fully utilized. (See Appendix)

Indicators of “Efficiency” and “Activity” by industrial sector (draft)

Sector			Indicator	
			Efficiency[1]	Activity
Power generation	All power sources[2]		CO_2 emissions per unit of generated output (weighted average emission factor of all power sources)	Generated output (GWh)
		Coal	Thermal efficiency in power generation[3]	
		Oil		
		Gas		
Energy industry			CO_2 emissions / energy use per unit of production	Production (t)
Energy-intensive industries	Iron and steel		CO_2 emissions / energy use per unit of production[4]	Production (t)
	Petrochemicals			
	Cement			
	Paper and pulp			
	Aluminum			
Residential/ commercial	Commercial		CO_2 emissions / energy use per unit of floor area	Floor area (m^2)[5]
	Residential		CO_2 emissions / energy use per household	No. of households (households)
Transportation	Freight		CO_2 emissions / energy use per unit of freight transported	Freight transported
	Passenger		CO_2 emissions / energy use per passenger transported	Passengers transported
Agriculture			[6]	
Land use, land use change, and forestry (LULUCF)			[7]	
Waste			Methane emissions per unit of waste buried CO_2 emissions per unit of waste incinerated	Waste buried (t), Waste incinerated (t)

[1] As efficiency indicators, it is appropriate to use energy efficiency in addition to CO2 emissions efficiency. For power generation sector, it is appropriate to adopt “thermal efficiency” for thermal power generation, and “weighted average emission factor” for “all power sources”. When using energy efficiency as a target, it is necessary to consider what degree of effect improvements in energy efficiency have on CO_2 emissions reductions.

[2] “All power sources” include non-fossil fuel power sources such as nuclear and renewables.

[3] Calculations of “thermal efficiency” in power generation sector are based on the method used in an existing report. (Source: ECOFYS, ”Comparison of Efficiency Fossil Power Generation,” August 2006.)

[4] Careful consideration for handling “CO_2 emissions / energy use per unit of production” is necessary as there is a possibility of large differences by product group.

[5] In some business category of commercial sector, [floor area x business hours] can be more appropriate to use for the “activity” indicator.

[6] In the agricultural sector, it is necessary to set appropriate indicators considering the difference of production system, type of products, GHG emissions calculation method and emission coefficients by nation or regions, due to climate and land conditions. It is also, needed to resolve the uncertainty of GHG emissions.
At the same time, careful consideration should be given to how “Activity” indicator of agriculture sector be handled, because agricultural activity fluctuates based on the state of farming activity and its trend, and emissions reduction associated with extreme contraction of the activity is likely to give substantial impact on the farming activity and the life of the people.

[7] Approaches based on the efficiency or BAT, which might be applicable to other emission sectors, are not necessarily applicable to Land use, land use change and forestry (LULUCF) sector, because of the following reasons; mitigation potential in this sector may vary by accounting options and definition of human-induced activities; this sector could have both aspects of source of emissions, and sink; and this sector is significantly influenced by natural, biological, and land conditions. There is a need to consider the analytical method that takes account of these characteristics and constraints of this sector.

2.2. Approach based on diffusion rate of BAT

○ As a method of measuring “efficiency,” the methodology of designating BAT and calculating the reduction potential based on its introduction and diffusion rate is also effective. In this case, the applicable technologies with the highest efficiency (Best Available Technology: BAT） are designated by key sectors, and the emissions reduction effect as of assuming utmost popularization of those technologies is quantified as the reduction potential.

3. Sectoral Approaches and Future Targets in Japan

○ In Japan, the Kyoto Protocol Target Achievement Plan will be reviewed to ensure Japan achieves the country’s target under the Kyoto Protocol. At the same time, the government will promote its initiatives to accelerate reduction of emissions, as well as launch national campaign and call for efforts of people. Following efforts will also be made to reduce GHG in the future.

- By 2030, achieve an additional improvement of at least 30% in energy efficiency (per GDP) from level of FY2003.
- By 2030 or after, increase the share of nuclear power in power generation up to about 30% to 40% or more.

By 2030, the oil dependency of the transportation sector will be reduced from the present 100% to approximately 80%. In order to achieve this target;
- By 2030, reduce production cost of batteries which consists bases of the electric automobiles to today’s fortieth, and improve their performances by seven times.
-By 2030, reduce the retail price of fuel-cell electric vehicles by to the level of gasoline vehicles.

Promote the deffusion of solar power, for example, with an aim to reduce its cost to the level of thermal power by 2030.

4. Conclusion

○ In the analysis of mitigation potential, it is necessary to reflect the actual circumstances of each country in order to share equitable burden. Giving enough consideration to equity makes it possible to set ambitious targets and implement sustainable countermeasures.

- ➢ To this end, a detailed sectoral analysis factorizing efficiency and activity is important.
- ➢ However, in cases where technical problems exist, for example, in collecting data on efficiency, etc., an analysis using a substitute indicator such as the diffusion rate of the Best Available Technology (BAT), etc. is appropriate.

○ For the work of quantification of mitigation potential, existing study results, including studies by the IEA, IPCC, APP, etc., should be fully utilized.

