FINANCING MECHANISM FOR LOW CARBON TECHNOLOGIES

How To Induce New Technologies Diffusion In Developing And Transition Countries

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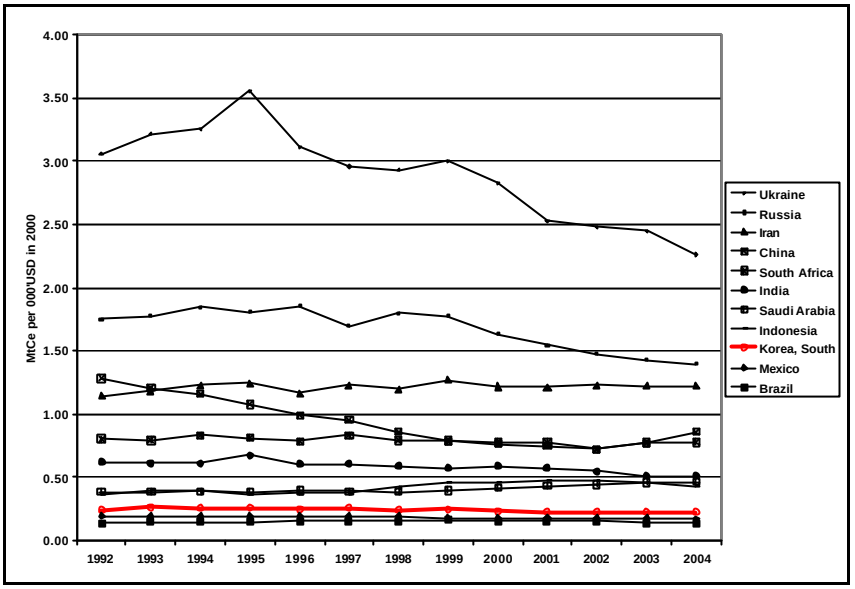
1. Introduction

The paper explores economic and institutional mechanisms for environmental finance with particular focus on mobilization of various financing sources available in developing countries including domestic investment, FDI, multilateral financial institutions and development agencies to support adoption and diffusion of environmental friendly technologies (EFT) with particular focus on energy efficient (EET) and low carbon technologies (LCT). A general framework for technology transfer mechanisms were presented in Metz et al, 2000. The report presented comprehensive description of various instruments and barriers for technology transfer, but under explored incentives associated with monetization of carbon benefits. For the next decade introduction of EET and LCT will generate local and global benefits and therefore will facilitate more environmentally friendly development. Special attention will be paid to Kyoto flexible mechanisms and financial institutions aimed to monetarize benefits from carbon emission reduction.

Empirical analysis of carbon emission dynamics in developing and transition countries demonstrated a positive correlation between cumulative FDI and improvements of energy efficiency. Integration of developing countries into the world economy brings new opportunities for adoption of energy efficient and low carbon technologies.

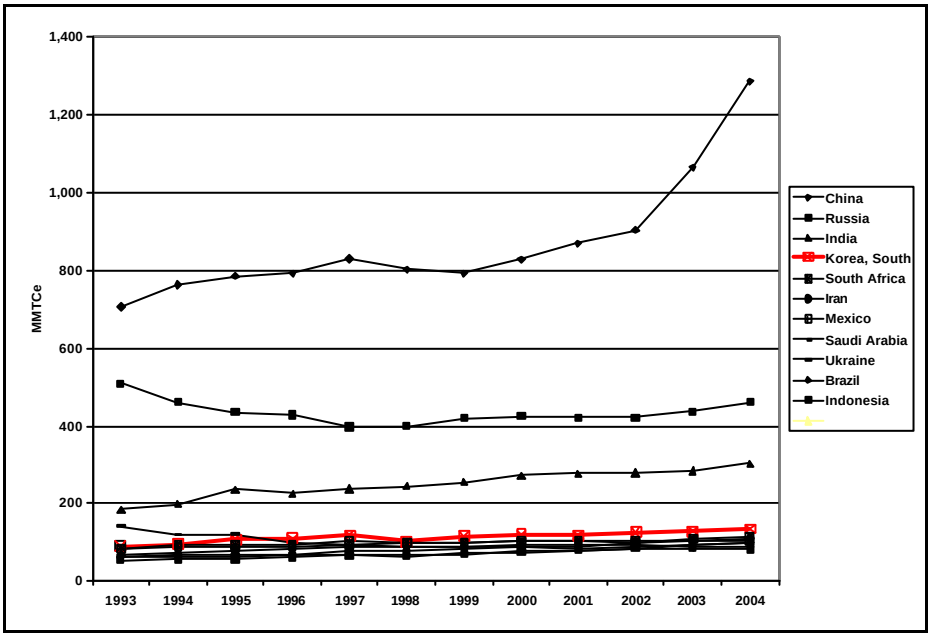
Regardless of significant improvements of GDP carbon intensity in developing countries in average over the last 12 years (see Figure 1) in absolute indicators, their carbon emissions continue to rise (see Figure 2). Moreover, despite these significant improvements, the gap in carbon intensity of GDP between developed and developing world remains significant (see Figure 3). Also, during last three years carbon intensity of the Chinese economy rose. A similar tendency was observed in some other developing countries. This occurred despite continuous GDP growth and could not be explained in the same way as intensity increases in transition economies during economic crisis.

Figure 1. Dynamics of Carbon Intensity for 12 Top Emitting Developing and Transition Countries



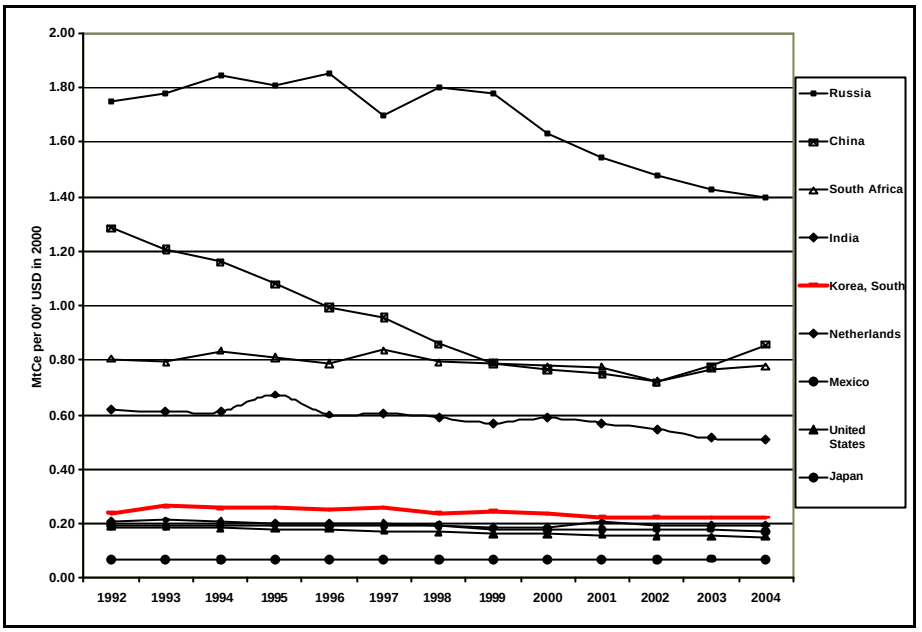
Source: www.eia.doe.gov

Figure 2. CO2 Emission Dynamics for Selected Countries



Source: www.eia.doe.gov

Figure 3. Carbon Intensity Of GDP For Selected Countries



Source: www.eia.doe.gov

The differences in carbon intensity of GDP illustrate significant potential for further improvements in the developing world based on low carbon technologies diffusion. At the same time we do not anticipate either absolute, or b-convergence[1]. Besides some convergence may take place as the element of transition and integration into the world economy.

