

Asian energy and environmental policy: Promoting growth while preserving the environment

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ABSTRACT

Asia has experienced spectacular economic growth over the past two decades. However, this economic progress has come at a high cost. It has led to unprecedented environmental consequences. So this region needs to shift the conventional pattern of “develop first and then treat the pollution” to a trajectory of sustainable development. To that end, this paper examines a variety of policy responses, at national, regional and international levels, to deal with growing concerns about the environmental challenges in Asia. In the context of national responses, special attention is paid to the following issues: coordination between the central and local governments, market-based environmental instruments and industrial policies, tougher emissions standards for mobile and stationary sources and fuel quality, policies to promote energy efficiency and the use of clean energy and biofuels, the integration of environmental policies with economic and sectoral policies, and engagement of the private sector through e.g., ecolabelling, green government procurement, corporate ratings and disclosure programs, and drawing the support of financial institutions to promote improved corporate environmental performance. The paper concludes that having the right policy mix, coupled with strengthened cooperation at national, local and regional levels, will ensure continuing economic growth in the region without compromising its limited ecological-carrying capacity and environmental quality.

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1. Introduction

Asia has truly experienced spectacular economic growth over the past 15 years. Some 270 million people have been raised out of poverty between 1990 and 2004. However, this economic progress has come at a high cost. Asia relies heavily on coal as its main commercial energy. Coal consumption in developing Asian countries accounts for 44% of their total primary energy and 57% of their total commercial energy consumption in 2004, in comparison with the corresponding world average of 25% and 28% (IEA, 2006a). This coal dominance in the energy mix in developing Asia and inefficiencies in production and use of energy and resources, combined with rapid urbanization and motorization, have led to unprecedented environmental consequences. An ongoing study by the Clean Air Initiative for Asian Cities (2006) shows that, despite that the levels of air pollution in Asian cities show downward trends over time, they regularly exceed the

World Health Organization (WHO) recommended guidelines as well as national air quality standards (Fig. 1). Air pollution levels in the most populated cities in this region are even reported to be among the highest in the world and continue to climb. Developing Asian countries are confronted with indoor air pollution from burning solid fuels as well. The WHO's first-ever country-by-country analysis shows that indoor air pollution is to blame for a total of about one million deaths in Asia, about 65% of the world's total (Table 1). Acid rain persists in this region, despite significant efforts towards reducing acidifying gas emissions. Periodic transboundary haze events are also prevalent in Southeast Asia. In this subregion, illegal forest resource exploitation also continues to be a problem. Many Asian countries are experiencing severe and in some cases, accelerating soil erosion, desertification and overgrazing in grasslands. Dust and sandstorms are now occurring more frequently than in the past, and are growing in scope and intensity in Northeast Asia (UNEP, 2004, 2005). Many developing Asian countries are confronted with water scarcity and water pollution (UNESCAP, 2006). On top of these environmental stresses, projected global climate change is expected to pose the additional threats to Asia (IPCC, 2007).

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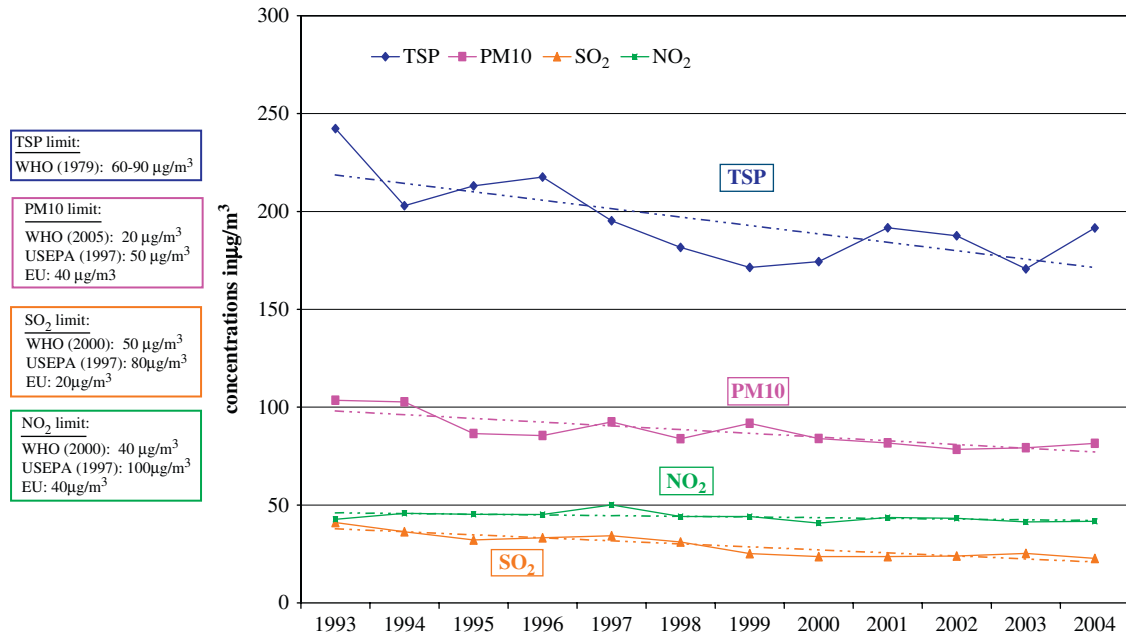