Examples of Relevant Research by International Organizations

Appendix

1. Examples of analysis related to "Efficiency"

- In the study of efficiency by sector, studies conducted by the IEA, ECOFYS, etc. provide good reference. The IEA conducted a study of sectoral energy efficiency indicators focusing on energy-intensive industries based on the Gleneagles Action Plan. ECOFYS carried out an international comparison of thermal efficiency in power generation by grid, and has published the results in a paper in the English journal specializing in energy problems, "Energy Policy, " which is highly regarded worldwide.
- The following tables are examples of these studies, in which work it is being carried out to establish CO2 intensity and energy intensity on a physical base such as production volume etc. by sector. In the future, the IEA plans to report sectoral energy efficiency indicators and the related analytical results at the Summit in Japan in 2008, based on a more detailed analysis and study.

Efficiency indicators by industrial sector

Sector	Energy Use Indicators	CO_2 Emissions Indicators	Explanatory Indicators
Pulp and paper	• Heat consumption in pulp and paper production vs. best available technology • Electricity consumption in pulp and paper production vs. best available technology	• CO_2 emissions/tonne of pulp and paper produced	• Recovered paper use vs. recovered paper ratio
Iron and steel	• Total primary and final energy use per tonne of crude steel (including finishing) • Total primary and final energy use per tonne of blast furnace-BOF steel production • Total final energy use per tonne of DRI (split gas and coal-based processes) • Total primary and final energy use per tonne of electric arc furnace steel (excluding finishing)	• Total direct CO_2 per tonne of crude steel	
Non-ferrous metals	• Specific power consumption in aluminium smelting		
Cement	• Energy requirement per tonne of clinker including alternative fuels • Electricity consumption per tonne of cement • Total primary energy equivalent per tonne of cement • Process and energy (including electricity) CO_2 emissions per tonne of cement	• CO_2 emissions from energy consumption (including electricity) per tonne of cement	• Clinker-to-cement ratio • Alternative fuel use in clinker production
Chemicals and petrochemicals	• Total energy consumption vs. best available technology	• Total CO_2 consumption vs. best available technology	

Source: *IEA (2007) "Indicators for Industrial Energy Use and CO2 Emissions" (Table 3.1)*

Energy use per unit of production (t) in the chemical and petrochemical industry (2004) (excluding electricity)

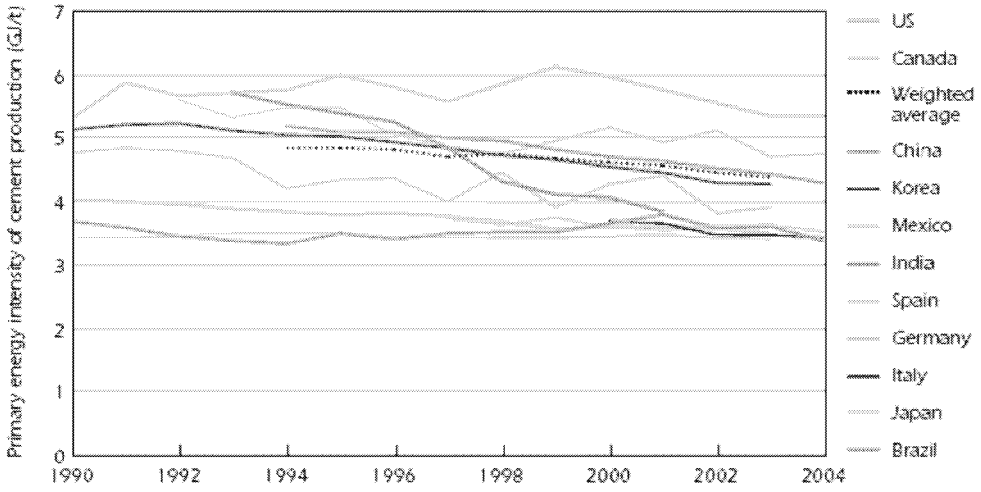
	Amount	LHV	Feedstock Energy Needed	Fuel		Total Fuel + Feedstock
	Mt/yr	*GJ/t*	*EJ/yr*	*GJ/t*	*EJ/yr*	*EJ/yr*
Ethylene	103.3	47.2	4.9	13	1.3	6.2
Propylene	65.3	46.7	3.0	13	0.8	3.9
Butadiene	9.4	47.0	0.4	13	0.1	0.6
Butylene	20.3	47.0	1.0	10	0.2	1.2
Benzene	36.7	42.6	1.6	7	0.3	1.8
Toluene	18.4	42.6	0.8	7	0.1	0.9
Xylenes	33.7	41.3	1.4	7	0.2	1.6
Methanol	34.7	21.1	0.7	10	0.3	1.1
Ammonia	140.0	21	2.9	19	2.7	5.6
Carbon black	9.0	32.8	0.3	30	0.3	0.6
Soda ash	38.0	0.0	0.0	11	0.4	0.4
Olefins processing excl. polymerization	100.0	0.0	0.0	10	1.0	1.0
Polymerisation	50.0	0.0	0.0	5	0.3	0.3
Chlorine and Sodium Hydroxide	45.0	0.0	0.0	2	0.1	0.1
Total			**17.0**		**8.2**	**25.2**

Note: Feedstock based on lower heating value of products except for ammonia.
Source: IEA statistics and estimates.

Source: *IEA (2007) "Indicators for Industrial Energy Use and CO2 Emissions" (Table 4.1)*

Primary energy use (GJ) per unit of cement production (t)

Key point: With the exception of Canada, China, India and Mexico, little improvement in the TPES equivalent per tonne of cement has been achieved since 1990.