Therefore, to some extent, technology transfer could be result of exogenous processes, i.e. some technological innovation may come along with economic development. However, the modern literature on technological innovation and climate change (Edenhofer et al, 2006; Goulder, 2004; Gruebler et al, 2002) emphasizes the importance of induced technological progress. In other words, exogenous technological innovations that come along with development are not sufficient to avert dangerous tendencies in carbon emission dynamics, especially in the developing world. Induced technological progress is the only way to break links between GDP growth and carbon emission. This paper will examine various instruments to induce technological progress in climate area

[1] For definition see for example Barro & Sala-i-Martin, 2004, p.14.

with particular focus on diffusion of new technologies from the developed to developing world. It is plausible to assume that knowledge accumulation and R&D investment would lead to technological innovation in most developed countries first, and then will be transferred to the developing world. This is a most common assumption in the literature, see, for example, Gruebler et al, 2002; Edenhofer et al, 2006). Strengthening European carbon regulation is shifting the most developed European countries toward the position of technological leader on climate mitigation technologies. For instance, the Netherlands have technological leadership in some renewable and alternative energy (SenterNovem). These technologies could be successfully disseminated in the developing world. However, there are important barriers for new technology diffusion. Some of them, most relevant to the issue of technology transfer, are discussed in this paper.

There are two critical issues. First, what incentives the host country has to adopt new technologies, preferring them over "traditional" way of development. For example, if China or Russia that have an abundant coal resources, would promote renewable and alternative energy. Second, if inventors should transfer new technologies to developing world.

Incentives in the developing countries, on one hand, are limited by emerging domestic environmental and energy policies and general market reforms. On another hand, incentives could be extended by application of Kyoto flexible mechanisms and development aid. The last one is a sensitive issue, as there are several competing priorities for development aid. Nevertheless, we believe that development aid may be done in a more environmentally friendly way.

Domestic incentives to reduce energy consumption and to switch to low carbon technologies, to some extend exist in developing and transition countries. However, these incentives are not sufficient. Increasing energy prices are strengthening these incentives, but negative price elasticity of demand is compensated by positive income elasticity. For example, recovery growth in Russia from 1999 to 2006 demonstrated that energy demand was growing despite significant price increase of energy resources. Poland demonstrated

a different example, where market reforms led not only to relative, but also to absolute reduction in energy consumption. China's situation is close to the one in Russia. So even successful market reforms do not guarantee the most energy efficient pathway. As we show in the paper, domestic investment in developing countries with high carbon emission play the leading role in capital formation. Foreign direct investment could be a conductor for new technobgies, but their share in capital formation is relatively modest. Finally, CDM, JI and emission trading could be potentially important sources to induce innovations. However, this potential has not yet been used.

In the next section we examine various source of investment that could be potentially available to support carbon emission reduction activity in developing and transition countries. Section 3 deals with domestic environmental policy that could influence technological choice and investment profile. In section 4 we discuss emerging future global climate finance, and in the last section we focus on financial and economic incentives for new energy efficiency and low carbon technologies on the project level.

2. Review of available sources of environmental finance

a. Domestic investments

For leading GHG emitters domestic investment plays a leading role in capital formation. According to Table 1 foreign direct investments are accountable for 1-3 percent of gross capital formation. Furthermore, in countries like China, Mexico, and South Korea international aid is 10 times smaller than foreign direct investment.

Table 1. Macroeconomic Characteristics of the Selected Developing and Transition countries, 2004

	GDP (current million US$)	Gross capital formation (current million US$)	Gross capital formation (% GDP)	Foreign direct investment, net inflows (% gross capital formation)	Aid (% of gross capital formation)	Estimated Annual ET/CDM Investment (% gross capital formation)	Annual CO2 emissions Mte
China	1,931,714	747,032	38.7%	2.8%	0.22%	0.05%	4,707
Mexico	683,486	150,979	22.1%	2.5%	0.08%	0.03%	385
South Korea	679,674	205,388	30.2%	1.2%	-0.03%	0.05%	497
Brazil	603,973	128,686	21.3%	3.0%	0.22%	0.12%	337
India* 2003	600,658	163,673	27.2%	0.8%	0.56%	0.07%	1,113
Russia	590,364	122,614	20.8%	2.1%	1.07%	4.08%	1,685
Indonesia	287,217	67,289	23.4%	0.4%	0.14%	0.01%	308
Saudi Arabia	250,339	47,435	18.9%	-0.1%	0.01%	0.00%	365
South Africa	214,663	37,582	17.5%	0.3%	1.64%	0.00%	430
Iran	163,446	60,815	37.2%	0.3%	0.31%	0.00%	402
Ukraine	64,883	15,872	24.5%	2.6%	2.90%	7.56%	364

Source: WDI 2006; www.cdm.unfccc.int; www.eia.doe.gov.

Taking as example the emerging economy like China, (see Table 1) responsible for large share of carbon emission (about 15 % of world CO2 emission and slightly above quota of CO2 emissions from developing and transition countries) we conclude that domestic investments potential is significantly larger than other sources to support innovations. Gross capital formation in China is equal to about 40 percent of GDP. Domestic investment that leads to capital formation is governed by domestic policy that has no climate imperatives incorporated yet. Therefore incentives to deploy EET, LCT and alternative energy are weak.

The key issue is internalization or monetarization of the benefits generated by adoption and diffusion of new technologies. One important instrument is domestic environmental policy. China, for example, confronts severe air pollution in urban areas introduced emission cap for SO2 emission (Yang & Schreifels, 2005). Under some circumstances such a policy may lead to carbon emission reduction as well. For instance, for Russia, there was an analysis that suggests "fungibility" between local and global environmental policy, ie. the policy that targets local pollution will produce ancillary CO2 reduction

and, vise versa, robust climate policy will improve local environmental quality (Gurvich et al, 1997; Dudek et al, 2003). Such cohering outcomes could be observed in the limited time horizon. At some point local and global environmental policy may deviate from each other, especially after a country completes transition and would follow a quasi optimal trajectory. Likewise energy efficient technologies are not equal to low carbon technologies. New efficient coal burning power plants will not solve the problem of carbon emission. Therefore there is a permanent and increasingly important call for climate policy especially for one that targets GHG reductions.

At the moment the way of Kyoto mechanisms implementation is far below expectations. Mechanisms like CDM suppose to internalize "carbon benefits" that would be complementary to conventional benefits like fuel saving etc. However, it is hard to believe that CDM would make a difference in countries-wide energy policy. For instance for country like China expected revenues from CDM are negligibly small. By the end of September 2006 CDM executive board registered 23 CDM projects with total avoided CO2 emission 37 MMT of CO2 equivalent. In best case scenario (all reduction will be certified and CERU will be valued $10/MtCO2) CDM will bring about $370 million annually. This figure is 3.5 times less then grants and technical assistance, 150 times smaller than FDI and practically equal to zero if compared to annual flow of capital formation. The same picture is true for India, Brazil, etc (Table 1). Even if over the next year CDM board registers more projects with the same amount of expected CERUs as it registered by 2006 it would not change the picture.

