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A Sectoral Approach as an Option for a Post-Kyoto Framework

Akihiro Sawa
21st Century Public Policy Institute
Japan

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Akihiro Sawa
Senior Executive Fellow
21st Century Public Policy Institute
akihiro_sawa@yahoo.co.jp

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THE HARVARD PROJECT ON INTERNATIONAL CLIMATE AGREEMENTS

The goal of the Harvard Project on International Climate Agreements is to help identify key design elements of a scientifically sound, economically rational, and politically pragmatic post-2012 international policy architecture for global climate change. It draws upon leading thinkers from academia, private industry, government, and non-governmental organizations from around the world to construct a small set of promising policy frameworks and then disseminate and discuss the design elements and frameworks with decision-makers. The Project is co-directed by Robert N. Stavins, Albert Pratt Professor of Business and Government, John F. Kennedy School of Government, Harvard University, and Joseph E. Aldy, Fellow, Resources for the Future. For more information, see the Project's website: http://belfercenter.ksg.harvard.edu/climate

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Abstract

This paper seeks to explore the potential of sectoral approaches as a post-Kyoto framework.

The shared understanding of sectoral approaches in the academic community can be outlined as follows:

1) Sectoral approaches can potentially engage developing countries in mitigation actions, which would be an accomplishment unachieved by the Kyoto Protocol, and determine politically acceptable national targets and domestic allowance allocations based on the analysis of reduction potentials from technological perspectives.
2) Sectoral approaches are inherently at a disadvantage compared to the Kyoto-type top-down approach with flexibility mechanisms in terms of cost effectiveness and environmental effectiveness.
3) Sectoral approach-based negotiations will be substantially complex, encompassing data collection issues and multiple sector-specific negotiation processes. Therefore, they are not cost-effective enough to constitute an international framework and can only be complementary or additional to the Protocol.

Given these drawbacks, this paper will propose the Policy-Based Sectoral Approach, under which sectoral approaches would be employed to establish national emission targets and governments would internationally pledge the implementation of policies and measures to achieve the targets.

Under this approach, individual sectors would be categorized according to their features into three groups of sectors in negotiations. The first group of sectors would comprise energy-intensive industries that are exposed to international trade and leakage issues (Group I). The second group of sectors would include sectors that are basically domestic, such as electricity and road transport, for which benchmarks (generation efficiency, vehicle fuel efficiency, etc) and best practices can be relatively easily identified, but which are susceptible to resource availability, geographic and natural factors and domestic policies and measures (renewables introduction rate, traffic measures, etc.), and thus need to be unilaterally adjusted with government policies and measures (Group II). The third group of sectors would be composed mainly of the household and commercial sectors, or sectors that encompass a wide range of technologies, thus complicating indicator-setting and international comparison

of indicators (Group III). In all groups of sectors, it is preferred that technical experts participate from industrial and academic circles to provide technological insight on benchmarking and calculating efficiency indicators and to promote negotiations. Through this process, the generation of hot air can be avoided to the maximum extent.

In addition to the basic structure, the paper will also discuss how to proceed with negotiations and what incentives would encourage developing countries to participate and how to ensure cost effectiveness.

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A Sectoral Approach as an Option for a Post-Kyoto Framework

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1. Introduction (Background)

This paper seeks to explore the potential of sectoral approaches as a post-Kyoto framework. A number of proposals have already been made for sectoral approaches. Common to all of these proposals is the concept that instead of the Kyoto-type top-down approach of negotiating caps for economy-wide emissions, a bottom-up approach should be taken to aggregate sectoral reduction potentials calculated based on technological analyses to determine a reduction target. Many surveys have been conducted on sectoral approaches and other similar approaches (Bodansky, 2004; Philibert, 2005a and 2005c; The Pew Center: Report of the Climate Dialogue at Pocantico, 2005; Siikavirta, 2006; IPCC, 2007).

Sectoral approaches have not only been studied in depth in the academic community in recent years, they have also attracted growing interest in political spheres as an option for multinational negotiations. A sectoral approach was coined in the Bali Action Plan as a "cooperative sectoral approach" and the Japanese government has led the world in making specific proposals for employing a sectoral approach as a basis for negotiations on the next framework to follow the Kyoto Protocol.

Sectoral approaches initially emerged against the backdrop of negotiation strategies in pursuit of a new approach that would resolve the resentment held by various parties against the Kyoto Protocol and stringent domestic measures implemented in line with it. Japan and the US under the Bush Administration have promoted the adoption of sectoral approaches at the government level. It is widely recognized now in the Government of Japan that partly because it hosted COP3, it could not help largely conceding in the final diplomatic give and take to accept quantitative targets that were expected to be almost impossible to achieve in terms of technological potential and economic costs. Over the recent years the Government of Japan has sought an alternative to establish a more realistic and equitable basis for national reduction targets on which diplomatic negotiations for the next framework should be proceeded. The US, led by the

Bush Administration, presents the engagement of developing countries in mitigation actions as a precondition for US participation but argues that developing countries are unlikely to commit themselves to reductions if the Kyoto framework is maintained. The EU has also begun to show interest in sectoral approaches, which would grant industrial circles opportunities to provide input regarding their opinions and demands, given the circumstances that even if the EU manages to achieve the targets set for the First Commitment Period, efforts towards ambitious targets in the succeeding period will require the cooperation of industries with large political influence in the region. Furthermore, although developing countries remain vigilant against consequential reduction targets, they have begun to show willingness towards considering sectoral approaches if they will lead to the transfer of technologies and financial resources.

Against this background, sectoral approaches have recently attracted increased attention, but some weaknesses have also been pointed out regarding their potential as an international framework to replace or complement the Kyoto Protocol and it remains unclear whether they can constitute a major element of the next international framework. This paper will provide an overview of previous findings on sectoral approaches and present an option for the next framework based on a sectoral approach.

More specifically, Section 2 will outline previous studies and practical efforts regarding sectoral approaches to present the general understanding and evaluations currently shared.

Section 3 will present an idea for the establishment of the next framework based on a sectoral approach that focuses on industrial sectors and analyzes sectoral reduction potentials in each country based on technological data to determine reduction targets and implementation measures through international negotiation, Section 3 also refers to methods for deriving national reduction targets by applying the approach to a wider range of sectors, such as the household / commercial and transport sectors as needed.

The characteristics of this proposal compared to previous studies are that 1) it clarifies the government's role in a sectoral agreement as an entity making an internationally legally binding commitment to adopt domestic policies and measures for mitigation; 2) it categorizes emitting sectors into three groups in order to simplify and smoothen negotiations; and 3) it refers to how to proceed with negotiations.

Section 4 will discuss some ideas for incentives to invite developing countries to participate including expanding or revising the current CDM scheme, or newly developing a crediting system (e.g. Ellis and Baron, 2005; Bosi and Ellis, 2005; Schmidt and Helme, 2005; Baron and Ellis, 2006; Schmidt et al., 2006) and a corrective measure to resolve cost effectiveness issues.

Section 5 will present the challenges to be faced in implementing the idea.

2. Theoretical Analysis and Practical Application of Sectoral Approaches

2.1. Studies on Sectoral Approaches to Date

"Sectoral approaches" have appeared in a number of previous writings but still remain without an established definition. Various surveys and reviews also have been done on categorization or typology of sectoral approaches (e.g. Siikavirta, 2006; Egenhofer and Fujiwara, 2008; Sawa, 2008). There is also much research on options for policy design based on sectoral approaches (e.g. Baron, 2006; Bradley et al., 2007). Furthermore, there are a countless number of proposals made from a bottom-up approach, under which sectoral approaches would be categorized, and others based on a policies and measures approach in which individual countries should make binding or non-binding commitments to adopt certain domestic policies and measures to reduce greenhouse gas emissions(e.g. Philbert and Pershing, 2001; Aldy et al., 2003; Sawa, 2007).

The following points have often been provided as reasons for focusing on sectoral approaches in envisaging a post-Kyoto framework (see METI 2004, Berk and Den Elzen, 2005; Watson et al., 2005; Bodansky, 2007; Bradley et al, 2007; Baron et al., 2007; Neuhoff and Droege, 2007 regarding 1) and 2) below):

1) A sectoral approach encourages the involvement of a wider range of countries:

Given forecasts of global future emissions, it is indispensable that non-Annex I countries experiencing drastic economic growth take meaningful actions of mitigation[1]. However, these countries have been unwilling to accept

[1] Bali Action Plan, 1(b)(ii), COP13; G8 Hokkaido Toyako Summit Leaders Declaration, Hokkaido Toyako, 8 July 2008; Declaration of Leaders' Meeting of Major Economies on

economy-wide caps from the concern that their economic development would be constrained. Also, even in the event that they decide to accept such caps, there remains the risk that the reliability of their emissions data collection and monitoring would be insufficient to verify the results of their mitigation actions. Sectoral approaches aim to mitigate emissions in specific sectors, and thus may serve to facilitate the involvement of developing countries depending on the incentives design or the policy design and arguably lessen "measurability, reportability and verifiability" issues.