Note: Includes impact of CHP electricity generation for Japan. Care must be taken in interpreting the absolute values of data in this figure, due to the possibility that different system boundaries have been used and that in some cases it is not clear whether LHV or HHV have been used.

Sources: As for Figures 6.4, 6.5, 6.8 and 6.9; IEA statistics.

Source: *IEA (2007) "Indicators for Industrial Energy Use and CO2 Emissions" (Table 6.10)*

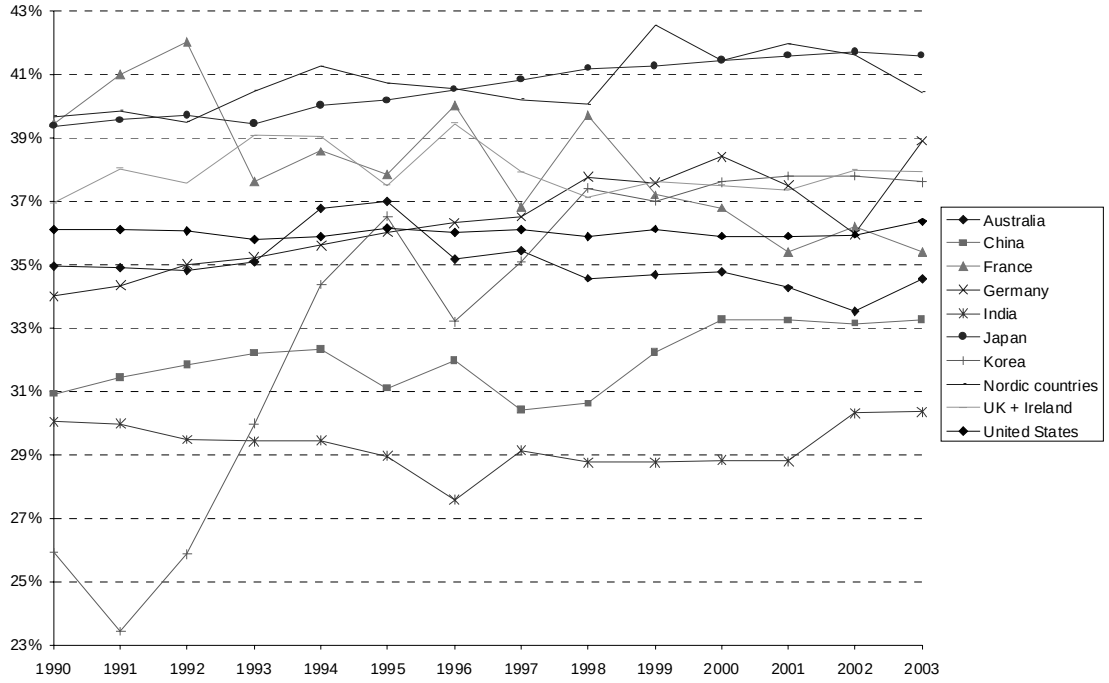
Efficiency of various types of energy in Canadian pulp and paper industry

	Reference Year	Modern Mill	Best	Worst	Median	Improvement Potential %	Source
Kraft mills (GJ steam/t)	2001	10	15	26	20	50	PAPRICAN, 2002, p. 11
Kraft mills (GJ steam/t)	2003	10	12	22	17	40	Francis & Browne, 2004
Kraft mills (kWh/t)	2001	600	650	1 200	850	30	PAPRICAN 2002, p. 11
Newsprint mills (GJ steam/t)	2001	0.4	2.2	12	7	96	PAPRICAN 2002, p. 20
Newsprint mills (GJ steam/t)	2003	0.4	2	14	6.5	94	Francis & Browne, 2004
Newsprint mills (kWh/t)	2001	2 475	2 475	3 500	3 100	20	PAPRICAN, 2002, p. 20
Paper machines in newsprint mills (GJ/adt)	2003		3.3	8	6	45	Francis & Browne, 2004

Sources: PAPRICAN (2002); Francis & Browne (2004).

Source: *IEA (2007) "Indicators for Industrial Energy Use and CO2 Emissions" (Table 7.7)*

International comparison of thermal efficiency in power generation (coal-fired thermal power)



Source: *ECOFYS(2006), " COMPARISON OF EFFICIENCY FOSSIL POWER GENERATION"*

2. Examples of analysis related to “Activity”

- A detailed analysis by sector is also important for “activity.” In addition regional trends in production have a large effect on those in GHG emissions in the sectors concerned.
- The following table shows world steel production (2005), and was compiled by the International Iron and Steel Institute (IISI). These data are important basic materials for analyzing the reduction potential in the field of iron and steel.