As for transition countries, the major CO2 emitters like Russia and Ukraine are not participating yet in Kyoto flexible mechanisms. There are no registered JI projects and no transactions of AAU under Article 17. Russia has not adopted JI procedure yet. Even if Russia steps forward with a full implementation of JI and emission trading, potential revenues would be just around 4 percent of capital formation (assuming annual sale equal to 500 MMTCO2e at the price $10 per t of CO2). In Ukraine similar indicators would be around 8 percent (120 MMTCO2e and the same price as for Russia). If revenues from emission trading had been wisely used as collateral investment, hypothetically, they

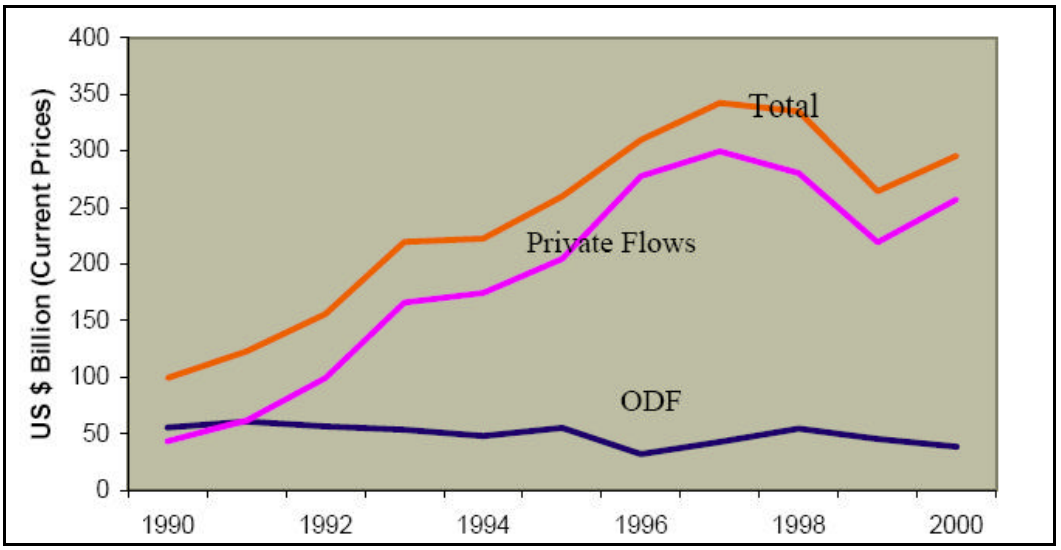
would create sufficient signals to modify investment choice in Russia and Ukraine. Unfortunately, there is no sign of progress neither from the side of buyer, nor from the side of the seller.

Thus, for the major emitters of GHG domestic investments will be a leading source of finance (roughly 10-20 times larger than other sources of finance. Domestic macroeconomic and environmental policy will determine carbon emission profile and demand for new technologies. Existing Kyoto mechanisms are insufficient to change investment choice in favor to energy efficient technologies and low carbon technologies in non Annex 1 countries. Although hypothetically, emission trading may create sufficient signals for transition countries, there is no positive sign yet. Developing and transition countries should adopt meaningful carbon policy in order to address domestic investment cycle. This policy should be complemented by external signals created by Kyoto and post Kyoto mechanisms for international cooperation to cut carbon emissions.

b. Foreign direct investments (FDI)

Private investment plays an increasingly important role in resource inflow to developing countries. If in 1990 private investment was comparable with official development assistance (ODF), in 2000 private investments were more than 2 times higher (Figure 4).

Figure 4. Foreign Investment into Developing World



Source: Heller & Shukla, 2003.

Although there is some drift of FDI from resource sector to manufacturing sector and high tech, natural resources exploration keeps significant share in FDI. For instance, investment in electricity and natural gas was about the third of total FDI in 2000. This investment kept the second place after telecom.

Among other sources of finance foreign direct investments (FDI) are important to determine the pattern of economic growth and innovation policy although its share in gross capital formation in investment portfolio of developing countries with highest carbon emission is modest. In China FDI constitutes 2.8 percent of gross capital formation, in Mexico – 2.5 percent, in Brazil – 3 percent, in Russia – 2.1 percent, in Ukraine – 2.6 percent (see Table 1). In South Africa FDI is just 0.3 percent of gross capital formation, while international aid is about 1.6 percent. International aid is also significant in Ukraine (almost 3 percent), and in Russia (about 1 percent of gross capital formation) (Table 1). In developing countries FDI and international aid are significantly higher than expected revenues from CDM. For instance, in China FDI and aid are about 60 times higher; in Mexico they are more than 100 times higher. In transition countries FDI along with aid are comparable with hypothetical revenue from AAUs trading.

Internalization of environmental benefits producing CER in CDM frame could be an important instrument to direct technological choice in favor of environmentally friendly technologies. Therefore FDI that generate emission reduction or avoided emission should be linked with CDM, JI or emission trading.

General profile of FDI by sector is presented in Table A.1.4 in World Investment Report, 2006. Significant share of FDI is channeled into polluting sectors. Therefore these investments could be conductors for new technologies. However, the flip side of these investments is polluting sectors growth. Total impact on GHG emissions could be positive, although emission intensity may decline.

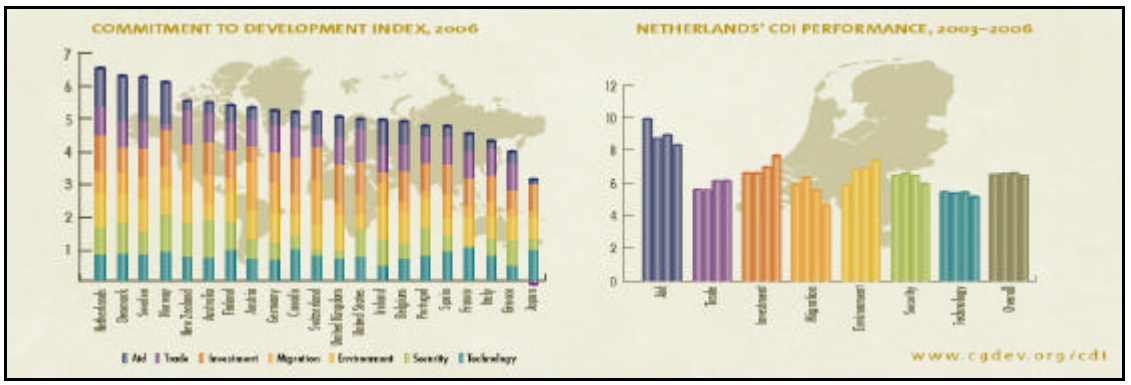
Historically, governmental policy to support FDI into developing countries was driven by promotion of domestic industries, export of goods and services. In the literature it was noted that FDI could exacerbated environmental problems (Mabey, McNally, 1999). To address this issue, a multilateral agency, like the WB, about 10 years ago started to incorporate environmental agenda in every investment project. Many developed countries followed this example acknowledging increasing priorities of environmental protection and climate change mitigation. However, environmental priorities compete with other motivations dictated by geopolitical interests, promotion of domestic business, energy security, etc. It is up to the government of the developed country to decide how to "correct" market signals and direct FDI into the area of interest. For example, in the Netherlands, FDI into developing countries in 2003 was 6.4 billion Euros (Table 6, UNCTAD FDI Country Profile: Netherlands, (2005), while annual average 2001-2004 outward FDI was 31 billion Euros, inward – 24.5 billion Euros. The largest share of FDI to developing countries goes to Latin America and Caribbean (3.9 billion Euros). FDI to China and India are relatively modest. Nevertheless, Dutch FDI into Chinese economy is about twice higher than expected revenues from CDM and about 3 times higher than expected CDM revenues in India. FDI may facilitate deployment of new technologies. The Netherlands already demonstrated strong environmental records from the perspectives of developing countries and was ranked number one with respect to "Commitment to Development Index" by Center for Global Development (Figure 5) that

ranked the 21 richest countries on how much they help poor countries build prosperity, good government, and security. Each rich country is ranked in seven policy areas, such as aid, trade, investment, migration, environment, security and technology. These ranks are averaged for an overall score. The Netherlands also keeps a high score (third place) on the policies that encourage constructive investment in the poor countries. The criteria of ranking are described as follows:

> "The index looks at what rich countries are doing to promote investment that is actually good for development. It looks at two kinds of capital flows: 1) foreign direct investment, which occurs when a company from one country buys a stake in an existing company or builds a factory in another country; and 2) portfolio investment, which occurs when foreigners buy securities that are traded on open exchanges. The component is built on a checklist of policies that matter. Do the governments offer political risk insurance, encouraging companies to invest in poor countries whose political climate would otherwise be deemed too insecure? If so, do they filter out projects likely to do egregious environmental harm or exploit workers? Do they have tax provisions or treaties to prevent overseas investors from being taxed both at home and in the investment country?" (http://www.cgdev.org/section/initiatives/_active/cdi/_components/investment/)

CDI include ranking of achievements in creation and dissemination of new technologies. This component "rewards government funding and tax breaks for research and development but penalizes certain patent and copyright rules deemed too restrictive to the flow of ideas across borders" (http://www.cgdev.org/section/initiatives/_active/cdi/_components/technology/). The Netherlands is in the middle of the group with regard to this index (thirteenth place).