2) A sectoral approach mitigates competitiveness issues

Sectoral approaches bear the potential of resolving two issues concerning competitiveness. First, under the Kyoto Protocol, there is a mixture of countries with carbon emissions restrictions and others without such limits, therefore imposing unfair competition upon energy-intensive industries in regulated jurisdictions, in particular. Secondly, the Kyoto Protocol determines an economy-wide cap but leaves the method of achievement up to each country to decide; therefore, if a country supports particular industries or imposes loose restrictions in order to protect domestic industries, relevant industries in other countries will not be able to compete on the same plane. Sectoral approaches will enable industries to make cross-border commitments to equitable targets, thus mitigating disparities among countries regarding carbon restrictions or domestic regulations.

Furthermore, sectoral approaches can abate leakage issues, or carbon leakage caused by energy-intensive industries relocating from countries with strict carbon restrictions to other countries free of such restrictions to escape a tilted playing field.

3) A sectoral approach promotes consensus by contributing to the establishment of equitable economy-wide reduction targets.

Some well-known approaches include the Triptych Approach, which served as a basis for the 1997 negotiations within the EU on the burden-sharing of emissions reductions among member countries (Groenenberg et al., 2002) and the Multi-sector Convergence Approach that differentiates emission standards among sectors seeking to eventually equalize per capita emissions in all

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Energy Security and Climate Change, 9 July 2008. Although the wording differs among the respective documents, they all imply that there is consensus regarding the expectations for mitigation actions by developing countries, especially those with a significant growth rate.

countries (Jansen et al., 2001; Sijim et al., 2001). A recent proposal said, "(E)ach major emitting country considers a sectoral reduction potential with indicators given to each sector, based on the technology to be in use in the future. Then, each country calculates the sectoral reduction volumes, based on the emission potential and prospects of productive activities which are examined through the review among countries. Sectoral reduction amounts are aggregated in the bottom up approach to set a quantified national GHG emissions reduction target." (Government of Japan, 2008) The proposal goes on to say that by expanding sectoral coverage beyond the industrial sector to the household / commercial and transport sectors, and further to the agriculture and Land Use, Land-use Change, and Forestry sectors, an equitable economy-wide reduction target can be set.

By applying such methods that determine reduction potentials based on technological analysis, national emissions targets can become more convincing to interests groups and pressure groups, thus facilitating diplomatic negotiations and increasing the chances of consensus. Furthermore, in comparison with economy-wide emissions targets, there is the practical advantage that the uncertainty of abatement costs attached to uncertain economic growth can be reduced because individual sectors under their respective targets wil be able to forecast their own costs irrespective of the whole economic situation, in part if not entirely. (cf. Philbert, 2005a).

It has also been noted that because the number of parties concerned is small under a sectoral approach involving mainly energy-intensive industries, the target-setting negotiation process can be more simplified, compared to that of the UNFCCC, and hence the greater likelihood to reach agreement (eg. Bodansky 2007; Bradley et al. 2007).

4) A sectoral approach achieves effective emissions reductions through the promotion of technology development and technology transfer

In order to achieve significant emissions reductions in the long-term, innovative technology development is indispensable (Barrett, 2003; Sugiyama and Sinton, 2005; Justus and Philbert, 2005; Barrett, 2007). In the short and mid-term, under proper incentive design, direct emission reductions can be achieved by identifying energy conservation technologies that will improve energy efficiency in each sector and transferring them to countries with large reduction potential, especially developing countries marking drastic economic

growth. Once equipment based on low carbon efficiency technology is installed in facilities with long operating lives, such as power generation plants, the opportunity for new emission reductions is lost until the time comes for the next renewal of equipment.

Although carbon prices may indeed have significant implications in promoting technology development, there is not evidence enough for the relationship to be proven true, and furthermore, it will be difficult for companies to determine a portfolio for technology development in a likely case in which carbon prices become unstable. Because the application of a certain technology is often limited to a single sector, sectoral approaches should be an effective means to identify and impose mandatory standards in sectors in which emissions trading are not relevant (transport, building, appliances, etc.) (De Coninck et al., 2007). The MARPOL Convention (International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1976 relating hereto) is a successful example of imposing technology standards on a specific sector to achieve the purposes of a multinational agreement and can be applied in climate change measures (Barrett, 2003).

Also, sectoral intensity targets and sector-specific R&D agreements can also accelerate technology development and further reduction effects (Watson et al., 2005). Emissions trading may undermine incentives towards technology development because of the uncertainty of future carbon prices and potential time-inconsistency (OECD, 2008).

On the other hand, the viability of sectoral approaches has been questioned as summarized below (eg. Watson et al., 2005; Philbert, 2005; Berk and Den Elzen, 2005; Baron, 2006; Baron et al., 2007; Bradley, 2007; Egenhofer and Fujiwara, 2008):

1) A sectoral approach faces barriers in constituting an international framework to replace the Kyoto Protocol:

A sectoral approach requires information exchange and sector-specific negotiations, and thus entails immense transaction costs. Negotiators of the UNFCCC process are reluctant to accept new approaches. Also, countries that have domestically introduced robust schemes such as the EU-ETS will try to avoid taking approaches that could risk introducing uncertainties to their scheme. Furthermore, a sectoral approach may make way for countries to slip on to the

negotiation table other competitiveness issues that concern domestic sectors but bear no direct significance to carbon restrictions, thus complicating negotiations.

Bradley (2007) provides several options as a final form of agreement based on sectoral approaches, namely, the Sector-Only model, the Addition model, the Complementary model, the Carve-out model and the Integration model, but states that it is in reality "difficult to envision" a multinational agreement based only on sectoral approaches, which would involve a sizeable number of independent agreements, and thus complex negotiations.

Furthermore, from the perspective of international law, Kulovesi and Keinanen (2008) contend that in order to implement "agreements concluded by representatives of industry sectors or between state(s) and industry sectors," a new legal framework unprecedented except at the regional level is called for.

2) A sectoral approach reduces cost-effectiveness.

Covering all sectors, economy-wide emissions targets can exploit abatement opportunities with minimum costs and thus are generally regarded as the ideal option in terms of cost-effectiveness. On the other hand, a sectoral approach forces reductions upon specific sectors and will thus be less cost-effective unless a marginal reduction cost abatement measure, such as an emissions trading scheme, is implemented. Marginal reductions costs may end up not equalized across sectors, in which case a sectoral approach would consequently contribute to protecting a particular industry sector. The importance of cost-effectiveness was given note also in the Bali Action Plan and measures for improved cost-effectiveness need to be contrived if a sectoral approach is to be pursued.

3) A sectoral approach cannot achieve environmental effectiveness.

A sectoral agreement only covers emissions reductions in specific sectors which succeed in reaching target agreements and does not necessarily induce mitigation actions from other sectors, compared to an economy-wide target agreement where all sectors would be involved.

Intensity targets that are envisaged in many sectoral approach proposals may be inferior to absolute targets in terms of the effect of reducing greenhouse gas emissions.

In addition, when a low-carbon product is exposed to inter-sectoral competition among sectors in which a sectoral approach has been adopted,

sectoral agreements and differences in the strictness or form of government regulations implemented to ensure compliance with such agreements may alter competitiveness conditions, and may risk driving low-carbon products out of the market in favor of high-carbon products produced by sectors without agreements and regulations.

4) A sectoral approach entails government intervention

A sectoral approach is likely to increase opportunities of government interventions compared with the Kyoto Protocol in two aspects. First, given the prevailing asymmetry of information between private and public sectors, if substantial effects are to be expected of a sectoral approach there may be a need to give the government some authority in collecting data on technology, production forecasts, and reduction costs, in which case government intervention in corporate activities will be aggrandized. Secondly, as long as the current international law regime prevails and only governments and intergovernmental organizations are eligible to become parties to international agreements, in order for an international consensus reached within a sector to gain legal status in public international law, governments would be required to make international pledges to ensure compliance within each country. Governments would then need to legally bind the relevant industries domestically.