Steel production in various countries (2005)

Total	Production	Share	Cumulative Production Share	BOF Steel	EAF Steel	Open Hearth Furnace Steel
	Mt/yr	%	%	%	%	%
China	349.4	30.9	30.9	87.1	12.9	
Japan	112.5	10.0	40.9	74.4	25.6	
United States	94.9	8.4	49.3	45.0	55.0	
Russia	66.1	5.9	55.1	61.6	16.3	22.1
Korea	47.8	4.2	59.4	55.9	44.1	
Germany	44.5	3.9	63.3	69.3	30.7	
Ukraine	38.6	3.4	66.7	49.9	9.8	40.2
India	38.1	3.4	70.1	52.5	44.9	2.6
Brazil	31.6	2.8	72.9	76.2	22.0	
Italy	29.3	2.6	75.5	39.9	60.1	
Turkey	21	1.9	77.4	29.2	70.8	
France	19.5	1.7	79.1	62.5	37.5	
Taiwan	18.6	1.6	80.7	53.7	46.3	
Spain	17.8	1.6	82.3	24.5	75.5	
Mexico	16.2	1.4	83.7	27.8	72.2	
Canada	15.3	1.4	85.1	58.5	41.5	
United Kingdom	13.2	1.2	86.3	79.6	20.4	
Belgium	10.4	0.9	87.2	74.6	25.4	
South Africa	9.5	0.8	88.0	55.4	44.6	
Iran	9.4	0.8	88.9	26.2	73.8	
Poland	8.4	0.7	89.6	59.1	40.9	
Other	117.5	10.4	100.0			
World	1 129.36	100.0	100.0			

Source: IISI, 2006.

Source: *IEA (2007) “Indicators for Industrial Energy Use and CO2 Emissions” (Table 5.2)*

Cement production（2005）

	Production	Share	Cumulative Production Share
	Mt/yr	%	%
China	1 064	46.4	46.4
India	130	5.7	52.1
United States	99	4.3	56.4
Japan	74	3.2	59.6
Korea	50	2.2	61.8
Spain	48	2.1	63.9
Russia	45	2.0	65.9
Thailand	40	1.7	67.6
Brazil	39	1.7	69.3
Italy	38	1.7	71.0
Turkey	38	1.7	72.6
Indonesia	37	1.6	74.3
Mexico	36	1.6	75.8
Germany	32	1.4	77.2
Iran	32	1.4	78.6
Egypt	27	1.2	79.8
Vietnam	27	1.2	81.0
Saudi Arabia	24	1.0	82.0
France	20	0.9	82.9
Other	392	17.1	100.0
World	2 292	100.0	

Source: US Geological Survey (USGS), 2006.

Source: *IEA (2007) "Indicators for Industrial Energy Use and CO2 Emissions" (Table 6.2)*

Paper and paperboard production（2004）

	Paper & Paperboard Mt	Share %	Cumulative Production Share %
United States	83.61	23.6	23.6
China	53.46	15.1	38.7
Japan	29.25	8.3	46.9
Canada	20.58	5.8	52.7
Germany	20.39	5.8	58.5
Finland	14.04	4.0	62.4
Sweden	11.59	3.3	65.7
Korea	10.51	3.0	68.7
France	10.25	2.9	71.6
Italy	9.67	2.7	74.3
Brazil	8.22	2.3	76.6
Indonesia	7.22	2.0	78.6
Russia	6.79	1.9	80.6
United Kingdom	6.24	1.8	82.3
Spain	5.49	1.5	83.9
Norway	2.29	0.6	84.5
Portugal	1.67	0.5	85.0
Chile	1.17	0.3	85.3
Others	52.04	14.7	100.0
World	354.49		

Source: Food and Agricultural Organization of the United Nations (FAO), 2006.

Source: *IEA (2007) "Indicators for Industrial Energy Use and CO2 Emissions" (Table 7.1)*

3. Analysis of potential based on diffusion rate of BAT

- It is necessary to continue research and development efforts on energy saving technologies/innovative reduction technologies. In R&D in the field of innovative technologies by which the possibility to create large reduction potential exists, efforts from a long-term perspective are important.
- Where reduction potential is concerned, it is extremely important to calculate sectoral potential accurately. A leading methodology for this is to designate the most efficient applicable technology, or Best Available Technology (BAT), in each sector, and to calculate the amount of CO2 emissions (or energy use) which can be reduced if applied.
  - For example, in the Steel and Cement Task Forces in the Asia-Pacific Partnership on Clean Development and Climate (APP), the reduction potential in each of the participating nations is being evaluated concretely through a survey of the diffusion rate of energy saving equipment.
- The IEA is making trial calculations of “reduction potential” by designation BAT by sector and applying these technologies to identify possible reduction of CO2 emission (or energy use).

Reduction potential by application of BAT in manufacturing industries (world)

	Low – High Estimates (Final energy, includes overlap)	Low – High Estimates of Technical Savings Potential (Primary energy, excludes overlap)			Total Energy & Feedstock Savings Potentials
	EJ/yr	*EJ/yr*	*Mtoe/yr*	*Mt CO_2/yr*	%
Sectoral Improvements					
Chemicals/petrochemicals	4.0 – 11.0	5.0 – 6.5	120 – 155	370 – 470	13 – 16
Iron and steel	2.0 – 4.0	2.3 – 4.5	55 – 108	220 – 360	9 – 18
Cement	2.2 – 2.7	2.5 – 3.0	60 – 72	480 – 520	28 – 33
Pulp and paper	1.0 – 2.4	1.3 – 1.5	31 – 36	52 – 105	15 – 18
Aluminium	0.1 – 0.6	0.3 – 0.4	7 – 10	20 – 30	6 – 8
Other non-metallic minerals and non-ferrous metals	0.4 – 0.8	0.5 – 1.0	12 – 24	40 – 70	13 – 25
System/life cycle Improvements					
Motor systems	2.6	6 – 8	143 – 191	340 – 750	
Combined heat and power	4.5	2 – 3	48 – 72	110 – 170	
Steam systems	3.3	1.5 – 2.5	36 – 60	110 – 180	
Process integration	2 – 5	1 – 2.5	24 – 60	70 – 180	
Increased recycling	3 – 4.5	1.5 – 2.5	36 – 60	80 – 210	
Energy recovery	3 – 4.5	1.5 – 2.3	36 – 55	80 – 190	
Total		25 – 37	600 – 900	1 900 – 3 200	
Global improvement potential – share of industrial energy use and CO_2 emissions		18 – 26%	18 – 26%	19 – 32%	
Global improvement potential – share of total energy use and CO_2 emissions		5.4 – 8.0%	5.4 – 8.0%	7.4 – 12.4%	