Fig. 1. Trends of major criteria air pollutants (1993–2004). Source: Clean Air Initiative for Asian Cities (2006).

Table 1
Estimated deaths caused by indoor and outdoor air pollution in 2002

	Indoor air pollution		Outdoor air pollution	
	Population using solid fuel (%)	Deaths per year ^a	Annual PM ₁₀ (µg/m ³)	Deaths per year
Bangladesh	89	46,000	157	8,200
Cambodia	>95	1,600	51	200
China	80	380,700	80	275,600
DPR Korea	No data	–	88	4,900
India	82	407,100	84	120,600
Indonesia	72	15,300	114	28,800
Japan	<5	–	33	23,800
Lao PDR	>95	2,400	25	<100
Malaysia	<5	<100	28	500
Myanmar	>95	14,700	75	3,900
Nepal	81	7,500	161	700
Pakistan	81	70,700	165	28,700
Philippines	45	6,900	34	3,900
Republic of Korea	<5	–	43	6,800
Singapore	<5	–	48	1,000
Sri Lanka	67	3,100	93	1,000
Thailand	72	4,600	77	2,800
Viet Nam	70	10,600	66	6,300
Asia	77	971,200	61	517,700
World	52	1,497,000	61	865,000

Sources: WHO (2007a, b).

^a For a country either with no data on the use of solid fuel or where less than 5% of its population use solid fuels, a national burden of disease assessment from indoor air pollution was not undertaken. In the latter case, that is because the method is not sensitive enough to provide reliable estimates.

The ecological footprint shows that, despite the fact that one-fifth of the population in Asia still lives on less than US\$1 per day (PPP-adjusted), this region already exceeds its biocapacity (Table 2). Put another way, the region is already living beyond its ecological-carrying capacity. As shown in Fig. 2, 13 countries or over 60% of countries in this region already run the ecological deficits (namely, footprint minus biocapacity is negative; if the sign is positive, then country has an ecological reserve). The region is facing a dilemma. On the one hand, compared with other

Table 2
Per capita ecological biocapacity, footprint and deficits/reserves by region in 2003

Region	Biocapacity (hectares)	Ecological footprint (hectares)	Ecological deficit or reserve	
			Value (hectares)	% of biocapacity
Asia Pacific	0.7	1.3	–0.6	–86
Africa	1.3	1.1	+0.2	+15
Latin America	5.4	2.0	+3.4	+62
Middle East and Central Asia	1.0	2.2	–1.2	–120
North America	5.7	9.4	–3.7	–65
European Union 25	2.2	4.8	–2.6	–118
The Rest of Europe	4.6	3.8	+0.8	+17
World	1.8	2.2	–0.5	–28

Notes: + ecological reserve; – ecological deficit.

Source: Global Footprint Network (2007).

regions like North America and European Union which also face ecological deficits but are well developed, Asia has to continue its rapid economic growth in order to alleviate the poverty of the two-thirds of the world's poor living in this region. On the other hand, that economic growth will further place tremendous strains on the environment. Thus, it is of paramount importance to the region to cooperate at national, local and regional levels and have the right policy mix to ensure continuing economic growth without compromising its limited ecological-carrying capacity and environmental quality.

Following an introduction, Section 2 discusses major causes for environmental degradation in Asia. Sections 3 and 4 examines responses, both at national and international levels, to deal with growing concerns about the environmental challenges in Asia in order to help to put the region on a more sustainable development path. Section 5 presents key findings and conclusions.