5) A sectoral approach faces challenges in data collection

The following citation applies to all versions of sectoral approaches: "The backbone of global sectoral industry approach is performance indicators, often expressed through industry performance benchmarks backed up by credible monitoring and verification." (Egenhofer and Fujiwara, 2008, p.27)

Major data related issues regarding sectoral approaches are provided below (Baron et al, 2007; Bradley, 2007; Egenhofer and Fujiwara, 2008):

-In developing countries, especially, the lack of data reliability and limited monitoring capacity reduce the potential of sectoral approaches.

-No agreement has yet been reached concerning the standardization of boundaries required in defining sectors.

-Benchmarking data could be confidential corporate information, in which case data collection would be complicated.

-Verification should be performed by a third party from transparency and

reliability perspectives and therefore such institutional design is called for.

-How should data marked by high uncertainty, such as prospects for future technologies and production forecasts required for baseline setting be acquired and managed?

6) A sectoral approach faces challenges with antitrust laws

Successful sectoral approaches will encompass the majority of companies belonging to a particular sector, and thus cover the greater part of that sector's total production volume. The mutual exchange of information on production, technology and costs could constitute a violation of antitrust laws (Egenhofer and Fujiwara, 2008).

Based on the earlier studies abovementioned, the evaluation of sectoral approaches shared among by the academic community at present can be outlined as follows:

1) A sectoral approach may potentially play a significant role in overcoming the challenges intractable by the Kyoto Protocol, such as developing country involvement in mitigation actions and technological analysis of reduction potentials as a basis for diplomatic negotiations which would make politically acceptable national targets for individual countries easier to set. In order to realize this potential advantage of a sectoral approach however, proper incentive policies in terms of financial and technology transfer should be designed for involving developing countries, and data problems like setting common benchmarks should be solved.

2) Questions regarding their cost effectiveness and environmental effectiveness remain and thus cannot be concluded to surpass the Kyoto-type method, a top-down approach coupled with flexibility mechanisms.

3) Furthermore, accompanied by data collection issues and numerous sectoral negotiations, sectoral approach-based negotiations will be substantially complex, and therefore can only be complementary or additional to the Kyoto Protocol, and not be cost-effective enough to replace it as an international framework for global warming measures calling for agreement in a limited amount of time.

2.2. Practical Application of Sectoral Approaches

Just as progress has been made in the theoretical analysis of sectoral approaches, developments have also been observed in terms of their application, represented by efforts made by the International Aluminium Institute (IAI), the Cement Sustainability Initiative / World Business Council for Sustainable Development (CSI), the International Iron and Steel Institute (IISI), and the Asia-Pacific Partnership on Clean Development and Climate (APP). An outline of the APP's accomplishments to date is provided below.[2]

The APP is an initiative for regional cooperation launched in July 2005 under the initiative of the United States. The membership comprises seven countries, namely, the US, Australia, South Korea, China, India, Japan and Canada. Its purpose is to pursue the development, deployment, and promotion of the transfer of clean and effective energy technologies in particular. Its climate change-related undertakings are regarded as complementary to the Kyoto Protocol by the parties concerned.

The APP has a Policy Implementation Committee (PIC) under its ministerial meeting which oversees the overall decisions and operations of the Partnership. The Partnership has identified eight sectors, for each of which it has created public-private Task Forces to individually develop and implement Action Plans.

With the seven Partner countries collectively accounting for more than half of the world's economy, energy consumption, and GHG emissions, the Partnership's work promises to lead to substantial progress in climate change measures[3]. It is a collaboration of public and private sectors and academics and the joint work of a smaller number of countries compared to the UNFCCC, and therefore, more accelerated and practical progress is possible. Each Task Force identifies and implements technologies and flagship projects strategically important in the climate change arena and in terms of efficient energy use, and promotes the sharing of technological information and best practices.

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[2] For efforts in the IAI, CSI and IISI, refer to Egenhofer and Fujiwara, 2008, main text and appendix.

[3] According to one of the Asia Pacific Partnership studies," (M)odeling indicates that accelerated adoption of world-best practice for thermal power generation alone would reduce global emissions by 1.5 percent by 2010…." http://asiapacificpartnership.org/PowerGeneration-TransmissionTF.aspx

The Power Generation and Transmission Task Force, Steel Task Force, and Cement Task Force have made the largest progress in the practical application of sectoral approaches. In the Power Generation and Transmission Task Force, peer review visits have been made to low-efficiency power plants, followed by workshops and on-site guidance on operational improvements to share best practices and derive actual emissions reductions. The Steel Task Force has developed a handbook on state-of-the-art clean technologies for their deployment and is engaged in establishing a common calculation method for reduction potential and performance indicators. The Cement Task Force conducts performance diagnosis of plants located in developing countries and has made significant progress in the sharing of technological information.

With a small membership of only seven countries, the APP represents a large scale of activities and thus its efforts can have significant implications on emissions reductions. The Partnership's joint work to present has fostered a common awareness that there is great reduction potential in China and India. Furthermore, direct corporate participation has facilitated the identification of energy and environment related investment barriers including intellectual property rights and tax systems in developing countries for governments to eliminate so that a good investment and business environment for effective and continued technology transfer can be ensured. The accumulation of successful undertakings by the APP provides developing countries a methodology for sustainable development through cooperation with developed countries and promises the smoother involvement of developing countries in a post-Kyoto framework.

Although in theory sectoral approaches have not won overriding support as the best approach towards global warming, in practice, they have begun to prove successful in industry-led efforts, complementing national emission reduction efforts under the Kyoto Protocol and in fostering international partnership.

The following section will propose a new global framework based on sectoral approaches so that practical activities that have already been launched will not be reversed, but rather incorporated into a more formal framework of multinational agreement with consideration for the weaknesses of sectoral approaches that have been noted in rational analyses.

3. The Case of Policy-Based Sectoral Approach

3.1. A Post-Kyoto Framework based on a Sectoral Approach

There are many advocators of the global linkage of emission trading markets in a post-Kyoto framework on the grounds that emissions trading schemes are an effective means to achieve given reduction targets with minimal costs[4]. However, more attention should be directed to how emission targets themselves are decided indeed.

Sectoral approaches may have no advantage over emissions trading schemes and environmental taxes when compared on the dimension of choosing the most cost-effective method to achieve a given target. However, they should be evaluated in terms of their effectiveness as an approach for allocating reduction targets among countries in a way that minimizes the generation of hot air. This aspect of sectoral approaches has been correctly recognized in the EU, where sectoral approaches are being considered in the form of benchmarking, as an effective method for allocating allowances among the actors in the EU-ETS. If sectoral approaches enable the allocation of allowances with minimized risks of hot air, they promise to lead to the increased stability of both domestic and international emissions trading markets already in place.

The second reason why sectoral approaches are worth being employed in the negotiation of the post-Kyoto framework is that they could work as a contingency framework for tentative agreement to prevent delays in implementing global warming countermeasures. If sectoral agreements are reached in the case that countries fail to agree on Kyoto-type economy-wide national targets, some ceaseless progress in mitigation can still be expected.

3.2. Policy-Based Sectoral Approach

The idea to be proposed hereunder is a framework that employs sectoral

[4] Under the Kyoto Protocol, this merit is not fully realized because of the supplementarity principle. Because "any such trading shall be supplemental to domestic action for the purpose of meeting quantified emission limitation and reduction commitments" (Article17, Kyoto Protocol), countries with stringent emission targets (in the sense that marginal reduction costs for the country as a whole exceed the world market price for carbon) are not permitted the full use of flexibility mechanisms and thus reductions of those countries cannot be achieved with minimal costs.

approaches in national target setting and involves international commitments by governments to implement policies for their achievement. Based on the proactive introduction of policies and measures by governments, it shall be referred to as the Policy-based Sectoral Approach.

A commitment period under this sectoral approach should be long enough to allow governments and industries the time required for investments in long term technology research and development. For example, a commitment period of ten years would be necessary for the new protocol.

3.2.1. Basic Structure of Policy-Based Sectoral Approach

Sectors would be divided into three groups of sectors according to their features and sectoral negotiations would be held group by group where negotiators are more familiar with sector-specific concepts, circumstances, and technologies, compared to the case of a single negotiation for agreements across all sectors.