Note: Data are compared to reference year 2004. Only 50% of the estimated potential system/life cycle improvements have been credited except for motor systems. The global improvement potential includes only energy and process CO_2 emissions; deforestation is excluded from total CO_2 emissions. Sectoral final savings high estimates include recycling. Sectoral primary savings exclude recycling and energy recovery. Primary energy columns exclude CHP and electricity savings for chemicals and petrochemicals. Primary energy columns exclude CHP for pulp and paper.

Source: *IEA (2007) “Indicators for Industrial Energy Use and CO2 Emissions” (Table 1.1)*

Country analysis of reduction potential in chemical and petrochemical industry

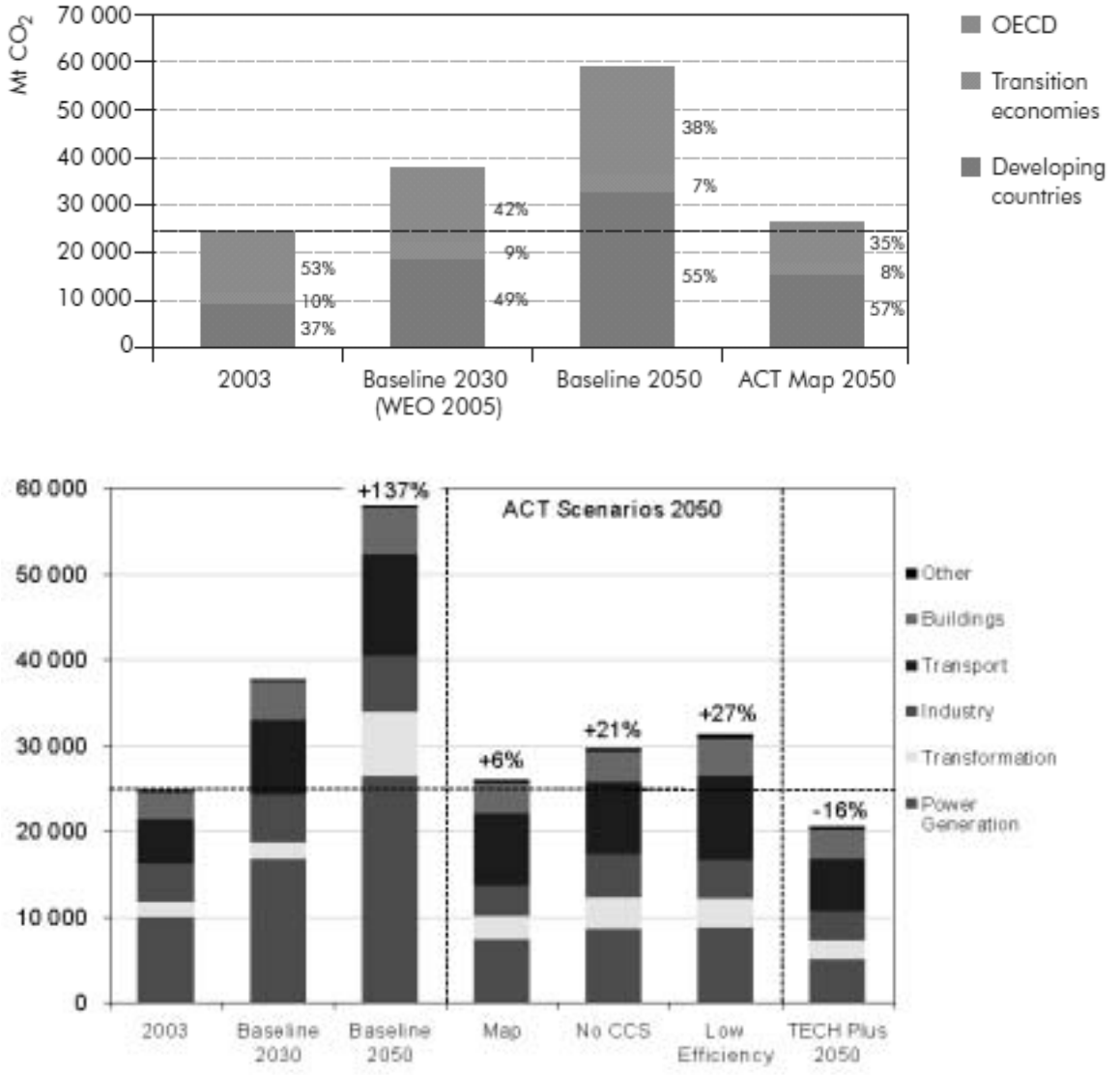
	Reported Energy Use PJ	BPT Calculated Energy Use PJ	Energy Efficiency Index	Improvement Potential %
United States	6 862	4 887	0.70	29.8
Japan	2 130	1 917	0.90	10.0
China	3 740	2 975	0.80	20.5
Saudi Arabia	1 115	917	0.82	17.8
Germany	1 157	1 044	0.90	9.8
Netherlands	618	509	0.82	17.8
France	654	582	0.88	11.0
Brazil	577	478	0.83	17.2
United Kingdom	490	460	0.94	6.2
India	1 091	910	0.84	15.8
Chinese Taipei	741	599	0.81	19.2
Italy	389	365	0.94	6.2
World	28 819	23 682	0.82	17.8

Sources: IEA statistics; SRI Consulting; METI.