2. Major causes of environmental degradation in Asia

Much of the environmental degradation in Asia occurs as a result of market failures, inefficiency in production and use of

energy and resources, local governments' inability or non-cooperation, lack of integrated planning, and weak environmental regulatory agencies.

The prices of energy resources have been kept low in developing Asian countries, and subsidizing fossil fuels is a quite common practice in this region, although the levels of these subsidies have been cut in some countries over the past years. In terms of fuels, the biggest subsidies in absolute (dollar) terms go to oil products in many countries (Fig. 3). Iran has the biggest oil subsidies estimated at about US\$24 billion. This is largely because Iran continues to heavily subsidize transport fuels (i.e. gasoline and diesel), while other countries have significantly cut subsidies to these fuels in percentage terms in recent years (Table 3). This oil subsidy, combined with other energy subsidies, puts the total Iranian subsidies at the estimated US\$37 billion in 2005, which are equal to about 20% of GDP in 2005—by far the highest in the world, and are more than all energy subsidies (estimated at US\$20–30 billion/year) in the OECD countries as a whole (IEA, 2006a,b). Indonesia has the second largest oil subsidies. ADB (2005) estimates that annual oil subsidies in Indonesia averaged US\$6 billion between 2000 and 2005. With the increases in world oil prices, oil subsidies in Indonesia were projected to have

ballooned to US\$6.8 billion in 2004 and more than US\$12 billion in 2005—equal to 5% of GDP and almost a third of the total government spending (ADB, 2005; IEA, 2006a,b). In percentage terms, under-pricing is the biggest for natural gas. On average, consumers in the countries listed in Table 3 pay less than half the true economic value of the gas that they use. Electricity subsidies are less prevalent, but are large in some countries (IEA, 2006a).

As a result of energy subsidies, energy prices in developing Asian countries don't even reflect the cost of production. Certainly they reflect neither the situation of supply and demand on the market, nor the scarcity of energy and resources. They also do not incorporate externalities such as environmental and health impacts. This has led to inefficient production and use of energy and resources, creates no incentive for energy and resource conservation, and gives rise to quite amount of emissions that can otherwise be avoided if subsidies are removed and resource prices get right.

Inefficiencies in production and use of energy and resources and in pollution reduction are widespread within the region. This pattern is reflected both in individual sectors of the economy, such as energy production and transportation in which energy-intensive and highly polluting outdated technologies and modes are still used, and in the economy as a whole. As indicated in Fig. 4, energy use per unit of GDP, a key indicator of patterns of energy use, is still high in many developing Asian countries, and even increased in countries such as Brunei, the Philippines, Malaysia, South Korean and Thailand between 1990 and 2004. Indonesia and Pakistan consumed almost the same amount of energy per unit of GDP as they were in 1990. In the meantime, as indicated in Fig. 5, the rate of energy efficiency improvement in IEA countries has been less than 1% per year since 1990—much lower than in previous decades (IEA, 2007a). This explains why Australia, the host country of the APEC Leaders Summit in September 2007, proposed that all 21 APEC economies, regardless of whether they are developed and developing economies, agree to reduce energy intensity by at least 25% by 2030, but in the end the leaders only agreed to work towards achieving an APEC-wide (emphasis added) aspirational goal in energy intensity by at least 25% by 2030, relative to 2005 levels (Zhang, 2007e).

For a pollution indicator like the amount of CO₂ emitted per unit of GDP, as indicated in Fig. 6, many Asian countries

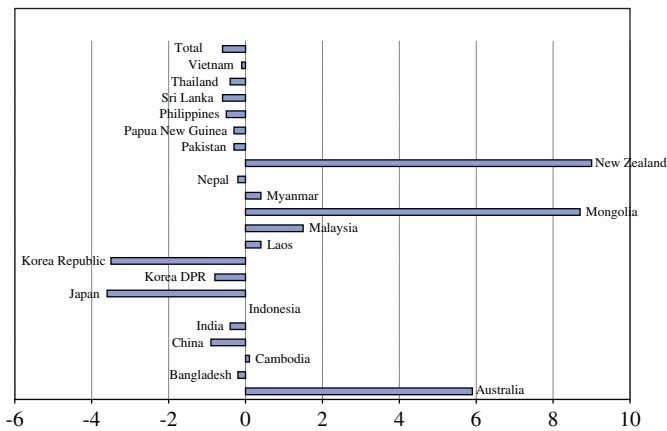


Fig. 2. Per capita ecological deficits and reserves in Asia and the Pacific in 2003 (hectares). Source: Drawn based on data from Global Footprint Network (2007).

