Financing Urban Bus Industry Restructuring within the Framework of Kyoto Protocol

Le financement de la restructuration de l'industrie du bus urbain dans le cadre du protocole de Kyoto

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ABSTRACT: Transport sector, particularly urban transport sector has long been recognized as the main contributor of Green House Gases Emissions. Investments in urban public transport is needed yet the conventional financing are often difficult to obtained due to the high level of investment and the current government priorities. Urban public transport is also seen as fall within the private sector domain - making it difficult for government to spend public money. The ratification of a Kyoto Protocol has paved ways to develop a financing alternative for sustainable development. Clean Development Mechanism of the Kyoto Protocol has provided an opportunity for urban transport authorities in developing countries to co-finance urban public transport project using the principle of a carbon trading. The capacity to implement CDM urban public transport project is essential to the project. Future works should be directed to investigate the methodology in incorporating soft measures and ensuring low project leakage.

RESUME : le secteur des transports, en particulier celui du transport urbain, est reconnu depuis longtemps comme le principal responsable des émissions de gaz à effet de serre. Les investissements dans les transports en commun sont nécessaires, et cependant il st souvent difficile d'obtenir un financement conventionnel en raison du niveau élevé d'investissement nécessaire et des priorités du gouvernement. Les transports urbains sont aussi souvent considérés comme faisant partie du domaine de l'initiative privée, ce qui rend difficile pour le gouvernement d'y affecter de l'argent public. La ratification du protocole de Kyoto a pavé le chemin de la recherche d'alternatives de financement pour le développement durable. Le « Mécanisme de Développement Propre » (MDP) de Kyoto a fourni une occasion pour les responsables du transport urbain dans les pays en développement de co-financer des projets de transport en commun urbain basés sur le principe de la commercialisation des droits d'émission du gaz carbonique . La possibilité de mettre en place des projets de transport en commun urbain dans le cadre du MDP est essentielle pour ce type de projets. De futurs travaux devraient être orientés vers la recherche d'une méthodologie permettant d'incorporer des mesures « douces » et d'assurer un bas niveau d'impact sur d'autres activités.

1 BACKGROUND: CLIMATE CHANGE AND TRANSPORTATION ACTIVITY

Emissions of greenhouse gases from the transportation sector increase at an alarmingly rapid pace in major cities in Indonesia. Greenhouse gas emissions from the transportation sector are especially of concern, since end-of-pipe measures that are effective in curbing local pollution will not work for greenhouse gas emissions. In 1990, transportation sector contributed one third of the 125 billion tons (gigatons, GT) carbon dioxide emissions in the energy sector, and most of the contribution came from road transportation. Approximately 30 GT of the 35 GT of the total emissions from the transportation sector in Indonesia were generated by road transportation.

Table 1. Projection of total CO2 emissions from the energy demand sectors in Indonesia to 2025

Sector	Total CO2 emission (million t)				Growth Rate
	2000	2010	2020	2025	(% year)
Industry	58	73	109	141	2.4
House-holds	21	23	22	25	0.4
Transport	55	76	128	168	3.4
Power plants	54	90	220	275	5.1
Energy - Industry	40	35	48	63	1.9
TOTAL	228	298	526	672	3.3

Source: National Strategy Study on CDM, 2001, SME-GTZ, pp. xxii

As a result of the expanding transportation sector, energy demand and the associated air pollution produced by the transportation sector are expected to increase rapidly. Between 1994 and 1999, the energy consumed by the entire transportation sector increased from 36.5 percent to 40.1 percent of all final commercial energy produced in Indonesia (Dalimi et al. 2000). In the years to come, it is expected that land transport will consume more than half of the total energy consumption in the transportation sector. Indonesia's subsidized fuel tariffs discourage energy efficiency. The recent report on fuel tariffs and taxation stated that, with US$ 0.07 and $ 0.16 per liter, Indonesia is ranked among the countries with very low diesel and gasoline prices, respectively. These tariffs are below the "before tax retail prices at the pumps" of $ 0.18 and $ 0.21 per liter, respectively (Metschies. 1999).

Partially as a result of the disparity in the economic development, urbanization will increase at an even more rapid pace. It is estimated that by the end of 1995, 45 percent of the 200 Indonesians inhabited the urban areas. This figure will be more than half in 2020, if no radical measures are initiated to flex the trajectory. As a result, demand for, and the impacts on the society and the environment of urban transportation will significantly increase. Eventually, the contribution to the increased greenhouse gas emissions as well as other pollutants from the transportation sector, especially land transportation, will increase.