The first group of sectors would comprise energy-intensive industries that are exposed to trade and leakage issues (hereinafter Group I). The second group of sectors would include sectors that are basically domestic, such as electricity and road transport, for which benchmarks (generation efficiency, vehicle fuel efficiency, etc) and best practices can be relatively easily identified, but which are susceptible to resource availability, geographic and natural factors and domestic policies and measures (renewables introduction rate, traffic measures, etc.), and thus need to be unilaterally adjusted with government policies and measures (hereinafter Group II). The third group of sectors would be composed mainly of the household and commercial sectors, or sectors that encompass a wide range of technologies, thus complicating indicator-setting and international comparison of indicators (hereinafter Group III). However, comparisons of and agreement on energy efficiencies in some products like household appliances are possible.

In all groups of sectors, it would be preferred that technical experts participate from industrial and academic circles to provide technological insight on benchmarking and calculating efficiency indicators and to promote negotiations. Through this process, the generation of hot air can be avoided to the maximum extent.

Each group of sectors will negotiate numerical targets and government policies and measures to achieve them, compiling conclusions into a policy template (see Table 1), which will constitute the new Protocol. Governments will pledge the implementation of policies and measures and the achievement of numerical targets. Legally binding numerical targets refer to numerical targets for industries exposed to international competition in Group I *and* national reduction targets. In Annex I countries, policies and measures shall be limited to legal regulations, government budgets and tax systems and other measures that involve resource allocation for the primary objective of reducing greenhouse gas emissions. Non-legal measures like national campaigns for mitigation not supported by government budget shall not be allowed.

In the case of non-Annex I countries, both numerical targets for Group I and national reduction targets may become non-binding as a result of negotiations. Furthermore, policies and measures in developing countries shall not be limited to those with the primary objective of reducing greenhouse gas emissions but may be expanded to include a wider range of policies and measures that serve to reduce greenhouse gas emissions as co-benefits.

National reduction targets shall not be represented by national emission caps for a particular point in time but *total reductions projected for a certain period of time as a result of implementing policies and measures.* They are defined as such on the grounds that the inequities imposed by base year setting can be avoided[5] and that it would be close to impossible to guarantee compliance with a specific emissions cap at a certain point in time unless economic changes can be precisely forecasted. CO2 emissions are naturally susceptible to fluctuations in the economy-wide volume of activity in the short term in which technological structures do not change. By constituting targets with total reductions, a higher level of certainty in reduction efforts can be expected (Baumert and Goldberg, 2006).

Countries will be able to stay in compliance with binding pledges to national emissions reductions by purchasing emissions, but leaving room for such options could delay national efforts towards a low-carbon society.

[5] The issue of what year should be set as the base year was officially raised in the UNFCCC negotiation recently by the Government of Japan, which believes that setting 1990 as the base year works too much to the advantage of the EU because it obtained hot air due to the energy conversion from coal to natural gas that took place before the Kyoto Protocol with no relation to greenhouse gas mitigation efforts.

Therefore, it may be conceivable to incorporate limits on purchasable amounts, in which case, however, cost-effectiveness will be reduced.

The reasons for including policies and measures in negotiations are threefold: 1) to address the often noted disadvantage of sectoral approaches that they fail to provide clear explanations of what role governments will play in ensuring compliance with the multinational sectoral agreements, and hence the need for governments to identify and internationally pledge domestic measures; 2) to encourage broader participation by making it more widely known to the international community that developing countries are also engaged in global warming countermeasures as well as providing support for policies and measures to which developing countries are committed (Lewis and Diringer, 2007); 3) to develop a built-in compliance promoting mechanism and to promote the sharing of information on effective and efficient policies and measures and policy best practices by applying the regular UNFCCC review process for national policies to policies and measures concerned.

Envisaged participants of these negotiations include not all countries but only MEM-level countries, but if incentive measures for developing countries to be elaborated in Section 4 function as leverage for other countries to want to join, they can be welcomed as well. Countries that are not engaged in the policy template shall be treated as non-Annex I countries under the Kyoto Protocol.

Also, if a non-Annex I country decides to participate in the policy template, parameters including the period and extent of policies and measures may be differentiated from those for Annex I countries, based on the principle of "common but differentiated responsibilities and respective capabilities." Furthermore, if negotiations conclude that further differentiation between Annex I and non-Annex I countries is required, then sectoral targets / national reduction targets in Group I sectors exposed to international competition in developing countries may be determined to be non-binding (see BASIC 2006).

Table 1: Policy Template to be Negotiated

		Energy-intensive industries				Electricity		Road transport		Household / Commercial		Projected amount of GHG reductions
		Iron and steel		Cement								
		Target & projected reductions	Policies & measures	Target & projected reductions	Policies & measures	Target & projected reductions	Policies & measures	Target & projected reductions	Policies & measures	Target & projected reductions	Policies & measures	
Annex1	US	binding		binding		non-binding		non-binding		non-binding		binding
	Japan											
	EU											
	UK											
	Germany											
	France											
	...											
non-Annex1	China	binding or nonbinding		binding or nonbinding								binding or nonbinding
	Brazil											
	India											
	...											
	Reference value for reduction potential derived from Method 1 or 2											Projected amount of global reductions

3.2.1. Derivation of Reference Values for Reduction Target Negotiations

Reduction potentials calculated by international organizations and research institutions should be inserted in the final row of the policy template to provide an idea of the reference level of numerical targets to be sought in negotiations. Then, the sum of national reduction targets provided in the most right-hand column on the final row can be compared with the mid to long-term target that should be predetermined in prior negotiations and in case of shortages, the burden-sharing of the remaining reductions shall be further negotiated. If coupled with a Kyoto-type top-down approach from the beginning, repetitious negotiations may be avoided, but it must be noted that Kyoto-type negotiations always contain the risk of generating hot air as mentioned above.

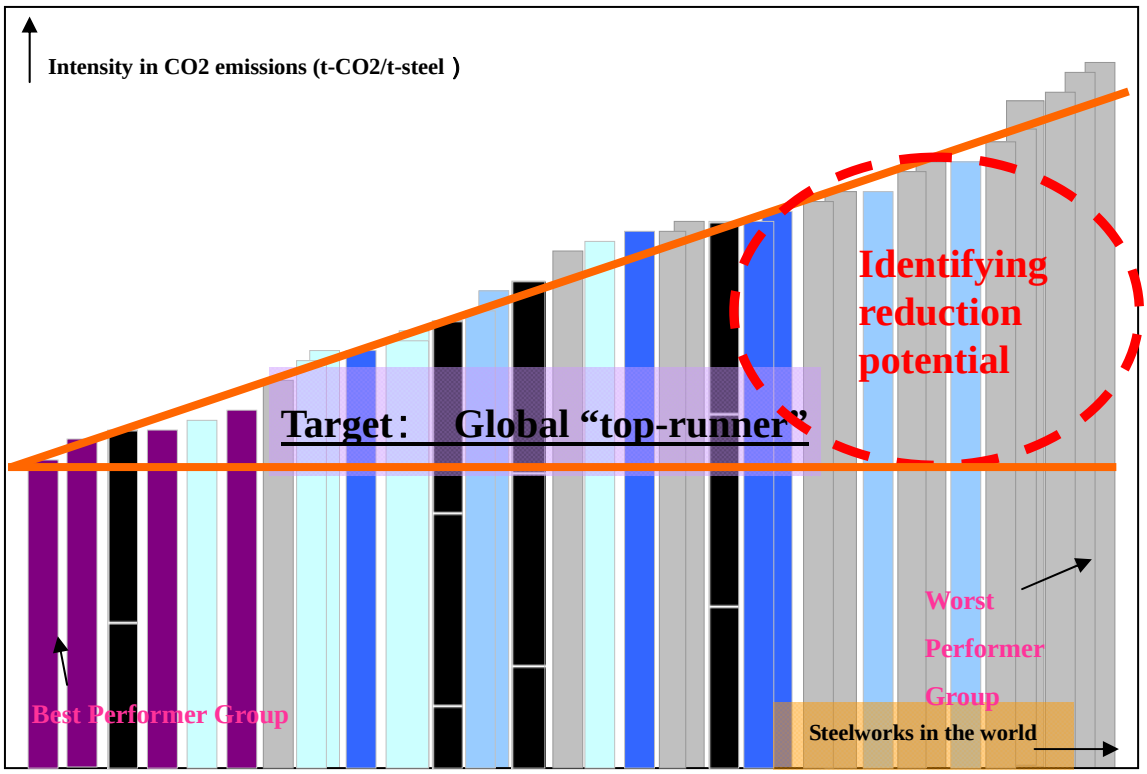
Reference numerical targets would generally be derived by using a bottom-up approach or by using model simulation. It would be preferred that parameters including economic growth rates, population growth rates, projected production for each sector, and other relevant parameters be common between the two methods.