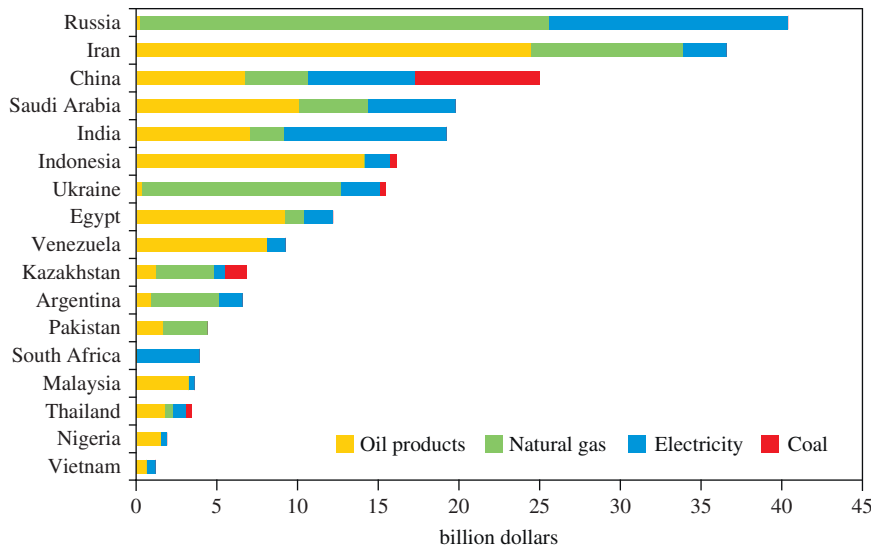


Fig. 3. Economic value of energy subsidies in non-OECD countries in 2005. Source: IEA (2006a).

Table 3
Consumption subsidy as percentage of reference energy price in non-OECD countries in 2005

	Gasoline	Diesel	Kerosene	LPG	Light fuel oil	Heavy fuel oil	Natural gas	Coal	Electricity
China	5	13	3	18	0	0	45	17	0
Chinese Taipei	0	0	0	9	27	6	0	5	0
India	0	0	47	26	0	0	70	0	5
Indonesia	24	54	58	30	35	n.a.	0	58	13
Malaysia	26	37	0	33	9	0	n.a.	n.a.	5
Thailand	0	16	0	35	0	0	65	57	10
Pakistan	0	28	19	n.a.	21	n.a.	59	0	n.a.
Philippines	0	0	5	0	34	n.a.	n.a.	n.a.	0
Vietnam	6	26	5	0	n.a.	n.a.	n.a.	n.a.	14
Iran	82	96	76	67	32	73	66	0	30
Saudi Arabia	51	81	6	n.a.	81	n.a.	89	n.a.	54
Egypt	65	80	88	94	80	71	76	0	4
South Africa	0	0	0	0	0	0	n.a.	0	41
Nigeria	19	17	42	6	n.a.	n.a.	n.a.	n.a.	24
Brazil	0	0	n.a.	0	0	n.a.	n.a.	n.a.	0
Argentina	20	5	0	0	0	0	58	n.a.	27
Venezuela	90	96	0	82	94	84	n.a.	n.a.	25
Russia	0	0	0	0	0	16	57	0	34
Kazakhstan	28	20	n.a.	n.a.	49	48	83	86	24
Ukraine	0	23	n.a.	n.a.	n.a.	n.a.	83	36	27
Weighted average	1	15	27	19	6	10	57	12	8

n.a.: not available.

Note: Based on weighted average subsidies and prices across final sectors for each fuel. Cross-subsidies between sectors are, therefore, not included.

Source: IEA (2006a).