Figure 5. Ranking of 21 Richest Countries based on Commitment to Development Index



Hence The Netherlands already has a leading position in channel private investments into new technologies and environmental protection. Taken into account significance of Dutch investments in comparison to total CDM annual flows, the Netherlands may consider to introduce carbon valuation into decision making process to provide support to private businesses investing in developing and transition countries. In the beginning they may use the carbon footprint approach to assess companies' performance. In the future more sophisticated decision-making rules could be introduced. Moreover, since the Netherlands alone initiate more than one third of CDM projects around the world and have seven investment facilities and funds targeting carbon reduction investment, government may consider coordination of investment policies between these facilities and private investors.

As it was demonstrated above, FDI flow exceeds significantly expected CDM revenues. Therefore, instruments for monetization of carbon revenues in developing countries offered by Kyoto Protocol are not sufficient to change profile of FDI. Until CDM remains major instrument to harvest carbon benefits in developing countries there is a strong demand for complimentary policies that would direct FDI in more climate friendly projects. In this context some voluntarily programs may play important role filling incentives gaps.

One way to influence investors' decisions would be long-term voluntary agreements. Voluntarily agreement is one of the major instruments in the Dutch energy policy. By voluntarily agreements energy intensive industries committed to meet "best in the world" standards for energy efficiency in processing plants. There are voluntarily agreements that specifically target coal-fired plants and large and medium-sized companies. Voluntarily agreements are complemented by standardized and improved monitoring system (IEA, 2000). The same type of arrangements could be extended to FDI related projects. Governmental agencies could subject their support to the agreement with the company to gradually turn to invest into low-carbon technologies in the host country.

In fact, business is more motivated to invest into low-carbon technologies if carbon benefits were translated into economic benefits. At the moment only CERUs generated by CDM or ERUs generated by JI are available for European business to internalize carbon benefits. Voluntary agreement with the government, linked to the governmental support of FDI into low-carbon technologies, would be a complimentary mechanism.

Know-how and technologies produced in the frame of the voluntarily programs, if transferred to developing and transitional countries, may help to curb carbon emission there. At the same time, if emission reduction is monetarized, it will help to increase IRR and reach 15 percent benchmark even deploying more advanced technology compare to one that would be adopted without consideration of carbon bene fits. Therefore, this cooperation not only establishes conditions for technology transfer, but also could boost innovation activity in the Netherlands.

According to additionally rule CDM covers just incremental costs private investment may play a role of complementary source to close the balance. So in this case private investors receive additional revenues from CERUs. At the same time, the investor is encouraged to pick more environmentally friendly technologies that generate emission reduction or allowed to avoid emission.

CDM mechanism as it is too narrow to accommodate cash-flow 100 times larger than currently approved CDM portfolio. Therefore, for the time being other instruments should be applied. One of them could be preferential status for FDI with ancillary carbon benefits to receive governmental guarantees and risk insurance.

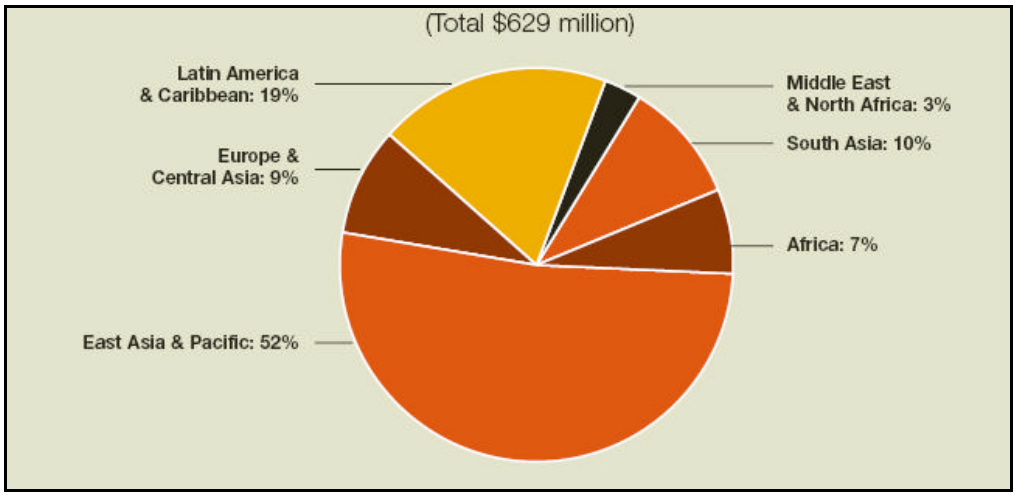
c. Multilateral agencies and green investment. The Word Bank. Prototype Carbon Fund. GEF. EBRD

There are about 20 national and multilateral funds and facilities that support carbon emission reduction. Among them are six facilities, funds and tender mechanisms established by Netherlands. Netherland's Government pledged about 1 billion USD to reduce 100 million t CO2. Emission reduction target for Netherlands is estimated at about 200 million t CO2[2]. About half of this reduction should be achieved applying Kyoto flexible mechanisms (JI and CDM). In order to purchase CERUs and ERUs in a cost-effective way the Dutch Government established procurement tender procedure: CERUPT for CDM and ERUPT for JI.

At the moment the World Bank and the Netherlands are leading investors and buyers at the carbon market. The World Bank established Prototype Carbon Fund that was aimed to mobilize private capital and technology transfer using Kyoto flexible mechanisms to create incentives to invest in clean technologies in developing and transition countries. According to 2005 report, PCF has 800 project ideas in the portfolio and 28 purchase agreements were signed (August 31, 2005) with total emission reduction 33.5 MMt CO2 for 139 million USD. 88 purchase agreements are under negotiation (125.7 MMt CO2 for 629 million USD). There are also 128 projects with approved documentations (179.6 MMt for 854 million USD). Roughly half of the portfolio are the projects in Eastern Asia and Pacific (Figure 5).

[2] Estimated difference between projected emission and Dutch emission budget under EU Burden Sharing Agreement.

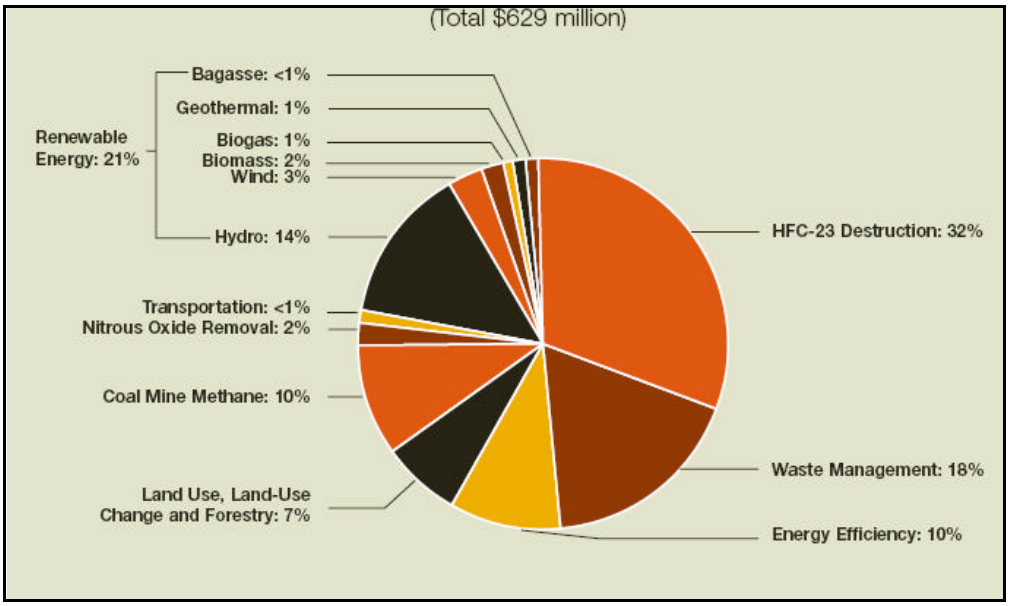
Figure 5. Geographical distribution of the Carbon Finance Unit Portfolio (2005)



Source: Carbon Finance Annual Report, 2005.