Method 1 calculates projected reductions for each sector for the case that best available technologies (BAT) and best practices (BP) are deployed. Method 2 calculates projected sectoral reductions in each country using a technology-based economic model identifying the comparability of sectoral reduction efforts in each country with the equalization of marginal reduction costs based on the status quo of existing technologies and a road map of future technologies. Sectoral numerical targets will be negotiated with reference to the values derived using these two methods.

An example of reference values determined using Method 1 is provided in Figure 1 which represents the iron and steel industry (Okazaki, 2008). As top-runners change with technological shifts, reduction potentials and benchmarking will need to be periodically reviewed, at five-year intervals, for example.

Although Method 1 needs to be improved so that it incorporates other factors such as regional differences in the accessibility and use of energy sources and materials, raw data of CO2 or energy intensities of plants can be expected to serve as a tentative sketch of where the subsequent negotiation should be headed.

Figure 1: Method 1: Global Top-Runner



An example of Method 2 is shown in Table 2 which employs the research results of the Systems Analysis Group of the Research Institute of Innovative Technology for the Earth (RITE)[6].

This study has been based on the assumptions that marginal reduction costs will be homogenized among countries and sectors to generate estimations of reduction potential represented by levels of physical intensity levels achieved by the introduction of newest conceived technology, equipment and products. The timing of capital investment should be contemplated with considerations for vintage.

In this research method, it would be possible to present specific physical intensity values for each country and sector at any given year up to 2050, such as 2020 or 2030. Table 2 presents calculations for the US in 2020. The study divides the world into 53 countries and regions and data is compiled accordingly.

Each cell can quantitatively indicate what each country can do, to what extent, in which sectors, to introduce what kind of technology and equipment to meet the requirement of equalizing marginal reduction costs. In general terms, larger improvement rate values would be given for countries and sectors that are currently marked by low

[6] The model employed for the analysis has been based on outcomes of "Assessment of Mitigation Frameworks after 2013 (Beyond 2010)," commissioned by the New Energy and Industrial Technology Development Organization (NEDO)

energy efficiency and require only limited costs for improvements. Method 2 can provide important reference values not only for Group I negotiations but also for negotiations in other Sectors (see Appendix for the details).

Table 2 - Method 2: Equalizing Marginal Abatement Cost

Negotiated agreement item / technological and policy responses		**Improved physical intensity (energy)**	**Improved physical intensity (CO2))**	**Reduced carbon contribution due to fuel diversification**	**Energy efficiency improvements**	**Innovative technology development**	**Projected CO2 reductions [MtCO2/yr]**
Sector Group I							
Power generation	Energy savings		1.397		Increased high efficiency gas-fired power generation (high-temperature NGCC)	Increased high-efficiency coal-fired power generation(2278TWh/yr)	242.405
	Biomass						0.000
	Photovoltaic						0.000
	Wind						0.000
	Hydro & geothermal			Increased hydro & geothermal power generation (2000: 248→268TWh/yr)			1.544
	Nuclear			Increased nuclear power generation (2000 : 756, BaU : 433→756 TWh/yr)			380.498
	Hydrogen						0.000

	Conversion among fossil fuels			Increase gas-fired power generation (Share among fossil fuel-fired power generation: 2000 : 22%, BaU : 0%→3%)			28.201
	CCS						-14.629
Other energy conversion and errors							43.669
Sector Group II							
Aluminum		0.964			Increased deployment of Prebake method (BaU : 8→9kton/day)		0.281
Chemical	Ethylene-propylene	0.865			Increased deployment of current BAT(BaU : 0→48kton/day)		5.483
	Ammonia	1.010					
Pulp & paper	Chemical pulp	1.020		Reduced purchased power due to CHP (BaU : 115→64TWh/yr)			4.197
	Paper/ paperboard	0.931					
Cement		1.185			Increased large-scale SP/NSP		2.420

					(current BAT) technology (BaU : 10→97kton/day)		
Iron & steel	Blast furnace/ converter	0.981		Increased DRI production (Share BaU : 1.8→2.4%)			0.488
	Scrap-based electric furnace	0.996					
Other industries							8.047
Sector Group III							
Transportation	Light passenger cars	0.725		Increased share of bioethanol (Share among automobile fuel: 27%)	More hybrid cars		179.815
	Heavy passenger cars	0.585			More hybrid cars		
	Buses	0.884					
	Light-duty trucks	0.879					
	Heavy-duty trucks	0.907					
Transportation, other than automobiles							0.000
Household & commercial							32.561
CO2 emissions under BaU [MtCO2/yr]		**7680.5**			**Projected CO2 emissions under BaU [MtCO2/yr]**		**914.980**

3.2.3 Measures to Ensure Compliance

Measures to ensure compliance and those against non-compliance need to be considered in two dimensions, namely, failure to achieve numerical targets and omission of policies and measures.

As in the current Kyoto Protocol, the new Protocol should stipulate that if a party is in non-compliance with national emission targets, it must compensate for the overage of emissions through the purchase of credits from other countries within the adjustment period succeeding the Commitment Period. This provision shall not apply to a non-Annex I country in the case that the national emissions target for that non-Annex I country is determined to be non-binding. However, emissions exceeding the target may be discounted to provide incentives for the implementation of policies and measures in the event that sectoral policies and measures pledged in the policy template have been fully implemented, as judged from reports of the regular UNFCCC review process.

When a binding target is not achieved in Group I, emission permits must be purchased to cover for emissions in excess of the target whether or not the country is in compliance with its national reductions target. Therefore, if that country has also failed to achieve its national reductions target, it would have to purchase twice the emission permits equivalent to the emissions in non-compliance with the Group I binding target. If not economically rational,, this "double-binding" rule will ensure the implementation of the international agreement made in the politically sensitive Group I.

After an adjustment period for purchasing emission permits, countries still in non-compliance will be required to accomplish additional reductions of a certain penalty rate combined with its national reductions target for the following commitment period.

In order to address non-compliance in terms of policies and measures by an Annex I country, the new Protocol should provide that a panel be established under the UNFCCC so that legal procedures can be taken against the governments in question or incorporate the provisions on settlement of disputes given in Article 14 of the United Nations Framework Convention on Climate Change.

In the latter case, considering the global characteristic of climate change issues, conflicts are unlikely to be bilateral, and therefore, the following options can be conceived: 1) newly establish an "objection system" where any country that believes a country is in violation of the new Protocol can make a submission to a panel that shall be established under this Protocol; or 2) create a totally new "dispute settlement scheme" taking into account the global characteristic of the issue.

On the other hand, in the event that a non-Annex country is in non-compliance, it should be exposed not to such penalty-oriented procedures but to compliance-encouraging procedures newly developed so that maximum contributions can be derived from non-Annex I countries based on assistance from developed countries in capacity-building and the provision of best practice information.

3.2.4. How to Proceed with Sectoral Negotiations

Group I

As described above, extensive data regarding Group I have begun to be compiled in many institutions and benchmarking methods have also come to be standardized. Thus, it is relatively easy for this sector to enter into negotiations. Data collection issues have often been raised as a shortcoming of sectoral approaches but the agreement reached at the Leaders Meeting of MEM held in Toyako in July to exchange mitigation information and analysis on sectoral efficiency has paved the way for addressing data collection issues. In the industrial and power generation sectors, the APP is engaged in identifying high energy efficiency technologies, examining technology diffusion rates and calculating potential[7]. In the iron and steel, cement and aluminium sectors, international industrial groups have been working with data on energy efficiency indicators and best available technology (BAT) and best practices (BP). The WBCSD has launched a standardized GHG Protocol. The IEA has estimated sectoral reduction potentials for the iron and steel, cement, power generation and petrochemical / chemical industries.

Negotiations can indeed be promptly initiated in Group I by employing all of the findings available. Given the increased availability of well-developed data for developing countries - mainly emerging countries - to date, measurement and reporting systems for sectoral emissions should be enhanced in these countries as well based on sectoral analyses performed by institutions including the IEA and assistance from developed countries in capacity building.

Accumulated data and methodologies will serve as a basis in the next step of internationally standardizing boundary setting methodologies, emissions calculation methodologies and performance indicators. Cooperation from institutions establishing international standards, such as the ISO, IEC and IEEE, will become essential. If they can

[7] The APP Steel Task Force has agreed on the standardization of calculation methods and is promoting the identification of efficient energy-saving technologies and the examination of diffusion rates in each country; the Cement Task Force is involved in similar efforts. The Power Generation and Transmission Task Force is developing a handbook on coal-fired power plant operations and maintenance / management and is also engaged in calculating reduction potentials.

assume the role of certifying sectoral agreements based on sectoral approaches to the UNFCCC then the complex technical issues of sectoral approaches negotiations can be significantly mitigated.