Source: *IEA (2007) "Indicators for Industrial Energy Use and C02 Emissions" (Table 4.19)*

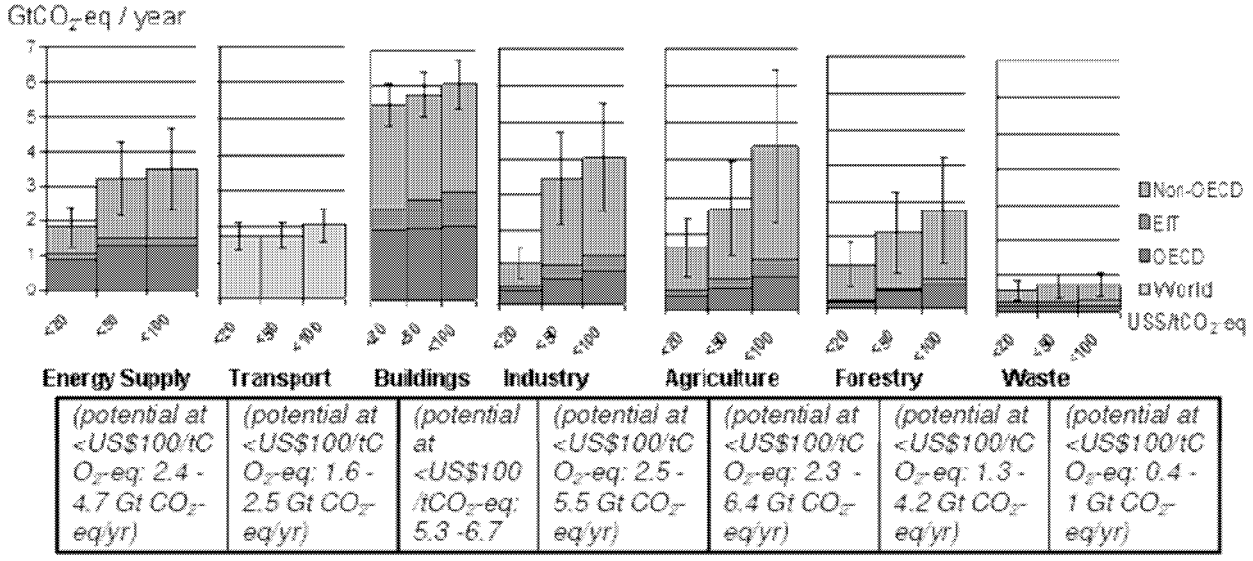
4. Analysis of potential considering “Cost of countermeasures,” etc.

- In analyzing mitigation potential, it is necessary to study the menu of concrete reduction countermeasures and the costs related to the implementation of the respective measures. Furthermore, the timing of replacement of inefficient old types of equipment also becomes an important factor in analyzing mitigation potential.
- For example, the IEA’s analysis in “Energy Technology Perspectives 2006” showed that it is possible to control the increment of CO2 emissions to approximately +6% in 2050 in comparison with 2003, in case existing and under developing countermeasure technologies are introduced on a certain cost.



Source: IEA (2006), “Energy Technology Perspectives 2006”

- The 4th Assessment Report of the IPCC (WG3) analyzed the sectoral and regional (OECD countries, economies in transition (EIT), non-OECD countries) reduction potential in 2030 (margin for reductions from business-as-usual (BAU) emissions) by cost category. By region, the reduction potential in the non-OECD countries is the largest.
- On the other hand, in the future analysis of mitigation potential in AWG, it is necessary to carry out a further detailed analysis of availability and feasibility of necessary technologies at the time of implementation, marginal mitigation cost of each country, and preceding efforts. Furthermore, segmentation of sectors, as well as detailed study of concrete technologies for CO2 reduction, costs, etc. is required in order to reflect the actual circumstances of each country and give consideration to equity.



(potential at <US$100/tCO2-eq: 2.4 - 4.7 Gt CO2-eq/yr)	(potential at <US$100/tCO2-eq: 1.6 - 2.5 Gt CO2-eq/yr)	(potential at <US$100/tCO2-eq: 5.3 -6.7	(potential at <US$100/tCO2-eq: 2.5 - 5.5 Gt CO2-eq/yr)	(potential at <US$100/tCO2-eq: 2.3 - 6.4 Gt CO2-eq/yr)	(potential at <US$100/tCO2-eq: 1.3 - 4.2 Gt CO2-eq/yr)	(potential at <US$100/tCO2-eq: 0.4 - 1 Gt CO2-eq/yr)

Figure SPM 6: Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. A full explanation of the derivation of this figure is found in 11.3.