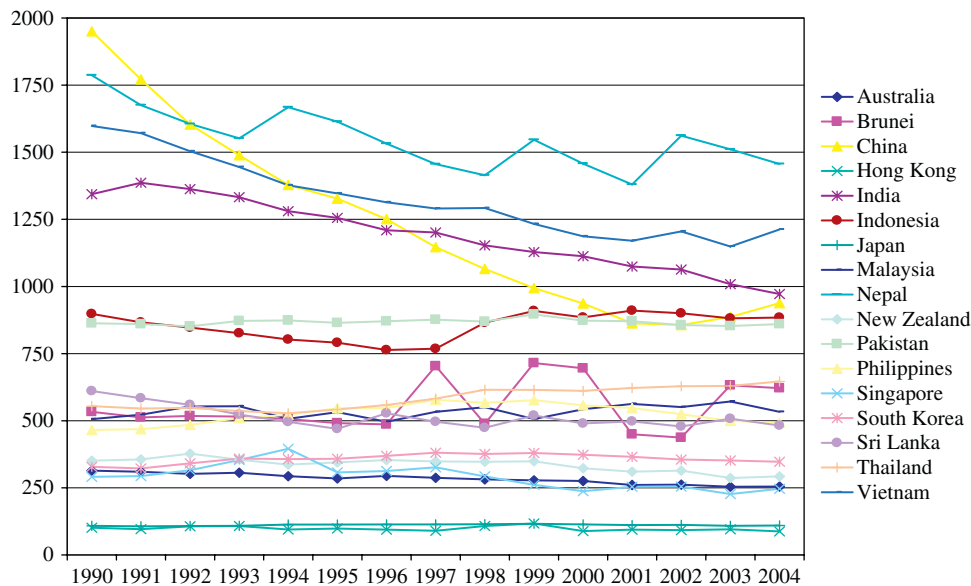


Fig. 4. Energy use per unit of GDP in the selected Asia Pacific countries, 1990–2004 (tons of oil equivalent/million 2000 US\$). Source: Drawn based on data from the World Bank (2007).

reduced the CO₂ intensities of their economies over the period 1990–2003. However, there were still quite a few countries that emitted more CO₂ per unit of GDP in 2003 than they were in 1990.

Local governments' inability, or non-cooperation, has been a major reason for the failure to meet energy efficiency and environmental goals set by the national governments. The national government of China has implemented policies to shut down plants that are inefficient and highly polluting, and to keep the frenzied expansion of offending industries under control. Local officials strongly resist, because these companies provide jobs and create tax revenues as well as personal payoffs.

Forcing companies out of business could even trigger local unrest. As an example, September 2006, the National Development and Reform Commission (NDRC), China's top economic planning agency, ordered provincial governments to raise power tariffs for eight energy-guzzling industries including cement, aluminum, iron and steel, and ferroalloy. However, it is reported that by mid-April 2007, not only had many local governments failed to implement the differentiated tariffs that charge more for companies classified as "eliminated types" or "restrained types" in these industries, but 14 of them even continued to offer preferential power tariffs for such industries (Zhang, 2007a, d, f).

Effectively addressing environmental problems not only needs to get local governments involved, but also involves many line ministries and multi-sectors. But the presence of a multitude of institutions with multiple objectives creates coordination problems. As a result of this institutional failure and high transaction costs, environmental goals and performance requirements, even if they were identified, are rarely integrated into the overall economic or sectoral policies, thus undermining their effectiveness during implementation.

Weak environmental regulatory agencies also have a large part to play for environmental degradation in this region. On the one hand, environmental protection in the region is regarded as a policy goal to be pursued exclusively within environmental ministries or equivalent agencies. Few countries effectively mobilize other line ministries to this challenging task. On the other hand, although there are so many environmental regulations, they only look good on paper. Environmental ministries or equivalent agencies in the region are often ill-equipped either to enforce existing regulations or to design, implement, monitor, inspect and enforce new effective environmental policies.

The State Environmental Protection Agency (SEPA) of China was for years seen as a powerless entity. While China's environmental regulatory agency was given a new lease on life and was

elevated from a lowly vice-ministry rank to full ministerial status, the SEPA still does not have the authority to suspend proposed projects violating environmental laws and regulations or to remove officials who should be held accountable for this non-compliance. It also lacks the authority to manage local environmental bureaus (Zhang, 2007a).

In case the SEPA decides to impose a penalty on violators of environmental impact assessment (EIA) laws and regulations, as indicated in Table 4, the maximum fine at its disposal is just 200,000 Yuan (about US\$25,000). Even for environmental accidents as serious as the Songhuajing River spill in November 2005 in Northern China, the incident that had unprecedented international implications as well as domestic social, economic and environmental ramifications, the maximum fine by China's current environmental laws is just 1 million Yuan, which was actually imposed 1 year after that incident. Moreover, the fine is only allowed to be imposed once (Zhang, 2007a, d, f). As a result, this low and one-off penalty is hardly a deterrent to environmental offenders. To make things worse, even these weak punishments empowered by current environmental laws are still weakly enforced in China because environmental protection agencies at all levels of the governments are underfunded and inadequately staffed.