Group I negotiations on numerical targets would be debated between intensity targets, namely energy intensity or CO2 emission intensity targets, or absolute reduction volumes. The difference between these two indicators is a matter of form of commitment and thus discussions over which is the more stringent in general terms are irrelevant. It is up to the member companies of the negotiating sector to decide which form to adopt depending on what level of uncertainties regarding future production is acceptable. In times of stagnant economic activity, intensity-based regulations could be more environmentally effective (Ellerman and Wing 2003; Kolstad, 2005; Herzog et al., 2006; see also Jotzo). Also, depending on industrial circumstances, the minimum efficiency of equipment to be installed after a given year, the ratio of existing facilities that have to install state-of-the-art technologies and equipment for efficiency improvements, and the energy efficiency of products and product standards may also be negotiated as targets. However, total emissions reductions must be calculated and provided in the policy template, regardless of whichever type of target is adopted.

In the event that international consensus is reached on the abovementioned numerical targets in a certain industrial sector, domestic measures implemented by each government in order to ensure compliance by the relevant industrial sectors will constitute Group I policies and measures. In EU countries, an option for such policies and measures could be an allowance allocation mechanism using domestic emissions trading schemes for EU countries whereas in Japan and China, options could include establishing technology standards to incorporate into laws to promote energy conservation and formal agreements with domestic industries. The internationally shared understanding that policies and measures can be diversified according to national circumstances should be maintained for some time, but there are also expectations towards accelerated efforts towards an internationally coordinated or harmonized framework, such as international linkages among emissions trading schemes.

Group II

The most effective global warming countermeasure against power generated in Group II would be to shift the power mix to low-carbon resources, but given the disparities in domestic resource availability, energy security policies and equipment vintage,

negotiations would have to reflect national circumstances. As many countries have recently adopted targets for renewables deployment in their policies and measures, such targets could be included in numerical targets.

However, in Group II, compared with Group I, it is much more difficult to designate CO2 intensities as targets because they affect the power mix as a whole.. Nevertheless, the power sector accounts for 41% of total energy-derived CO2 in 2005, and therefore efficiency improvements in the power sector, especially improvements in thermal power plants that combust fossil fuels, have significant meaning in global warming countermeasures. It is projected that the reduction potential of efficiency improvements in coal-fired power plants alone is 1.4Gt-CO2 to 2.0Gt-CO2 (IEA, 2008a). Thus, the most appropriate commitment to numerical targets would be to increase the average efficiency level of coal-fired power plants which ranged from 33% in China to 42% in Japan in 2005 (IEA, 2008b) up to the highest viable level.

Since transferring technology and know-how from private companies in developed countries, extending information on best practices and providing on-site diagnosis and guidance would play a major role, financial support for such activities by private companies should be a major option for government policies and measures.

Emissions from the road transport sector include those from automobile manufacturers, automobile users, fuel producers and government, and thus reductions must also engage each actor to fulfill their separate roles.

Emissions from the road transport sector can be determined in the following equation:

CO2Emissions =Emissions Intensity × Activity Volume

=On-road Fuel Efficiency × CO2 Emissions Coefficient × Total Distance Traveled

=Certified Fuel Efficiency (km/ℓ)-1 × Traveling Coefficient × CO2 Emissions Coefficient (gCO2/ℓ) × Total Distance Traveled (vehicle-km)

Certified fuel efficiency (km/ℓ) -1 represents the value that should be achieved by automobile manufacturers; the Traveling Coefficient, the value to be achieved in government measures to relieve traffic jams and user efforts towards eco-friendly driving; the CO2 Emissions Coefficient (gCO2/ℓ), the value to be achieved by fuel producers and automobile manufacturers through government regulations; Total Distance Traveled (vehicle-km), the target to be achieved through a modal shift by the government or the users' choice of transportation means.

Of these values, benchmarks and technologies are identifiable for Certified Fuel Efficiency (km/ℓ)-1 and the CO2 Emissions Coefficient (gCO2/ℓ) and thus can serve as

numerical targets in a policy template. Other indicators can constitute targets for policies and measures if reductions can be quantified. Thus, in order for sectoral approaches to function in Group II, data collection and a standardized accounting methodology would be essential (JAMA, 2008).

Group III

Group III is closely related with lifestyles and working styles, and basically with the level of development in domestic service industries. Therefore, it is questionable to what extent government policies and measures that may restrain individual freedom of choice can be justified in this Group. On the other hand, efficiency indicators of household appliances in domestic markets and policies and measures on construction standards for houses and buildings can serve as numerical targets in Group III. In Japan, these two sectors are bound by mandatory energy efficiency regulations under the Law Concerning the Rationalization of Energy Use (Energy Saving Law). In developing countries as well, policies and measures such as tariff reductions and regulations regarding usage, implemented to promote the diffusion of highest efficiency household appliances in domestic markets, can be considered as policies and measures to be pledged in a policy template.

4. Incentives to Encourage Developing Country Involvement and Measures to Ensure Cost Effectiveness

4.1. Sectoral Crediting Mechanism

In order to involve developing countries in sectoral approaches, they must be presented financial or technological incentives that are more attractive than those related to conventional project-based CDM. Without such incentives, developing countries are more likely to devote their negotiation resources to the maintenance of the Kyoto Protocol, and thus they will not be economically motivated to take part in sectoral approaches to begin with. A diversity of options can be conceived as incentive measures to promote developing country involvement in the sectoral agreements proposed herein; options may be varied among Groups I to III.

If a numerical target agreed upon in an industrial sector belonging to Group I is represented by an intensity indicator, credits can be granted for efforts to deviate from the baseline emission intensity projected for the relevant industry in a developing country. The

advantage of this method is that wider coverage is possible compared to project-based CDM. A major example of this mechanism involves pledging a voluntary "no lose" target of GHG intensity, the reductions exceeding which will be recognized as credits (Schmidt and Helme, 2005; Schmidt et al., 2006). However, in this case the following challenges must be resolved upon implementation (Ellis and Baron, 2005; Baron and Ellis, 2006):

1) How can developing countries be kept from being motivated to deliberately set moderate baseline intensity indicators or no-lose targets? Pledged targets would have to undergo expert third party assessment, the quality of which could risk being undermined by the constraints in data collection in developing countries. CDM/EB or ISO could assume the role of the third party. Baseline setting methods need to be consistent with those under conventional CDM in terms of environmental effectiveness.

2) Should the mechanism address the retrofitting of existing equipment, or should it be limited to the installation of new equipment or should it include both? If existing equipment are included, the administration costs for institutional operations will be enlarged.

3) When the credits generated are issued to governments instead of individual companies, which is the assumed case, there is the question of whether domestic incentives are designed to appropriately reflect the efforts of companies belonging to the relevant sectors of that country. For example, if a portion of revenues is granted to inefficient companies as subsidies for the sake of protecting domestic industries, it would be the equivalent of penalizing companies that have put in much effort in improving their performance by putting them at a disadvantage in terms of competitiveness and competitive circumstances would be distorted from the developed countries viewpoint as well. In that case, the original objective for adopting sectoral approaches would be undermined.

Would developing countries tolerate restricting conditions on the use of credit-based revenue? If negotiations conclude that numerical targets should be binding for developing countries as well and companies in developing countries directly participate in international emissions trading, such problems will be eliminated.

Another proposal, the Dual Intensity Targets Mechanism (Samaniego and Figures, 2002) is centered on national emission intensities and gives each country dual intensity targets, namely a "compliance target," a target if not achieved will constitute grounds for non-compliance, and a "selling target," a target if successfully exceeded, the difference with which can be sold as credits. The adoption of this approach in sectoral agreements in Group I is worth consideration.

Furthermore, if the established numerical target is not represented by emission intensity but by a minimum efficiency requirement for newly installed equipment, then incentive measures could include funds from international financial institutions or preferential treatment in trade insurances and export credits to be granted in the event that new equipment surpasses such minimum efficiency requirements. Also, if products manufactured at plants meeting minimum efficiency standards could be labeled internationally, trade expansion measures could also be considered as incentives that will both climate change countermeasures and economic expansion.

It should be noted however, that compliance with policies and measures in Group I, unlike those in Groups II and III, will not be given any incentives as long as credits under the abovementioned sectoral crediting mechanism are issued to developing countries.