Source: *IPCC AR4 WG3 "Mitigation of Climate Change - Summary for Policymakers"*

PAPER NO. 3: NEW ZEALAND

AD HOC WORKING GROUP ON FURTHER COMMITMENTS FOR ANNEX I PARTIES UNDER THE KYOTO PROTOCOL

1. The AWG has invited Annex I Parties to submit information and data on the mitigation potential of policies, measures and technologies at their disposal, with a view to providing a basis for indicative ranges of emission reduction objectives by Annex I Parties. Part One of this paper contains an update on New Zealand since our submission in February 2007.

2. The AWG also requested the secretariat to prepare, under the guidance of the Chair of the AWG and subject to the availability of resources, a technical paper that synthesizes these submissions and available information, inter alia, considering factors and criteria, relevant to the determination of the mitigation potential and to the identification of possible ranges of emission reduction objectives of Annex I Parties. New Zealand offers in the second part of this paper some preliminary thoughts on factors and criteria; these are without prejudice to the nature of the commitments that will apply after 2012.

Part One

Context for ongoing work

3. New Zealand has consistently stated that it is prepared to take on commitments to address climate change beyond 2012 in the context of the broadest international agreement to do so. We are encouraged by recent international developments, including the G8 Summit held in Heiligendamm, Germany that agreed to work towards achieving a comprehensive post 2012-agreement that should include all major emitters. We are hopeful that such an approach will lead to environmentally effective and fair outcomes.

4. The broader context for commitments beyond 2012 also includes having greater certainty in a number of areas, including on the rules for LULUCF, the issue of reducing emissions from deforestation in developing countries (and any implications that this may have for new Annex I commitments), and the Kyoto flexibility mechanisms. New Zealand considers it will be important to have greater certainty in these areas to inform the AWG's consideration of indicative ranges of emission reductions for Annex I Parties.

New Zealand Domestic Policy

5. As New Zealand looks to develop durable climate change policies for the future, investigating the mitigation potential of each of our domestic sectors is underway. Consultation with domestic stakeholders on a range of climate change policy issues took place from December 2006 to March 2007. These consultations were based on the following five energy and climate change discussion documents:

   a. Measures to Reduce Greenhouse Gas Emissions in New Zealand Post-2012;
   b. Powering Our Future – The Draft New Zealand Energy Strategy to 2050;
   c. Transitional Measures: Options to Move Towards Low Emissions Electricity and Stationary Energy Supply and to Facilitate a Transition to Greenhouse Gas Pricing in the Future;
   d. Draft New Zealand Energy Efficiency and Conservation Strategy; and
   e. Sustainable Land Management and Climate Change – Discussion Document.

6. The New Zealand Prime Minister, in her Statement to Parliament on 13 February 2007, said that issues around sustainability and climate change have become the compelling issues of our time, and that New Zealand can aim to be the first nation to be truly sustainable.

7. The New Zealand Government is considering a domestic greenhouse gas emissions trading scheme with international linkages as part of its drive to take action on climate change and achieve sustainability. The government has expressed a preference for all sectors of the economy and all greenhouse gases to be included in an emissions trading scheme over time. This will support cost-effective emission reductions and promote fairness across the economy, while recognising that some sectors have a greater ability than others to reduce emissions. An emissions trading scheme would support New Zealand's compliance with its international obligations, including those under the UNFCCC and the Kyoto Protocol, and enhance its ability to contribute to future international efforts to reduce greenhouse gas emissions.

Part Two

Determining Mitigation Potential: Factors and Criteria

8. The determination of future commitments across countries within the context of a shared vision is one of the most challenging issues in climate negotiations. At the point our shared vision needs to be expressed as hard commitments, Parties will expect considerations of equity and fair burden-sharing to apply. Yet there is no agreed methodology for establishing individual country commitments, and no agreed factors or criteria against which equity and comparable effort can be judged.

9. At this stage there is clearly a wish to have a common analytical base to inform the process of reaching agreement on new commitments. This includes increasing our shared understanding about differences in national circumstances, including future uncertainty and dynamic change, and their role in greenhouse gas emissions. This does not imply that new commitments can simply be derived from a mathematical exercise. The final process will be a negotiation. Our aim should be to make that negotiation well-informed and transparent.

10. Providing scope for countries to make contributions to international climate efforts in ways that make sense for them is important. In New Zealand’s view, we should keep open the options of commitments other than a single quantified emission limitation or reduction objective per country as in the present Annex B of the Kyoto Protocol. For example, sectoral or intensity target commitments could also form part of a new package of commitments. The factors and criteria presented in this paper would be relevant to the consideration of any type of commitment.

11. We note that some useful and relevant work has been pioneered by the European Union on burden sharing. Further work is also being carried out by research organisations such as the Center for Clean Air Policy and the Pew Center on Global Climate Change; all this work deserves attention by the AWG, and New Zealand would favour having the opportunity for a thorough discussion of this work.

12. In the following table we have drawn together, in three different groups, a number of the factors and criteria that have been suggested as providing a basis for comparing domestic

mitigation potential between countries. It is a non-exhaustive list aimed to facilitate discussion, and is not presented as a New Zealand proposal.

13. The first group of factors and criteria are what we have described as emissions-related metrics. These are entirely objective measures of costs etc, directly linked to emissions. Then comes another group of objective measures relating to the economy. The third group are less simply expressed, less directly measurable, are perhaps semi-qualitative, and are not directly and immediately identifiable in the way the first two types are. These could however be useful in assessing relative effort and equitable burden sharing.