The Ministry of the Environment introduced an environmental program of the Blue Sky Program in July 1992 and launched in August 1996 (in 4 provinces). An immediate action of the program was the installment of air quality monitoring instruments in participating regions. As part of the program, land transport sector has produced a document entitled *The Implementation of an Environmentally-Sound Land Transportation Programme*. Several action programs have been listed, including the utilization of CNG buses, electric-rail based public transport in big cities, the use of ATCS (Automated Traffic Control System) in big cities, and implementation of catalytic converter, 16 and 24 valve technology as well as reducing the number of two-stroke vehicles. There was 4 years delay in commencing the program and the slow implementation of program listed in the document showing that more efforts are necessary to promote and implement "green mobility" concept.

2 THE KYOTO PROTOCOL AND THE CLEAN DEVELOPMENT MECHANISM

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was formally adopted by the third session of the Conference of the Parties (COP 3) on 11 December 1997 in Kyoto, Japan. The Protocol establishes a legally binding obligation on Annex I countries (subject to entry into force) to reduce emissions for six greenhouse gases (GHGs) in total by about 5.0% below 1990 levels by the years 2008-2012. Six greenhouse gases are covered, not only carbon dioxide which accounts for the vast majority of emissions, but also methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride.

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An important element of the Protocol lies in the adoption of a five-year commitment period, rather than a target set for a single year. In the Article 10 of Kyoto Protocol, it was stated that "All Parties, taking into account their common but differentiated responsibilities, shall formulate, implement, publish and update programmes including measures to mitigate, and adapt to, climate change, covering energy, industry and transport sectors. Parties should also develop and promote modalities for the transfer of environmentally sound technologies."

In the Article 12 of the protocol a measure called Clean Development Mechanism is available for non Annex I countries which include Indonesia. In the article it was stated that "A Clean Development mechanism is established to assist non-Annex I Parties in achieving sustainable development. Certified emission reductions achieved through individual projects which reduce GHG emissions beyond what would have occurred in the absence of that project, can be used by Annex I Parties to help meet part of their commitments in Article 3. Certified emission reductions achieved between 2000 and 2008 can be credited against commitments under the first commitment period (2008-2012). A share of the proceeds from certified project activities is to be used to assist developing countries vulnerable to the adverse effects of climate change to meet the costs of adaptation."

3 THE PRINCIPLES OF CDM APPLIED TO TRANSPORT SECTOR

The Clean Development Mechanism is the sole mechanism to allow countries not included in the

Annex I, which are industrialised countries to participate in the global effort in reducing GHG emissions. The developing countries will now have the opportunity to attract investment in projects where potential reduction in GHG exists. This opportunity occurs because locations of projects are indifference in contributing the GHG emissions reduction while their abatement costs may differ substantially. Costs of reducing similar amount of carbon in a developed country will relatively higher than in developing countries.

The term "creditable emissions" is therefore defined as the difference of GHG emissions between the implementation of the project and the baseline condition where the project is not implemented or is otherwise implemented with "dirtier" technology. The estimation of GHG emissions reduction can be diagrammatically shown in the figure below.

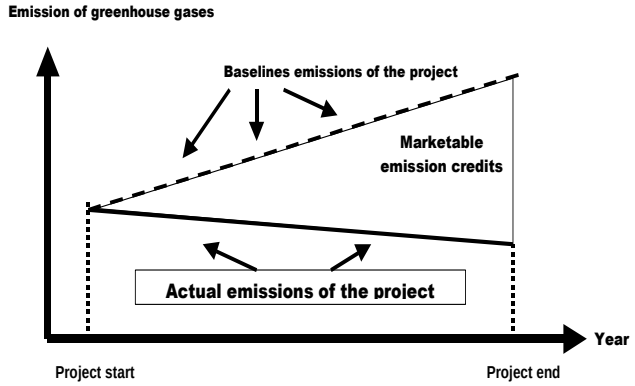

Figure 1. Estimation of tradeable carbon credits

The CDM has been designed to comply a set of steps and to comply with a certain regulatory rules. Figure 2 below demonstrates the typical project cycle.