In Group II as well, credits could be issued based on the sectoral crediting mechanism in the entire power sector for emissions reductions generated by capital investment in thermal power plants that better a minimum efficiency requirement. In addition, given that the performance diagnosis of operations and maintenance in thermal power plants were the most appreciated projects of all APP activities in developing countries, support from developed country governments to continue such projects could constitute incentives for developing countries to participate in the sense that practical opportunities for technology acquirement will be increased and energy security can be improved.

Also, in road transport, automobiles with cleaner technology can be widely deployed through the implementation of fuel efficiency regulations in the domestic markets of developing countries. The wider recognition of demand side management (DSM)-type CDM could help accelerate such trends; DSM-type CDMs attach incentives such as cash-back incentives (partial refunds of sales price) to energy efficient products to additionally deploy them in comparison with "BAU sales", reduce power (energy) consumption and acquire CERs. This can be applied to household appliances in Group III as well[8].

[8] This method was put into practice in a project to promote the replacement of incandescent lamps with compact fluorescent lamps (CFL) with Japan's cooperation in China's Shijiazhuang City in Heibei Province in 2005. Based on the outcomes of this project a new methodology (NM0157; Open-DSM type CDM for Green Lighting in Shijiazhuang City, China and NM0157-rev) was proposed to the CDM Executive Board which gave it a "B" recommendation in February 2007 and thus requiring it to be reconsidered for final approval.

More general incentives for Groups II and III include those employing programmatic CDM under the current Kyoto Protocol. In CDM/EB32 Annex 38, it provides that, "A programme of activities (PoA) is a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes) which leads to anthropogenic GHG emission reductions or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of" CDM programme activities. Programattic CDM will be a promising method that mitigates the approval procedure or requirements for developing countries participating in a policy template.

Also, the definition for programmatic CDMs can be further relaxed to cover also general Sustainable Development Policies and Measures (SD-PAM) to invite the wider participation of developing countries. However, in that case, it must be determined what kind of SD-PAMs should be included in a policy template. Decisions on the inclusion of policies and measures related to Groups II and III such as traffic measures, energy policies, industry policies and urban policies could pose problems. A government's fiscal or regulatory actions including mandates, standards,or sectoral reforms, or those with any other formal status that can be numerically represented and generate reductions, direct, or indirect, could generally be included whether or not their primary objective is emissions mitigation. Definitions and boundaries of SD-PAM are already discussed in several studies. (Heller and Shukra, 2002, Bradley and Baumert, 2005, Ellis et al, 2007.)

4.2. Trade and Investment Related Measures

One of the objectives of sectoral approaches is to mitigate international competitiveness issues. Therefore, it is only natural that the introduction of trade measures as incentives for compliance of agreements based on sectoral negotiations or as penalties against non-compliance be a subject of debate. Such measures have been explicitly included in bills, such as the Lieberman – Warner bill for a US domestic emissions trading system and the EU-ETS reform plan under discussion.

The relationship between WTO and multinational environmental agreements (MEA) embraces many issues yet to be debated (Cosbey and Tarasofsky, 2007). Acknowledging that talks must be furthered among WTO and global warming negotiators, the following incentive systems can be contrived in support of sectoral approaches:

i. Introduce trade restriction measures against imports from non-parties to sectoral agreements
ii. Incorporate better treatment for imports from parties to sectoral agreements

iii. Raise tariffs or collect credits from importers for imported goods and services from relevant sectors of parties in non-compliance
iv. Reduce tariffs or issue credits to importers for imported goods and services from relevant sectors of compliant parties.
v. Impose a process tax, a tax against underperforming manufacturing processes failing to meet agreed benchmarks, as border tax adjustment
vi. In the automobile and household appliance sectors, impose import restrictions and unfavorable treatment in government procurement upon products not reaching labeling and technology standards agreed upon in sectoral negotiations

Furthermore, industries and institutional investors could introduce common codes of conduct such as those for green procurement to address transactions with companies belonging to sectors in countries, not limited to developing countries, in non-compliance with numerical targets or not implementing agreed policies and measures.

4.3. Measures to Ensure Cost Effectiveness

The issue of cost-effectiveness, often noted as a weak point of sectoral approaches, can be resolved to a certain point by establishing an intensity-based market for emissions trading. Because this proposal has been based on the assumption that governments will legally ensure compliance with sectoral agreements at least in Annex I countries, cross-border emissions trading markets could be easily established within a single industrial sector where common measurement, reporting and verification methods have been stipulated and shared in the sectoral agreement (Philbert, 2006). In order to take full advantage of emissions trading, linkages with cross-sectoral transactions, different emissions trading markets, such as absolute reductions-based emissions trading markets, the crediting mechanism under the Kyoto Protocol, and the crediting mechanism herein proposed must be envisaged. Although domestic emissions trading markets may or may not be arranged in countries other than the EU, it would be necessary to conceive the establishment of an international emissions trading market, in order to achieve sectoral agreements with minimal costs.

The general idea here is to establish both an absolute reductions-based market and an intensity-based market, setting a gateway between the two markets to restrict the net flow of allowances from the latter into the former. The net flow of allowances must be avoided because if it is allowed, participants of intensity-based emissions trading market will acquire more allowances, thus increasing production in excess and undermining

economic efficiency (Gildas de Muizon and Matthieu Glachant, 2004).

5. Conclusion

-Challenges for the Policy-Based Sectoral Approach as an Option for a Post-Kyoto Framework-

The sections above have demonstrated that a post-Kyoto framework based on sectoral approaches can be designed to equitably allocate reduction efforts among developed countries, and at the same time engage developing countries. However, in order to actually implement this idea, the following challenges must be overcome in addition to the issues presented in Section 2.

1) Political challenges: As can be guessed from the policy template, negotiations for a post-Kyoto framework based on sectoral approaches involve substantially complex procedures, including setting the forum for negotiations and incorporating UNFCCC negotiations, compared to Kyoto-type negotiations which substantively address only reduction targets for developed countries. By including policies and measures in negotiations, there would be higher chances of real GHG reductions compared to the compliance scheme under the Kyoto Protocol which ensures compliance with legal commitments by simply purchasing allowances instead of physically reducing emissions. However, the US, in particular, could be disinclined to accept a framework in which options for domestic measures could also constitute binding international commitments unlike the Kyoto Protocol which left domestic measures to be decided by each government. Such resistance would be aggrandized in request and offer-type negotiations; thus, governments might have to be given the freedom to select which policies and measures they will pledge, if the resistance towards the framework is to be lowered.

2) Economic challenges: The proposed idea has facilitated participation for each country by installing national targets of total emissions reduction quantity instead of emissions caps at a certain point in time, commitments which risk non-fulfillment depending on uncertainties in economic growth. However, the idea may be an insufficient answer to initial allocation issues regarding the volume of emissions reductions to be assigned to each country.

Sectoral approaches are methods to determine national reductions using a bottom-up approach and thus can better reflect national circumstances than top-down methods to determine mid and long-term targets, the burden-sharing of which is decided in a diplomatic game among countries. However, efforts to distribute emissions based on an equitability principle of equalizing marginal abatement costs could be undermined by the uncertainties of parameters required for the calculation of those costs. Even

estimations of national marginal abatement costs provided by research institutions including the IPCC are varied. Therefore, top-down negotiations may be called for at the final stage, after reduction potentials have been revealed by sectoral approaches for each country and each sector

Also, if sectoral crediting is to be incorporated as an incentive measure to involve developing countries, then the issue of determining the volume of credits to be issued and the coverage of polices and measures to be eligible for credits is inextricably linked to the issue of deciding on an acceptable volume of total reductions among developed countries constituting the demand side of credits. An issue that further complicates matters is how much market access should be recognized for the credits issued. If credits become widely distributed, marginal costs of emissions reduction can be fully equalized, thus achieving maximum effects from emissions trading schemes. However, allowance prices would risk decline, provoking negative reaction from interested parties regarding emissions trading markets as promising financial markets with optimal business opportunities and companies holding allowances as assets.

3) Technological challenges: One of the main objectives of sectoral approaches is to increase developing country involvement through promoting technology transfer. However, it is extremely difficult to mandate technology transfer to private companies. Therefore, technology transfer based on sectoral agreements must be accompanied by incentive measures that will drive companies to transfer technology. These incentive measures should be included in the policies and measures identified in policy templates, but political concerns towards technology leakage to their future or present rivals in developing countries may be expressed within developed countries where state-of-the-art technologies could be an important element of their competitiveness. In addition, if bilateral measures providing fiscal/financial support to developing countries are implemented as untied loans, in which case there is a higher risk that a country providing financial aid to a developing country will lose a project funded with that aid to a company in another country, then financial leakage could also pose political problems. Furthermore, from intellectual property perspectives, industries in developed countries may apply pressure upon their governments to formulate sectoral agreements which limit the scale and/or range of technologies transfer. Yielding to such pressures will jeopardize the involvement of developing countries. There is a need to consider the expansion of export insurance system coverage to infringements of intellectual property rights in preparation of such obstacles.