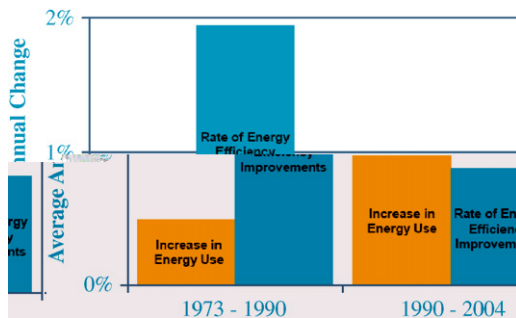


Fig. 5. The rates of both energy efficiency improvement and increase in energy use in IEA countries, 1973–2004. Source: IEA (2007a).

Table 4

Maximum fines by category of violators of environmental laws and regulations in China

Category	Applicable laws	Maximum fines allowed (10,000 Yuan)
Exceed the pollution limit	Atmosphere Pollution Prevention and Control Act	10
Air pollution accidents	Atmosphere Pollution Prevention and Control Act	50
EIA violators, imposed only after the grace period	Environmental Impact Assessment (EIA) Law	20
Extraordinarily environmental accidents	Water Pollution Prevention and Control Act	100

Sources: Zhang (2007d, f).

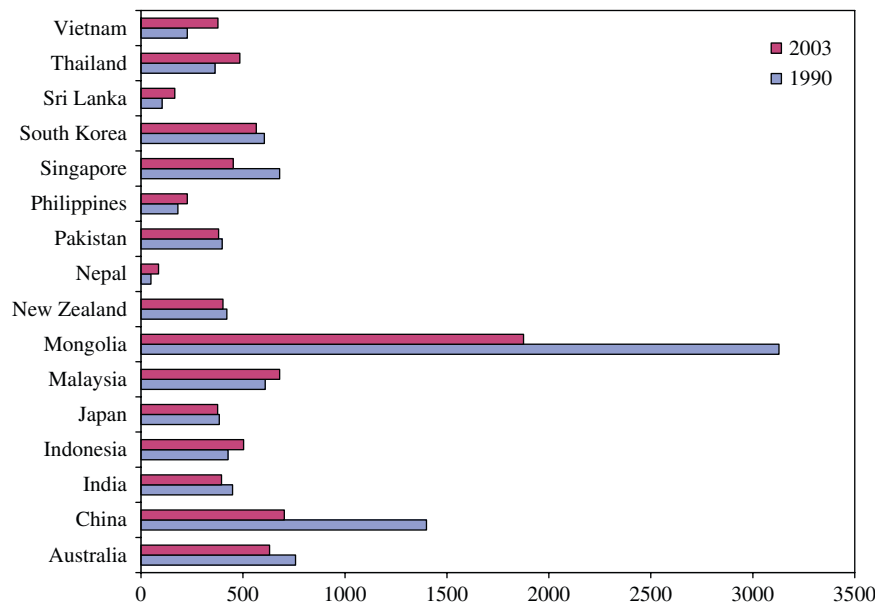


Fig. 6. CO₂ emitted per unit of GDP in the selected Asia Pacific countries, 1990–2003 (tons of carbon dioxide per million 2000 US\$). Source: Drawn based on data from the World Resources Institute (2007).

3. National responses

3.1. Get local governments and polluting companies cooperation

Confronted with the rising costs of environmental degradation associated with rapid economic growth, the central governments in Asian countries have gradually recognized that the conventional path of encouraging economic growth at the expense of the environment has to be changed. They are convinced of the need to clean up their countries' environmental act. Accordingly, they set environmental goals and environmental performance requirements. But they are not adequately equipped with their tasks. As a result, poor compliance and weak enforcement are common in this region. Correcting such a problem requires a major investment in strengthening the institutions of environmental governance to ensure that they have the adequate institutional, financial and technical capabilities to do the job. This is a necessary step, but not enough. We need the full participation of all stakeholders in protecting the environment. In this regard, local government's cooperation is crucial to the overall outcomes. As often be the case, what the center wants isn't necessarily what the center gets. An old Chinese saying goes, "The mountains are high, and the emperor is far away". Central governments need to let go of the notion that they should or even can do it all. Clearly, the central governments need local officials' cooperation to get these policies implemented. Otherwise, there is no use to set and defend stringent national environmental goals if the central governments are unable to get local governments cooperation.