Annex B transition countries are accountable only for 9 percent of this portfolio. Therefore the potential for new technology deployment and cost efficient carbon reduction is not adequately represented in the PCF portfolio (Figure 6).

Figure 6. Technological distribution of the Carbon Finance Unit Portfolio (2005)



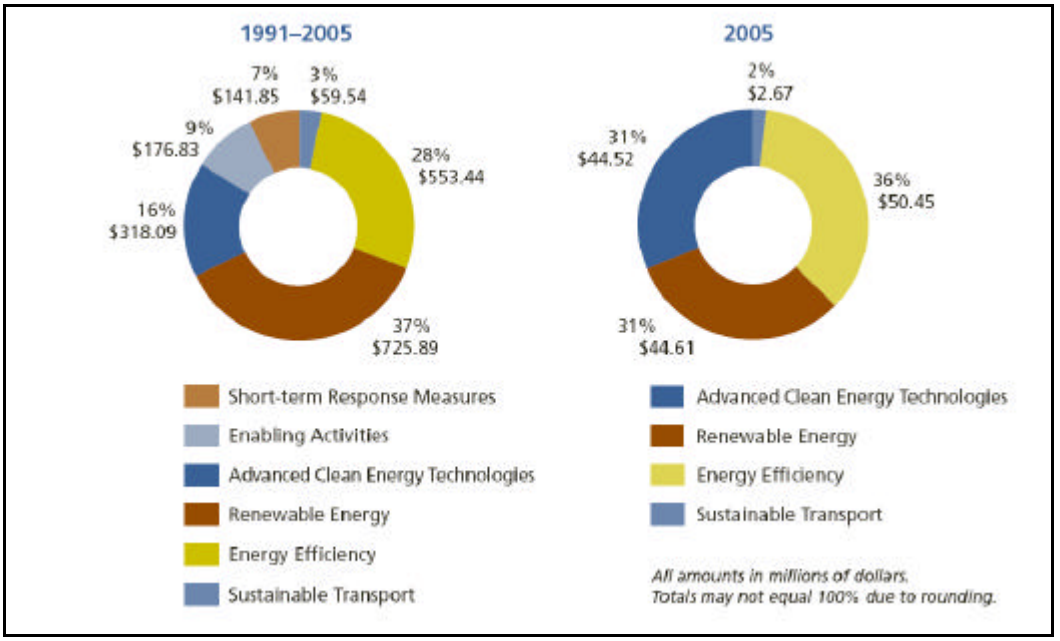
Source: Carbon Finance Annual Report, 2005.

On one hand, PCF managed to mobilize investment. However, it is an unlikely the most reliable vehicle for new technologies deployment. PCF plays the role of financial mediator and focuses on low cost carbon emission reduction that is not necessarily associated with new technologies. It is illustrated by overweighed small gases fraction of project portfolio. In terms of sectors and technology choice, the largest share in portfolio (32 percent) is represented by HFS-23 reduction projects, while renewable energy projects have only 21 percent, out of which 14 percentage points is represented by hydro energy projects. Wind energy was 16 percent of project portfolio in 2003. In 2005 it collapsed to 3 percent. Biomass was 5 percent in 2003 and in 2005 it reduced to 2 percent. Geothermal energy reduced from 4 to 1 percent. The dramatic shift in project portfolio demonstrated deviation between cost efficient carbon reduction priorities and priorities related to deployment of new technologies. Especially at the onset of carbon policy implementation, there are a lot of low hanging fruit that are not related to technological innovations. Low cost solutions may involve, but may not involve also deployment of new technology. New technologies with long-term learning effect like wind energy or biomass energy, would require support before cost of the technologies decline to the level acceptable in the market. Therefore these technologies would always loose completion to the alternatives with lower short term costs.

Global Environmental Facility used to support carbon emission reduction projects. GEF spends about one third of its resources (960 million USD on climate change related projects). If in past years only mitigation projects were supported, now adaptation projects are considered too. At the same time deployment of advanced clean energy technologies is one of the priorities of climate program. Over last five years the share of the projects in this area significantly increased (31 percent in 2005 versus 16 percent in average 1991-2005) (See Figure 7). In absolute figures GEF annual spending on advanced clean energy technologies was 44.52 million USD. Taking into account that GEF covers only incremental cost those investment may catalyze collateral investment on average 6-7 times higher: 1.9 billion USD of GEF grants generated investment activity with a total value of 12 billion USD (GEF, 2005). Sometimes grant/collateral investment ratio could be higher. For example Yantai Integrated Gasification Combined Cycle

(IGCC) project in China generated 80 million USD equity investment and 322 million USD domestic loan for 15-18 million USD GEF grant. Another example is Hybrid Solar Thermal Power Plant in Mexico with total GEF grant 49.7 million USD and co-financing 128.3 million USD.

Figure 7. GEF portfolio in Climate Change



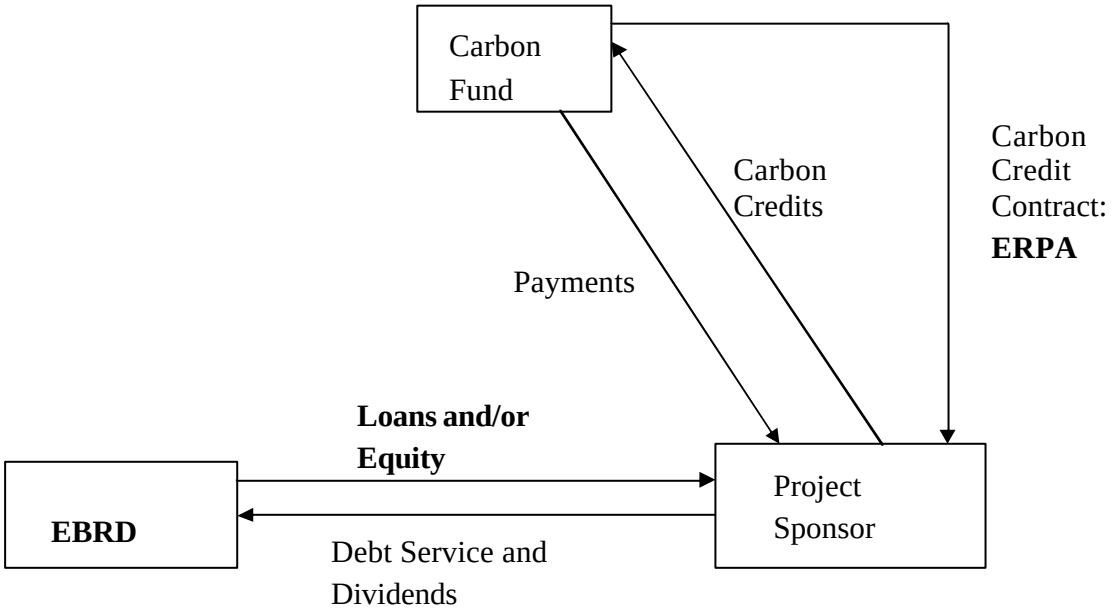
Source: GEF, 2005

EBRD is another multilateral institute that provides support to deploy new technologies for carbon emission reduction. At the moment carbon reduction and new technologies deployment is pronounced as one of the EBRD priorities. However, carbon program is at the emerging stage. In 2003 Government of Netherlands and EBRD have created one of the first carbon funds in Europe: the Netherlands EBRD Carbon Fund (see www.ebrd.com). It is aimed to allocate about $40 million in CDM, JI and emission trading carbon reduction projects, including renewable energy projects, energy efficiency projects, recovery and use of methane projects and fuel switch projects. This Fund promotes market based approach combining equity investment and carbon reduction investment that would be recovered based on the revenue generated by carbon emission reduction. Among other direct project finance instruments are loans and partial

guaranties. Indirect project finance instruments include credit lines, energy service companies and equity funds.