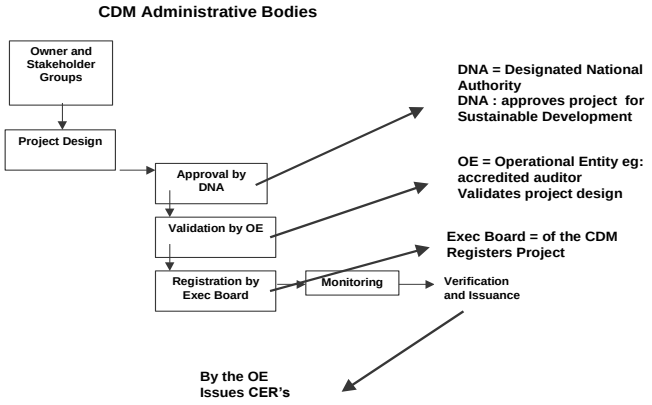

Figure 2. CDM Project Cycle

There are several institutions involved in the project before the emission reduction can be listed or "sold" at the negotiated price. There are Designated National Authority, Operational Entity, and Executive Board which are the three bodies prerequisite to endorse, validate and register the CER. Meanwhile there will also be a monitoring entity and a institution to verify the actual CER.

While the above cycle represents the typical project cycle, the actual cycle may vary between unilateral project, bilateral, multilateral and "open architecture".

4 YOGYAKARTA URBAN BUS PROJECT AND CDM OPPORTUNITY

Yogyakarta, a city with around 475.000 inhabitants has developed into an urban area with population of around 1.000.000, living in places beyond the city's administrative boundaries. With 32.50 km2 of area, its population density is ranging from 7,327 person/km2 to 27,373 person/km2, creating a dense city and thus ideal for public transport operation. In the suburban area, the density remains low with approximately 5,000 person/km2. The city has also 238,249-km road network covering approximately 5% of the city area. It means that the road is relatively narrow with low capacity. It should be pointed out that the attempt to widen the road is unlikely to happen due to high building density along its roads. The urban area of Yogyakarta is an agglomeration of the city of Yogyakarta and two nearby regencies, Bantul and Sleman. The city is known as the cultural capital of Java attracting a number of foreign and domestic tourists. Over the years, the number of domestic as well as foreign tourists showed a promising future of tourism expect during the economic-turn-political crisis. Despite such condition, it estimated that the number of domestic and foreign tourist will reach 1.225.000 and 300.000 in 2003 respectively (CTRD, 1999)

Figure 3 Map of Yogyakarta City.

With around 50 universities and colleges, Yogyakarta is certainly a magnet for students around the country, demonstrated by a number (69.744 students) and high percentage (15%) of university/college students to the city population. It also at-

tracts foreign students to stay for educational purposes. The tremendous increase in the use of motorcycle and public buses in recent years are the powerful reflection on how much is the influence of Yogyakarta as an education-city.

At the moment, Yogyakarta public transport system is a combination of 30 – 40 seater urban buses operating individually (owned by both public and private companies), taxis, rickshaw and horse drawn cart. The buses are operated by sub-letting the vehicle to the bus driver and leaving the bus owner with a certain sum of money as a bus-rent. Rickshaw and horse drawn cart are already non-air polluted mode of transport. The numbers of taxis are not too many and thus leaving urban buses as the potential target for Carbon Emission Reduction Programme. Recent study has demonstrated that the bus system operates in the over-supply environment creating energy inefficient operation, neck-to-neck competition resulting in high traffic violation and a danger of severe accidents. The condition is worsened with the fact that buses are 10-20 years old and inadequately maintained. At the moment the urban bus system has approximately 500 buses and 17 routes producing more than 20 million vehicle-km annually.

Figure 4. Photographs of Yogyakarta Urban Buses

Recent survey conducted by Local Environmental Impact Assessment Agency (1999-2000) has demonstrated that the despite a good ambient level in Yogyakarta selected locations, the pollution emitted by urban public buses have exceeded the preferred level.

Table 2. CO2 Emission level for Transportation Activity in Yogyakarta City

CO2 Emission (Tons)			
Year	Community	Corporate	Total
2001	236,102	1,014	237,116
2005	325,013	1,484	326,497
2010	489,669	2,390	492,059

Source: Draft Report, 2002. The City Government of Yogyakarta and The Center for Transportation and Logistics Studies Gadjah Mada University

5 SETTING THE TARGET OF CDM PROJECT

In developing a CDM project it is important to identify a target so the estimation of the equivalent carbon dioxide reduction can be quantified. The project has established the following target and the source of reduction:

a. 25% reduction in the carbon dioxide emitted by urban buses at the end of demonstration project
b. 10 – 15% reduction in the carbon dioxide emitted by the urban bus system
c. 5 – 10% reduction in carbon dioxide ambient

It is expected – although beyond the GHG scope, to have a 15% reduction in tail-pipe black smoke produced by urban buses which will improve public transport image and maintain or improve public transport ridership

As a by-product of the project, it is expected that a substantial reduction in bus-related traffic violations and accidents and an increased bus operator's revenue will occur.