To gain local officials' cooperation on the environmental issues, incentives need to be provided. Over the past decades, many Asian countries have decentralized in the allocation and responsibility and have shifted control over resources and decision-making to local governments. This devolution of decision-making to local levels has placed environmental stewardship in the hands of local officials who are more concerned with economic growth than the environment. Therefore, effective environmental protection must be placed in this context of government decentralization.

Under the current evaluation criterion for officials in China, local officials typically have been promoted based on how fast they expand their local economies. That has created an incentive for officials to tempt to disregard the environmental costs of economic growth. To correct this distorted view of local officials' accomplishments and to implant environmental consequences in their minds, environmental performance has to be considered as well. If environmental quality does not get improved during the official's tenure, that official should not be promoted. This will help the local officials realize that they should take their jobs seriously because they have a very real stake in meeting environmental goals.

To that end, the central government of China has been using a variety of the tactics to incentivize local governments. They include placing those cities that meet the specified criteria on the honor role (the so-called model environmental city program), publicly naming the blacklist of "the 10 most polluted cities" and those cities with air quality below the class III standard designed for industrial areas, having officials hold accountable for major environmental accidents, releasing the first-ever report on economic costs of pollution (the so-called green GDP) to help the general public and officials alike to understand how seriously China confronts the rising costs of environmental degradation associated with its rapid economic growth, blacklisting those industrial projects (some even being considered the so-called "national key projects") that had not undergone proper EIAs, and suspending the local governments' rights to approve new projects in case there are offenders of environmental laws and regulations

in their turfs. The latter is the so-called regional permit restriction. It is based on an ancient Chinese punishment of incriminating relatives and associates related to the main suspect. In January 2007, the SEPA made an unprecedented move, suspending EIA approval of any new construction projects in the four cities and the four major national power-generating groups until they bring their existing facilities into compliance with environmental regulations. Once their EIA approval rights are suspended, no new construction projects are allowed to be built in these cities and by these power-generating groups until all violators are in compliance with environmental regulations. Given that China's economy is investment-driven, local governments are fully aware of the consequences of the suspension of their right to approve new construction projects. To disregard the environmental problems in their regions now can cost them a lot (Zhang, 2007a). Moreover, the central government embarks on fund specifically for cleaning up the environment, and encourages local governments to experiment market-based instruments to help to lower the compliance costs.

China launched the bulletin system to release data on energy use per unit of GDP and other indicators by provincial region in 2006 (People's Daily, 2005). According to the first bulletin on energy use per unit of GDP and other indicators for 2006, only Beijing met energy-saving and emissions-cutting goals in 2006, cutting its energy use per unit of GDP by 5.25%, followed by Tianjin, another metropolitan city in China, with the energy-intensity reduction of 3.98% (NBS et al., 2007).¹ The SEPA could suspend the right to approve new construction projects in those provinces if they continue non-compliance with the energy-saving and environmental goals (Zhang, 2007a).

In addition to this distorted evaluation criterion for officials, objectively speaking, the current fiscal system in China plays a part in driving local governments to seek higher GDP growths because that system makes it hard to reconcile the interests of the central and local governments. Since the tax-sharing system was adopted in China in 1994, taxes are grouped into taxes collected by the central government, taxes collected by local governments, and taxes shared between the central and local governments. All those taxes that have steady sources and broad bases and are easily collected, such as consumption tax, tariffs, vehicle purchase tax, are assigned to the central government. VAT and income tax are split between the central and local governments, with 75% of VAT and 60% of income tax going to the central government. As a result, the central government revenue increased by 200% in 1994 relative to its 1993 level. This led the share of the central government in the total government revenue to go up to 55.7% in 1994 from 22.0% in the previous year. In the meantime, the share of the central government in the total government expenditure just rose by 2%. By 2006, local governments only accounted for 47.2% of the total government revenue, but their expenditure accounted for 75.3% of the total government expenditure in China (National Bureau of Statistics of China, 2007). To enable to pay their expenditure for culture and education, supporting agricultural production, social security subsidiary, etc., local governments have little choice to focus on local development and GDP. That will in turn enable them to enlarge their tax revenue by collecting urban maintenance and development tax, contract tax, arable land occupation tax, urban land-use tax, etc.