Comparing different financial multilateral institutions, we conclude that EBRD Carbon Fund potentially may have better chances to induce deployment of new technologies. Providing loans to the companies holding know-how, this mechanism creates better incentives for these companies to transfer technologies to transition countries. Lending against expected revenues from carbon emission reduction EBRD leaves it up to the project operator to internalize, combine and capture all kinds of revenues, including Schumpeterian rent from innovations and carbon revenues. Figure 8 presents the scheme of lending and payments under EBRD carbon credit contract.

Figure 8. The Scheme Of Lending And Payments Under EBRD Carbon Credit Contract



Source: Van de Ven, 2004

In contrast, PCF separates carbon allowance buyer from project operator. As a result, the synergy between benefits from innovations and carbon benefits, most likely, is lost. As

we mentioned before, PCF is shifting its focus to low cost carbon reduction option that are not necessarily related to new technologies. Furthermore, using direct (partial guarantees) and indirect project finance instruments EBRD to some extend could manage technology choice giving preference to most advanced technologies which, however, could be on the learning curve.

Both EBRD Carbon Fund and PCF are the forms of "Green Investment Scheme". They complement each other at the emerging carbon market, with PCF focusing on low cost and no regret options on expense of separating operator from purchaser of emission reduction, and with EBRD Carbon Fund more focus on deployment of new technologies on expense of some learning cost absorption related to adjustment of new technologies transferred into transition and developing countries. Also, there are several attempts to build national Green Investment Schemes (GIS). First description of national Green Investment or Carbon Investment Scheme was described in the Russian National Strategy Study on Climate Change (Golub et al, 1999). However first practical implementation of this idea started recently. Romania, Bulgaria and Lithuania may be the first countries that established national GIS. Potentially, GIS could be an efficient vehicle to promote new technologies. However, the success depends on the implementation model. The PCF like GIS would do a better job mobilizing low cost GHG emission reduction, but a EBRD like model would encourage more technology transfer as part of business to business relations, facilitated by described above project finance instruments.

3. Domestic environmental policy

As it was mentioned above, the key issue for leading polluters is how to influence domestic investment that has dominating share in gross capital formation (see table 1).

Market reforms in transition and developing countries should lead to efficiency improvements and technological innovations. For instance energy subsidies elimination is another important way to create incentives for adoption of low energy and perhaps low-carbon technologies (Gurvich et al, 1997). However even rapid growth of energy prices

in Russia in 1999-2006 was not sufficient to curb energy demand and carbon emission. Energy prices elasticity of demand in Russia was less than income elasticity (Golub, Shaposhnikov, 2006).

General impact on environment from transition to market economy is positive in relative terms, but it is not sufficient to stabilize either, or global pollution. Although there are some examples of strengthening environmental regulation like SO2 cap in China and harmonization of environmental regulation in CEE countries with EU regulation, in most cases environmental regulation is weakening, like in Russia, Ukraine and Central Asian countries while improving in new EU members and EU accession countries. Two different pathways for transformation of environmental regulation in transition countries, is presented in the Box 1.

Box 1. Environmental Regulation and Development in Transition Countries

In the late 1980s, CEE and the Russia had similar environmental institutions, established based on the same concept. The concept of state environmental protection was defined by the understood necessity for technological solutions to waste reduction, but realizing the lack of financial and capital resources to provide industry with the necessary equipment. There was a clear gap in the Soviet Union between the declared environmental requirements and possibilities, and the political will of the state to ensure the implementation of those policies.

In the early 1990s with the start of the period of economic and political liberalization there has been a significant advancement in the development of environmental regulation institutions, including procedures for licensing resource use, with establishment of maximum allowable limits on emissions and discharge, and extraction of natural resources; introduction of payment for natural resources, including their use, protection and reproduction, and fines for overuse; payment for pollution within the set limits and beyond; establishment of the basis for development of a system of

environmental funds; and the system of economic responsibility for environmental damage and violation.

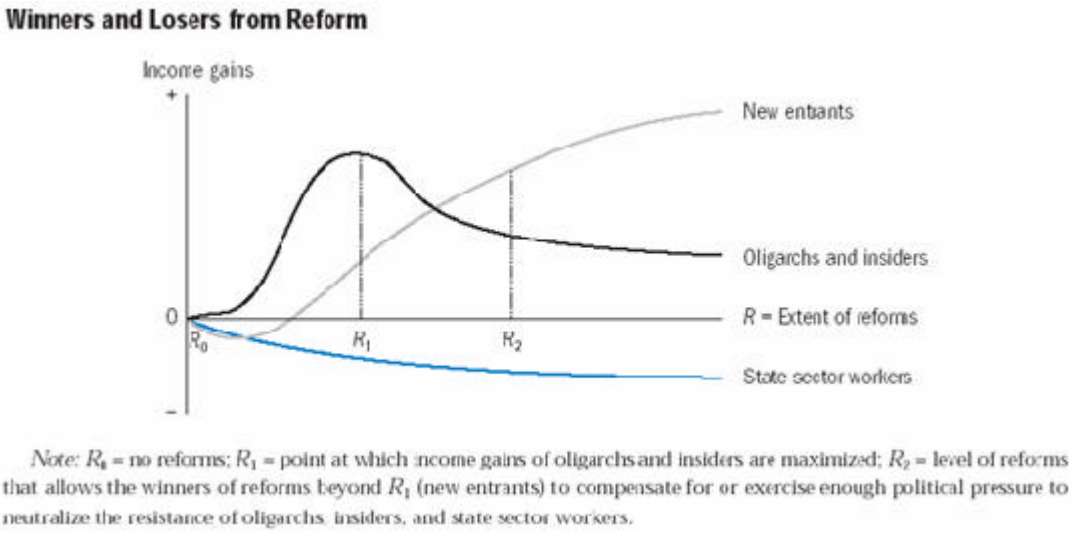
CEE countries maintained and developed the above environmental institutions throughout their transition, while Russia has followed the opposite path. For example, at the beginning of the transition, the National Environmental Policy of Poland looked much like that of Russia, including mention of the "polluter pays" principle and economic instruments for environmental protection, including fees and funds, but little in the way of concrete objectives and plans. However, less than 10 years later, Poland had strengthened its existing regulations and institutions, instated new financial mechanisms, increased investment, and reduced air pollution significantly (OECD WPEP 2000). Similarly, in the 1990s, Hungary adopted several pieces of important environmental legislation and enacted a set of environmental laws. The country also introduced pollution fees, established environmental funds, and invested heavily into cleaning air and water, and waste management. Further, the country adopted the first National Environmental Programme, from 1997-2002, to help bring its policies in line with EU environmental legislation (OECD WPEP 2000). While some policies and enforcement could be strengthened, the country has been rewarded with increased investment and improved environmental performance.

Russia, on the contrary, took a path toward gradual elimination of the environmental regulation system. It followed a general weakening of federal authorities and shrinking of resources to maintain the existing Government. One important indicator is the available government budget. While the share of the consolidated budget declined by about 10 percentage points in 1992-1997, local budgets fluctuated about 2 percentage points, and the federal budget took the largest hit (Institute for the Economy in Transition, 2004).

The decline in the pace of environmental reforms, leading to the eventual destruction of the system of environmental institutions in Russia, fits well with the theory of political economy of the overall reform process within the framework of discipline and

encouragement, as described in a World Bank report (World Bank 2002 pp.91-95). The theory begins by tracing the paths of winners and losers in the reform process (as presented in Figure 9), distinguishing between state sector workers that lack the skills to enter the competitive market; the potential new entrants, including state sector workers who acquired new skills and new entrepreneurs; and oligarchs and insiders, who began the transition with substantial de facto control over state assets and ties with the political elite.