Factors and Criteria Relevant To Mitigation Efforts

	Factors, criteria	Comment
Emissions Related Metric	Emissions per capita	
	Emissions per unit of GDP	An expression of the aggregate emission intensity of the economy.
	Emissions per unit of production	Relative production efficiency between countries is important. Need to avoid perverse incentives that see sectors with highly efficient production cut back and "leaked" to other less efficient systems.
	Cost of abatement per tonne of CO2e, by sector and aggregate	The simplest way of expressing the absolute costs.
	Mitigation potential at $50 and $100/t C02e	Already used by IPCC globally. Could be a useful standard metric to apply nationally.
	Aggregate macroeconomic cost of measures	
	Sectoral and economy-wide abatement cost curves	If available this would be a simple point of comparison among economies. Needs economic modelling work. One size does not fit all, as noted in IPCC AR4.
Economic metric	Population growth	Population growth would tend to increase Business As Usual emissions trajectories.
	GDP per capita, corrected for PPP	Relevant to the ability to pay for emission reductions.
	Average GDP growth	A fast-growing economy, even if growth is decoupled from emissions, would tend to have the same effect as population growth.

Economic & Social Structure	Degree of sustainability of energy generation	High percentage of sustainability means less low hanging fruit.
	Technological mitigation potential	Differs hugely between sectors. For example, an economy with a high proportion of agriculture emissions will tend to have a lower aggregate mitigation potential.
	Distance from world's best practice energy intensity by sector	Similar considerations as for energy generation above.
	Total cumulative emissions since [1750] [1850] [1950] [1990]	Could be seen as belonging to the first group except that there is no agreement on a start date for this, or on the concept of responsibility. Not useful in relation to the current flows of emissions. May have some application in considering how much further responsibility a country should take over and above its domestic mitigation target. But there is an element of double counting here, if GDP is also to be used as a measure of responsibility – to what extent can the extra cumulative emissions be assumed to be captured in the higher GDP figures?
	Exports as a percentage of GDP	Captures export-orientation of an economy, which could influence mitigation potential; competitiveness at risk issues may also be greater.
	Human Development Index	Has been suggested as a useful comparator. GDP figures alone may not adequately capture a country's stage of development.

PAPER NO. 4: SWITZERLAND

Kyoto Protocol, AWG 4

Information on data on the mitigation potential of policies, measures and technologies at the disposal of Annex I Parties, with a view to providing a basis for indicative ranges of emission reduction objectives by Annex I Parties

Introduction

1. According to the conclusions of AWG 3, Switzerland welcomes the opportunity to present initial relevant information for the work of the AWG in order to facilitate discussions at its fourth and subsequent sessions. Switzerland has already presented relevant information in its submission to the AWG 3.

2. We understand, from the discussions during the AWG 3 session, that the technical paper that will synthesize these submissions and available information, will contain aggregated – and not individual – as well as comprehensive information on the Annex I Parties, inter alia, considering factors and criteria, relevant to the determination of the mitigation potential and to the identification of possible ranges of emission reduction objectives of Annex I Parties, noting that the sole reductions from Annex I Parties will not be sufficient to reach the ultimate objective of the UNFCCC (Article 2).

Mitigation potential of policies, measures and technologies

3. Switzerland is currently examining its climate policy for the period after 2012, including national and international aspects.

4. Switzerland is committed to adopting ambitious targets under the Kyoto Protocol for the period after 2012. In-depth studies and consultations to that effect are currently underway. Switzerland wishes to make a distinction between domestic and international mitigation ranges.

5. As concerns its domestic range, Switzerland is facing major challenges for further reducing its energy-induced CO2 emissions (other gases ad sources are still being assessed), because of the following reasons:

   i) Due to the structure of its economy (a pre-eminent tertiary sector, few energy-intensive industries), Switzerland's per capita and per GDP emissions are already among the lowest of the OECD countries (less than half the OECD average) and its per GDP emissions are among the lowest worldwide. Therefore, the cost of incremental domestic abatement measures exceeds the cost of measures abroad by then-fold or more;

   ii) Switzerland's electricity generation is currently practically carbon-free. Consequently, there are no emissions reductions to be achieved. On the contrary, Switzerland may face an increase in emissions from the electricity sector, depending on how a looming electricity supply gap will be covered in the future: gas-fired power or nuclear are the two options, since even ambitious energy efficiency gains and renewables promotion may not suffice to bridge the gap

iii) One of the highest energy-related CO2 mitigation potential lies in the building sector. However, even if more stringent policy measures are taken into account, these will not yield rapid results due to the low renewal and refurbishment rates of the building stock;

iv) Additional policy measures are being prepared to curb emissions from the transport sector. However, bottom-line effects are limited and due to the low demand elasticity, dieselization and overriding international trends in freight transport;

6. The aforementioned factors restrict the range of emissions reductions which Switzerland can achieve domestically. Without prejudice to its commitment to an ambitious domestic climate policy, Switzerland stresses the fact that, the more Parties will be allowed to make use of international cooperation and flexible mechanisms under the Kyoto Protocol in the period after 2012, the more ambitious national commitments will be;

7. Furthermore, with increasing use of international cooperation and flexible mechanisms, international carbon abatement costs will tend to converge and to be derived from the international level of ambition to reduce emissions. Therefore, the international level of ambition will have a bearing on Switzerland's own level of ambition.

- - - - -