The feature of the CDM project is unfortunately in favour of "hard measures", that is interventions that are giving a direct measurable impact to the GHG reduction efforts. The hard measures planned for the project are as follows.

5.1 *Providing cleaner engines*

Measures to promote cleaner engines may include minor modification and adjustments to conform factory standards, improving efficiency. This is a non-expensive option. The use of fuel additive seems inefficient although during the course of project, such alternatives can be investigated further. The fact that most fleet now are over 16 years of age, introducing cleaner and more efficient engine may cut fuel consumption and also carbon around 10-15%.

5.2 *Introducing alternative fuels*

Alternative fuel will be developed or introduced – in the presence of available technology, to reduce carbon emission. Using lower C/H ratio will reduce carbon emission considerably. For instance, CH4 (methane) will produce 2.75 kg CO2 fuel, while C8H18 (octane) will emit 3.08 kg CO2 pr kg fuel in exhaust gas. From energy production point of view, CH4 will release 0.055 kg CO2 per MJ energy produced by the combustion and C8H18 will produce 0.068 kg C02 per MJ. This means a reduction of carbon emission around 20%. Possible options will be LPG, natural gas, and gasohol/biomass. Learning from gas implementation for taxis and buses in Ja-

karta, a model for gas operated midi buses can be developed in Yogyakarta. Alternative fuels may also include the introduction of a mixture on diesel fuel to assure lower carbon emission, e.g. to produce better spray in engine nozzles.

5.3 *Vehicle replacement strategy*

Most buses in Yogyakarta are old at age. Yet renewal seems to be not working accordingly especially due to vehicle cost increase as a result of the economic crisis. Alternatives should be developed to assure that no dirty engines operate. Alternatives may include (on the order at increasing cost).

i. Engine replacement (with younger engines)
ii. Engine renewal
iii. Bus retrofit
iv. Bus renewal

Replacement can be so arranged that benefit can be claimed by choosing certain make or types of vehicles and set collaboration with the vehicle/engine producer on a mutual basis.

The improvement of the management, e.g. soft measures can be incorporated using revenue stream from the selling of CERs. While it is beyond the CDM scope, the improvement of public transport management, namely the restructuring urban public transport management (Sirait and Parikesit, 2000), improving routing and scheduling (Tan, 2000), and an enabling environment for efficient urban bus system operation.

6 ISSUES IN THE CDM PROJECT

6.1 *Sustainable development issues*

CDM project requires that it does not only produce a reduction in GHG emissions but must also contribute to sustainable development of the host country. The sustainability, as defined by the Brutland Comission, should ensure economic, social, environment and more recently technological (or rather technological indepence) sustainability of the project.

6.2 *Determination of baseline and project duration*

The project chooses to use a static baseline (as opposed to dynamic baseline) because of its simplicity. It however requires a maximum of 7 years project duration. The investor also tends to prefer static baseline since it gives a relative security and easy estimation of CERs. The project is aimed as a-fast track project with 7 years credited period which happens also to coincide with the duration required by the Indonesian government for a mandatory vehicle renewal programme.

6.3 *Project leakage*

Project leakage is defined as “Potential sources if increased green house gases emissions outside project boundary that are significant and reasonably attributable to project activity” (Para. 89 (c) FCCC/CP/2000/CRP.2/Add as quoted in SME, 2001). The example of the project leakage in urban transport project is when the new buses are introduced, old buses use elsewhere are regarded as the leakage.

6.4 *Financing architecture*

As stated above, project must choose between unilateral, bilateral, multilateral and "open architecture". The choice is far from trivial since they reflect the opportunity to provide "best negotiated prices" of both project owner and buyer. The financing architecture is also important since there are several other players than just buyer and seller. In the carbon market, like in the stock market, we must recognize the roles and motives of the country, carbon broker, fund manager and clearing house fund.

6.5 *Mitigating project risks*

The soft measures would produce significant impacts since the current system has been running for two decades. To implement the scheme, a close collaboration from Transport Authority at Yogyakarta (DLLAJ) and the oldest and largest bus company (KOPATA) will be the key to success. But the challenges may rise from inefficient bus operators and officials who issuing license. To this end government support is required. The other impacts may accrue to bus operators for the new system. In order to overcome such problem, this management training is needed to prepare operators for the new system.