Solutions for the abovementioned issues have yet to be studied in more depth, but giving up sectoral approaches on these grounds would be equal to dismissing an option

that can address issues such as the equitable allocation of reduction efforts and developing country involvement that have been intractable under the Kyoto Protocol. Today, negotiators representing each country and academic communities are being tested their imagination.

Appendix

Assumptions for RITE model (Technological specifications and economic factors)

A: Assumptions

<table>
<tr><td rowspan="3">Assumptions for fossil fuel prices</td><td colspan="5">2000 FOB prices adjusted to equal following values:</td></tr>
<tr><td colspan="2">Coal ; 57.5$/toe</td><td colspan="2">Petroleum ; 31$/bbl(199$/toe)</td><td>Natural Gas ; 110$/toe</td></tr>
<tr><td colspan="5">Fossil fuel prices for 2000 and beyond estimated so that production costs will increment depending on accumulated production.</td></tr>
<tr><td rowspan="8">Technological assumptions</td><td rowspan="8">Innovative technological development</td><td rowspan="8">Power Generation</td><td>Coal-fired power generation</td><td colspan="2">High efficiency generation with IGCC/IGFC assumed
Equipment costs : 1,050$/kW
Generation efficiency : 42-55%</td></tr>
<tr><td rowspan="2">CCS</td><td colspan="2">Equipment costs and required power volumes assumed for post-combustion CO2 capture from coal-fired, natural gas-fired and biomass power generation.</td></tr>
<tr><td colspan="2">Equipment costs and required power volumes assumed for IGCC/IGFC with pre-combustion CO2 capture and oxygen combustion generation employing natural gas.</td></tr>
<tr><td rowspan="2">Nuclear power generation</td><td colspan="2">Advanced nuclear power generation technologies available beyond 2030 assumed.
Equipment costs: 1,200$/kW
Equipment lifetime: 40 years
Utilized capacity: 85%</td></tr>
<tr><td colspan="2">30% increase of total power demand projected to be possible in 30 years. Also, no more than 50% of grid power can be supplied from this source (not applicable to regions where share already exceeds 50%).</td></tr>
<tr><td rowspan="3">Innovative PV technologies</td><td rowspan="2">PV power generation</td><td>209-720$/MWh(2000)</td></tr>
<tr><td>37-128$/MWh(2050)</td></tr>
<tr><td>Storage system</td><td>375$/MWh(2000 年)</td></tr>
</table>

					7.6$/MWh(2050 年)
				No more than 15% of grid power can be supplied. With a storage system an additional 15% may be supplied.	
		Transportation	Fuel cell cars, plug in hybrid electric cars	Vehicle prices and energy efficiency assumed by car type.	
				Equipment costs for hydrogen supply infrastructure assumed.	
		Industry (Iron & Steel)	Blast furnace / converter process	Equipment costs and energy efficiency for next-generation coke oven and hydrogen reduction in steel, etc.	
			Direct reduction process	Equipment costs and energy efficiency assumed for direct reduction process with hydrogen gas.	
	Energy efficiency improvements	Power Generation	Coal-fired power generation	Supercritical technologies currently mainly used in developed countries (also projecting future shift to combined generation) assumed to be available as medium efficiency technology. Generating efficiency:36-43.5 [%LHV]	
			Natural gas-fired power generation	State-of-the-art high-temperature NGCC (future use of FC also projected) assumed to be available as high efficiency technology. Generating efficiency: 52-62 [%LHV]	
		Industry	Iron & steel	Improvements in energy efficiency through upgrading and dissemination of CDQ, TRT and byproduct gases in blast furnace / converter method.	
			Other	High energy efficiency technology options are assumed to be available also for cement, pulp & paper, chemical, aluminum	

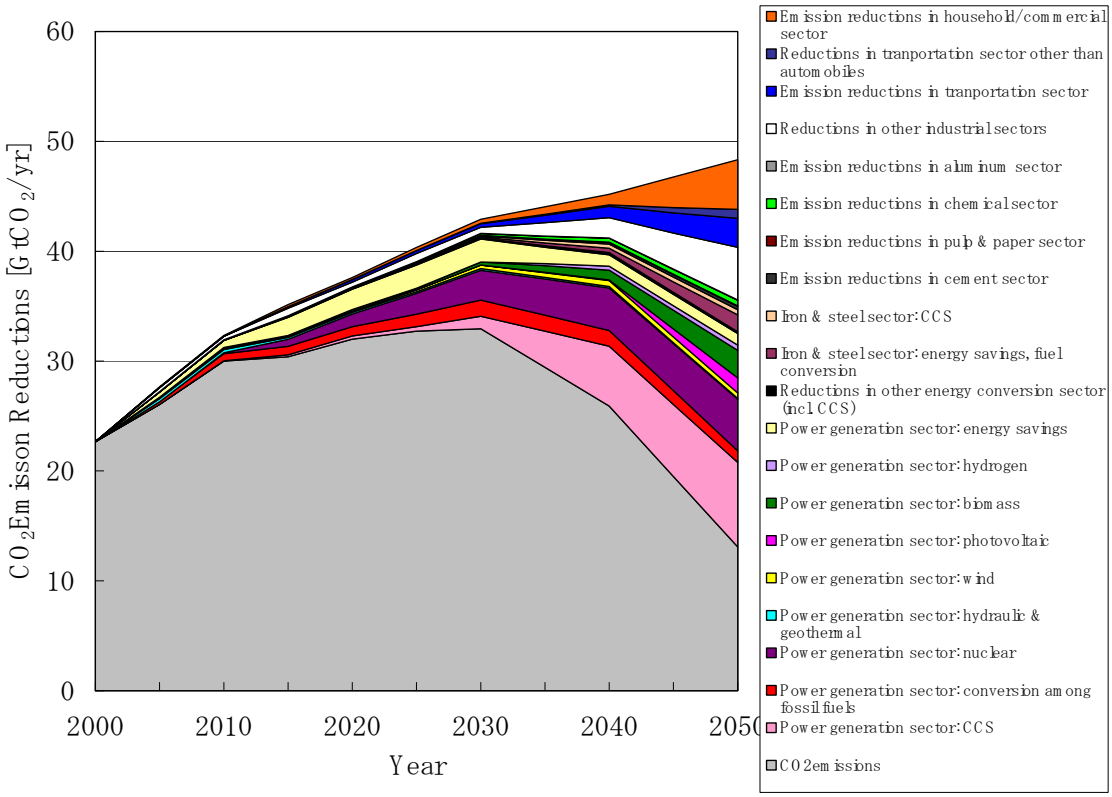
		Transportation	Vehicle efficiency	Improved efficiency in conventional internal combustion engine cars hybrid cars
	Fuel conversion	Power generation	Nuclear (conventional), hydro and geothermal, wind, biomass and hydrogen power generation are assumed.	
		Industry	Replacement of crude steel production using the blast furnace/converter process with electric furnace or direct reduction processes (natural gas)	
		Transport-tation	Utilization of alternative fuels (bio-ethanol, biodiesel)	
Other assumptions	Policies related to major CO2 emission reduction measures currently implemented			
	2008－2012 Kyoto Protocol (Emissions trading, inclusive of former USSR and Eastern Europe, is possible)			
	～2010 US: per unit GDP CO2 emissions reduction target (annual reduction rate 2%)			

B: Projected Scenario for Halving Emissions

In 2050, emissions are to be reduced to 13.1 GtCO2, or half of global emissions in 2005, which marked 26.2 GtCO2 (exclusive of bunker oil and other sources that are not included in national allocations), according to 2007 IEA statistics (refer to Graph 1).

- Setting emission levels to bring peak-out of emissions in 2030 (32.9 GtCO2); 13.1 GtCO2 in 2050.
- Equalization of marginal reduction costs assumed. 2020:5$/tCO2; 2030:7$/tCO2; 2050:334$/tCO2
- Baseline (global) emissions for 2020, 2030, 2050 are as follows:
  - 2020 : 37.6Gt
  - 2030 : 42.9Gt
  - 2050 : 48.3Gt

Graph 1: Trends in emission reduction by sector/technology (～2050)



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