Figure 9.



Note: R_0 = no reforms; R_1 = point at which income gains of oligarchs and insiders are maximized; R_2 = level of reforms that allows the winners of reforms beyond R_1 (new entrants) to compensate for or exercise enough political pressure to neutralize the resistance of oligarchs, insiders, and state sector workers.

Source: World Bank, 2002 (p.93).

Without going into detail, one can clearly see that oligarchs are interested in supporting reforms at the partial level, around R_1- the point of maximized gains from rent seeking and tunneling. Russia is a clear example of what the authors of the World Bank report call the 'partial reform paradox,' when the state has been captured by narrow private interests. The liquidation of the system of state environmental institutions, which were in the way of those private rent-seeking interests, is a clear example of one of the core impediments to the reform process in Russia.

Then institutionally, environmental regulation doesn't serve to weaken the investment climate in Russia, but instead could improve it. The destruction of the environmental

system, despite the promise, has not led to growth of investments into the resource sector of the Russian economy. On the contrary, it has created uncertainty over the future legislative and regulatory climate, which is an important risk factor in investors' decision-making processes. "Ignoring the needs to environmental protection is economically unsound in the short as well as the long term. The dismantling of Russia's system of environmental control has greatly reduced state revenues in the form of payments by business for use and pollution of the environment, and attractiveness of investing in Russian natural resources has actually fallen instead of growing" (Human Development Report for the Russian Federation, p. 108). It has also negatively impacted the competitiveness of Russian companies at the international (especially European) markets, where companies are held to tougher environmental standards. Those countries which have accomplished reforms that conform with EU regulations, appear to have fared better than those countries that have not. It has been shown to be to the advantage of transition economies to develop policies that are similar to the EU's policies, at least with regard to investment security and predictability. Domestic environmental policy could be described as a "correction mechanism" that should create additional incentives to change firm's behavior and attract investments.

Nevertheless, domestic environmental policy can not substitute carbon policy. Furthermore, for countries like Russia and Ukraine carbon policy may emerge before strengthening of domestic environmental policy. According to Table 1 Russia and Ukraine may significantly benefit exploring Kyoto flexible mechanisms.

4. Emerging future global climate finance

Although Kyoto Protocol creates incentives for developing countries to adopt EFT, these incentives may not be sufficient to ensure economic growth based on EFT. Major sources of growth capital formation are domestic investments that are not affected neither by domestic, nor international climate policy yet. By the end of 2006 countries like Russia have no mechanism to manage JI projects. Although China is the most advance country

in CDM implementation, potential revenues from CDM are just a fraction of percent of domestic investment. The same is true for India, Brazil, Mexico, etc.

Even if CDM revenues will have the same multiplier as GEF grants, it is still under one percent of gross capital formation. Even if number of approved CDM projects triples over the next few months, it is not sufficient to change investment profile of major emitters. In best case scenario for Russia and Ukraine (emission trading initiated) the revenues from AAUs sale may be late to influence investment decision over the next few years. All of that suggest that the gears should be shift to the second commitment period. Kyoto framework created sufficient conditions for Annex B transition countries. That is why Kyoto framework deserves to be preserved beyond 2012.

As for developing countries, there is no solution other than substituting more efficient mechanism for CDM. As we demonstrated before, CDM is not an instrument to change investment profile in developing countries with largest GHG emission. However, it could be a reliable mechanism for least developed countries. In order to mobilize emission reduction potential of China, India, Brazil, Mexico, etc. more efficient incentives are urgent. On one hand these countries have tremendous emission reduction potential. On another hand, the developed world has technologies that could mobilize this potential. There is no sign that the developed world would be willing to transfer these technologies for free. There is also no sign that the developing world will realize its reduction potential voluntarily.

Economic growth based on technological innovations is a long and complicated process associated with a variety of uncertainties and risks. Shaky environmental policy would add to these uncertainties and discourage innovators. Clearly stated long-term policy should encourage innovators. Therefore for the post 2012 we propose a policy that covers two sequent commitment periods.

Leapfrogging innovation is the most radical way to cut carbon intensity on the long run. Society should start accumulate knowledge, know-how, invest into R&D with regard to

the targets for the third commitment period. In the meantime we should squeeze as much as possible from existing technological structure. The latter was built in the pre-carbon constrained world and therefore provides significant opportunities for low-cost emission reduction. Thus there is no need for immediate draconian measures to cut carbon emission. If there is a clear understanding of increasing value of allowances, then even Kyoto Protocol as it is would provide sufficient incentives to enable emission reduction potential of the existing technological structure.

World economy should be ready for technological leapfrog; therefore more strict rules for allowances allocation would be feasible. So budget allocation to developing countries should be the key new element. However, in the subsequent commitment periods this allocation should not impose financial burden on developing world. In other words, this allocation should be based on the principle of compensated reduction. Some efforts to reduce emission should be compensated by benefits of leapfrogging technological revolution.

Since leapfrogging technological innovations are the major avenue to solve climate problem by decoupling economic growth and carbon emission and bringing down the latter to the level that significantly reduces risks of dangerous anthropogenic interference, international regulation of GHG emissions should be, first of all, oriented on creation robust incentives for technological innovations. At the same time the total emission cap should be tightened at some point. Idea of voluntarily commitments and excessive allocations that played an important role at the first budget period should become obsolete in the following commitment periods. Therefore, compensated reduction should become a key element of international climate policy.

Cap on emission is the most preferable tool to stimulate innovations. Cost cap, intensity target, sectoral caps, etc. are less preferable tools. In case of uncertainties and risk averse behavior they create less incentives for innovations. Since we assume that Annex II countries are technological leaders, innovations and low–carbon technologies should come from Annex II to the rest of the world. Innovations are not rival goods, but inventor

would like to make them exclusive in order to capture Schumpeterian rent. Therefore for technology transfers, a compensation mechanism is needed. Allowances budget creates the "mean of payment" for low-carbon technologies. EU proposal for the future commitment period emission budget for developed countries could be complemented by AAU allocation to developing countries. AAUs flow from developing countries would be complemented by cash flow from developed countries as payment for technology transfer. These payments will create incremental findings to create a critical mass of incentives to adopt low-carbon technologies.

Choosing among different technologies, the host country considers IRR of these technologies while taking into account various benefits including monetarized carbon benefits, social benefits (employment, local pollution reduction, etc.), and financial benefits. Various financial instruments applied by developed countries could correct this IRR increasing it for EFT and suppressing for polluting technologies. But the final choice is up to the host country. A foreign investor who holds new technology also estimates his economic return and makes a final decision comparing various alternatives. He could also be under the influence of additional incentives like political risk guarantees, general investment climate, and co-financing available. Brief analysis of CDM portfolio demonstrated that institutions created for JI and CDM in some countries (Bulgaria, Romania, China, Brazil) appear to the investor as the institutions that mitigate risks related to general investment climate in the host country. To some extent these institutions themselves may create incremental benefits for an investor of top of carbon benefits although he pays high transaction costs related to JI and CDM.

From macroeconomic perspective one should realize that environmental policy aimed to induce technological innovations is a temporary phenomenon with respect to each new technology, i.e. it should imitate the pattern of the new technology on the learning phase of the deployment cycle until this technology becomes commercially attractive and turns into part of business as usual in climate policy context. Although principals of environmental policy that induce technological progress stay the same, the object of the policy would change overtime.

5. New incentives for technological transfer

There are two ways to create incentives. One is to build financial institutions to cover the shortfall in the investments. The second way is to modernize international climate policy in order to eliminate barriers for monetarization of carbon benefits generated by deployment of new technologies. While the goal is to promote transfer of most advanced technologies to the developing countries, major focus should be on energy efficiency and alternative energy ventures and energy efficiency projects.