For hard measures where they may be costly, a financial arrangement should be properly planned. For vehicle renewal or engine replacement, the involvement of banks for private sector lending as previously occur need to be combined with the proposed plan is this project. It is also possible to obtain support from environmental concern groups. Financial support can also developed by involving a certain make of buses or engines in vehicle or engine renewal project.

6.6 *Financial feasibility*

Financial feasibility of the project is essentially follow the basic principles of creditable carbon reduction investment as suggested by Clean Development

Mechanism Process. As far as the cost of reducing the carbon dioxide (and perhaps later, other GHG) is less than the reduction of CO2 than the project will considered financially acceptable. The project will assume that the cost of CO2 is between 5 – 15 USD/ton. With the recent pull-out of the US, it is estimated that the international price of tradeable carbon is reduced quite substantially down to approximately 3 USD/ton.

In the presence of extra investment, for example in the case of bank loan required supplementing the vehicle replacement strategy, the amount of extra investment should be regarded externally and offsetted by the revenue stream. The funds received for carbon reduction programme will be used as incentives for replacing the engines, which will not, happened otherwise. This will later require a delicate cost and revenue (in terms of cash and carbon savings) accounting to ensure that impacts of both investments can be clearly separated.

Another important aspect in estimating the financial feasibility of the project is the project duration. While the investment is made in two years time, the carbon reduction will be gained beyond that period. Hard measures will produce an instant result. Meanwhile applied soft measures may yield an immediate and long term results. In many cases of bus renewal programme, a period of 7 years is seen an appropriate evaluation period.

7 CONCLUDING REMARKS

Investments in urban public transport is needed yet the conventional financing schemes from internal government revenue as well as from donor and lending agencies are often difficult to obtained due to the high level of investment and the current government priorities. Urban public transport in developing countries is also seen as fall within the private sector domain - making it difficult for government to spend public money. The ratification of a Kyoto Protocol has paved ways to develop a financing alternative for environmental projects. CDM or Clean Development Mechanism as one of the mechanism within the Kyoto Protocol has provided an opportunity for governments, especially urban transport authorities in developing countries to finance urban public transport project using the principle of a carbon trading.

Transport sector has not been fully utilizing the opportunity in CDM of the Kyoto Protocol. Other sector, notably the energy sectors and housing sector has been the forefront of the attempts. The difficulties in determining the baseline, reducing the leakage and improving monitoring methodology require intensive research to improve the chance for transport sector to gain full access to the world carbon market.

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9 REFERENCES

Anonymous. 2002. *Strategies for Blue Sky and Energy Efficiency Programme for The City of Yogyakarta.* Draft Report. Unpublished. City Government of Yogyakarta and Center for Transportation and Logistics Studies Gadjah Mada University. Yogyakarta.

Center for Tourism Research and Development, 2001. *Yogyakarta Tourism Masterplan Review*. Yogyakarta: CTRD.

Dalimi, R., et al., 2000. Indonesia 2000*: Energy Outlook & Statistics*. Jakarta: Ministry of Mining and Energy.

Gelbspan. R. 2000. In Focus*: The Climate Crisis and Carbon Trading.* Vol. 5. http://www.lightparty. com/Foreign Policy/FPIP-05-20.html

Janssen.J.& W. Kaegi. 2001. *Introduction to Joint Implementation, Clean Development Mechanism, International Emissions Trading.* IWOw-HSG. http://searchpdf.adobe.com/proxies/2/34/30/46.html

Metschies, G. 1999. Fuel Prices and Taxation with comparative tables for 160 countries: *Pricing Policies for Diesel Fuel and Gasoline in Developing Countries and Global Motorization Data*. GTZ.

Sirait, M & D. Parikesit. 2000, Integration for Public Transportation in Urban Area under Natural Monopoly and Competition among Operators: *A Case Study of Yogyakarta, Indonesia*, EASTS 2000 Proceedings. Hanoi: EASTS.

State Ministry of Environment, 2001, *National Strategy Study on the Clean Development Mechanism in Indonesia*, State Ministry of Environment, Jakarta: State Ministry of Environment.

Tan, C. 2000. *Service Frequency Analysis, Case Study: City Bus Line Number 4 in Yogkarta.* Final Assignment. Unpublished. Civil Engineering Department. Gadjah Mada University. Yogyakarta

Toman. M & M. Carzola. 1998. The Clean Development Mechanism: *A Primer*. http://www. weatherane.rtf.org/feature/feature048.html

UNEP. 2001. *Climate Change Information Sheets*. UNEP/UNFCCC.