Between the two ways of technology transfer, energy efficiency projects would prevail in developing and transition countries. Although energy efficiency and alternative energy projects would pay back in the long run, the major problem is to raise upfront revenues to cover one time investment costs. Therefore, debt instruments, guarantees, and collateral investments are essential for the project success. Basically, the institutions as described above EBRD Carbon Fund may provide such support. Grants and development aid also may be used as debt instruments, but on a limited scale and in premature market economies. According to theory, public sector interventions should not distort the market. Debt financing may employ several instruments that combine lending and granting procedures, like soft loans, no interest loan or loan that should be partially paid back, etc. An interesting example is a Bulgarian Energy Efficiency And Renewable Energy Credit Line (Makinson, 2006). This facility provides loans, offers technical assistance and grants support to Bulgarian industry efficiency projects and small renewable energy projects. This facility has 50 million Euro from EBRD and a 10 million Euro earmarked grant. This facility is partnering with Bulgarian domestic banks that provide loans to companies. Similar institutions were created in Mexico, Thailand, Brazil, Hungary, etc.

Another important instrument to reduce debt is monetarization of carbon benefits that would increase cash flow and reduce pay back period. Finally, if companies with patents on new technology implement the project, then there is no need to include license fees into the upfront cost. The company collects benefits from deployment of new technology over the lifetime of the project.

Therefore the mechanism should encourage direct involvement of new technology holders. It would reduce the up front cost and increase competitiveness of the project.

Although the European pre-Kyoto carbon trading scheme was not too challenging for the industrial sector covered by ETS[3], the expectations of the new target during the Kyoto 2008-2012 period should lead to more innovations. According to various studies, the Netherlands has the highest CO2 abatement cost in European Union (Van der Ven, 2004). About 100 million tones of CO2e should be abated domestically (see above). For sources covered by ETS this burden can be alleviated by emission trading within the EU. However, AAUs prices may be significantly higher than carbon allowances prices at the pre-Kyoto European carbon market. The sectors that are not covered by ETS would have no flexibility and they will confront high abatement cost. The only way to cut them would be technological innovations. The sources covered by ETS will confront higher than current and more uncertain carbon allowances prices[4]. Pre-Kyoto policy EU cap-and-trade system mobilized the existing capacity to reduce carbon emissions in covered sectors. Since ETS's introduction of carbon allowance, prices at the European market dropped from about 30 Euro per tons of CO2e to about 10 Euro per ton of CO2e. Thus industry already picked up an easy catch. At the next stage investment into new technologies will be vital. Therefore, we anticipate more innovations in Europe.

[3] In the Netherlands industry and energy sectors were given allowances for the period 2005-7 equating to 96% of average 2001/02 emissions, with adjustments made for sector growth and efficiency. The sectors had asked for an overall cap of 121m tonnes but the government has limited it to 115m tonnes of CO2-equivalent. (European CO2 trading preparations gather pace. URL: http://www.eceee.org/news/news_2004/2004-02-26b).

[4] Since 2008 European carbon allowances should be backed up by AAUs, CERUs and RMUs.

Dutch industry is confronting strict climate policy that induces technological innovations. These innovations may be transferred to the developing world later. Direct participation of new technology holders would allow avoiding the problem of split incentives. On one hand, technology holders already paid R&D and learning costs in order to meet requirements of domestic climate policy. There is no need to get immediate reimbursement for technology transfer. On the other hand, European Linking Directive allows to individual businesses to participate in CDM and JI for compliance purposes. Industries under the domestic emission regulations would also benefit from possessing carbon emission reduction. This multi-benefit approach is possible only on the level of business to business relations that exclude a mediator, but require a financial facilitator. Therefore, in order to promote Dutch technologies in developing and transition countries, in the midterm, they should rely on EBRD-like schemes that provide debt instruments to the project implementation. In the long term there should be easier ways to capture and monetarize carbon benefits.

In the future European businesses should be allowed to participate in emission trading. Even during the first commitment period there is a possibility for business to participate in allowances trading with transition countries. Emission trading is the most direct way to capture and monetize carbon benefits of investment projects. The entity in the host country receives allocation that is backed up by the Annex B AAUs emission budget. Then the entity could use part of this allocation as a collateral investment into emission reduction project. If an investor from the developed country owns a new technology, the emission reduction mentioned above could be means of payment for technology transfer. In contrast to JI there is no need for baseline justification and long bureaucratic process of JI approval. Unfortunately, European trading directive prevents allowances trading outside of the ETS.

Allowances trading with transition countries would be possible if the Dutch Government signs bilateral agreements with selected Annex B transition countries. Under the conditions of the agreements, the Dutch Government could buy carbon allowances on behalf of a particular industry that is involved in an emission reduction project in a

transition country. Transactions between Annex B parties are allowed by European trading directive. This legal mechanism creates opportunities to facilitate carbon investment projects that bring new technologies to Annex B transition countries. For non-Annex B countries CDM is the only channel to harvest and monetize carbon benefits generated by new technologies transfer.

6. Conclusions

- *Changing profile of technical assistance and development aid*

Existing Kyoto mechanisms are not sufficient to ensure large scale deployment of new technologies in the developing world. Technical assistance and grants including development aid constitute financial flows more than ten times larger than expected revenues from CDM. Therefore, the first recommendation is to incorporate carbon indicators into the project cycle of governmental assistance to the developing countries.

FDI is another important element that determines technological choice in developing and transition countries. The government can promote green investments, EET, and LCI using various instruments like bank guarantees, political risks insurance, etc.

Support of economic development, based on low carbon technologies, use of renewable and alternative energy, capturing methane, etc., should be an important priority for development aid, technological cooperation, support of trade, etc. This strategy should be executed by national governments and multi-national agencies. Both EBRD Carbon Fund and PCF are the forms of the "Green Investment Scheme". They complement each other in the emerging carbon market, with PCF focusing on low cost and no regret options in the expense of separating operator from purchaser of emission reduction. The EBRD Carbon Fund focuses more on deployment of new technologies in the expense of some learning cost absorption related to adjustment of new technologies transferred into transition and developing countries.

- *Domestic investments and necessity for domestic climate policy in developing and transition countries*

Domestic investments play an increasingly important role in capital formation in developing and transition countries. It is a dominant source of investment followed by FDI, grants and assistance, and finally, by expected revenues from CDM, JI, and emission trading. These investments will determine the "carbon profile" of each developing and transition economy as well as the demand for new technologies generated in the developed world. Only robust domestic climate policy in developing and transition countries will induce massive deployment of EET and LCT. Since the developed world will remain dominant in technology in the long term, the demand of developing countries will be satisfied via import of EET and LCT from the developed countries. Therefore, the long-term goal for international negotiations should be the adoption of robust emission policy in the developing world. The emission cap appears as a good institutional instrument to build robust carbon policy in developing countries. The emissions trading will create a means of payment for technology transfer.

- *Promotion of new technological policy*

Promotion of a new technological policy should be selective and have adequate financial recourses available.

Since in the short and mid-term, CDM, technical assistance and development aid are the only available instruments used to influence technological choice in favor of EET and LCT, while taking into account that those channels can generate only limited financial recourses, they should primarily focus on renewable and alternative energy, methane capturing and other technologically sophisticated projects. In other words, this source of investment is comparable with investment needs for deployment of the above mentioned technologies and is not sufficient to influence diffusion of new technologies at large power plants. The deployment of new technologies in a "traditional" energy could be induced only by a robust domestic policy. Revenues from CDM, technical assistance, aid,

and FDI may play the role on the margin as a "correction" mechanism that would slightly change technological choice. The statement above is true for large emitters like China, India, Brazil, Mexico, South Africa, etc. However, for the least developed countries with an undeveloped energy sector, even a modest investment project can radically change the energy mix and the emission profile. It should be taken into account in the context of individual countries.

However, if FDI or carbon investment in the form of CDM or JI is the target of large scale investment projects, then these projects should have a significant multiplicative effect comparable to the one observed in the GEF practice. In this case the FDI or carbon investment would influence domestic investment flow and could potentially change the trajectory of capital formation in favor of the EFT.

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