Another example of the improper tax-sharing scheme in China is related to the aforementioned differentiated tariffs. The NDRC (2006c) ordered provincial governments to raise power tariffs for

¹ Beijing is the first provincial region in China to establish in 2006 the bulletin system to release data on energy use and water use per unit of GDP, quarterly releasing these and other indicators by county. See Zhang (2007a, d, f) for detailed discussion on why Beijing met but the country missed the energy-saving goals.

Table 5
Differentiated tariffs for eight energy-guzzling industries in China

		Existing additional charge (Yuan/kWh)	Additional charge since 1 October 2006 (Yuan/kWh)	Additional charge since 1 January 2007 (Yuan/kWh)	Additional charge since 1 January 2008 (Yuan/kWh)
Eight energy-guzzling industries	Eliminated types	0.05	0.10	0.15	0.20
	Restrained types	0.02	0.03	0.04	0.05

Source: NDRC (2006c).

eight energy-guzzling industries from 1 October 2006 onwards (see Table 5), but many local governments failed to implement the differentiated tariffs that charge more for companies classified as “eliminated types” or “restrained types” in these industries, with 14 of them even continuing to offer preferential power tariffs for such industries (Zhang, 2007a,d,f). The reason for this failure is the lack of incentive for local governments to implement this policy, because all the revenue collected from these additional charges go to the central government (Zhang, 2007f). To provide incentive for local governments, these revenue should be assigned to local governments, but the central government requires local governments to use the revenue specifically for industrial upgrading, energy saving and emissions cutting.

3.2. Economic policies

Having the right economic policies is crucial because it sends clear signals to both producers and consumers of energy. Given the widespread use of fossil fuel subsidies in developing Asian region, removing these subsidies is essential to provide incentives for efficient fuel use and adoption of clean technologies that reduce emissions at sources. By definition, a subsidy lowers the cost of production, increases the price received by producers or lowers the price paid by consumers. By lowering the prices of fossil fuels, such fossil fuel subsidies not only are widely considered to distort international trade, but also increase the amount of such fuels consumed and thus the amount of harmful emissions (Zhang and Assunção, 2004). China, Indonesia and Malaysia are among the developing Asian countries that have since 2005 raised domestic energy prices to bring them more into line with international prices. This has led to sharp fall in overall energy subsidies in these countries despite rising international prices. For example, China cut its total energy subsidies to around US\$11 billion in 2006 (IEA, 2007b). This corresponds to a reduction of 58% compared to its 2005 level of around US\$26 billion (see Fig. 3). Despite this is long-awaited and encouraging, removing such subsidies is but a first step in getting the energy prices right. Further steps include incorporating the costs of resources themselves to reflect their scarcity and internalizing the costs of externalities. For example, current royalties on coal resources in China are based on production. That is, a coal miner pays certain amount of fees for each ton of coal produced. As a result, once a coal miner obtains mining permits, it mines recklessly. This irresponsible mining behavior is very common for small coal mines, and has led to a severe waste of coal resources, even to the destruction of coal resources. As would be expected, the coal recovery rate is reported to be only 10–15% for small coal mines. For the country as a whole, the average recovery rate is about 30%,² only 60% of the advanced level abroad

² Coal recovery rates differ with scale of mines, the level of mining technologies, and type of mines. For key state-owned coal mines, the rate is 50%.

Table 6
Levels of charges for atmospheric pollutants in China

Pollutants	Starting time	Levels of charge (Yuan/kg pollution equivalent)
SO ₂ emissions	1 July 2003	0.2
	1 July 2004	0.4
	1 July 2005	0.6
	1 July 2010	1.2
NO _x emissions	1 July 2003	0
	1 July 2004	0.6

Sources: SDPC et al. (2003), The State Council (2007).

(He, 2006). To avoid wasteful production of coal, current way in levying royalties on coal resources in China should be changed. The rational royalties on coal resources should be indexed with both the reserves and recovery rate of coal mines.

Market-based instruments, such as pollution charges, green taxes, tradeable permits, and penalties for the infringement of environmental regulations, are common ways to internalize externality costs into the market prices. Many Asian countries have traditionally relied on rigid command-and-control (CAC) approaches. With the poor environmental performance of such approaches and the cost and complexity associated with their implementation, more and more countries in this region are transforming from current reliance on CAC regulations to market-based policy instruments. The added pollution charges will be imposed on polluting companies as a simple cost of doing business that can be reduced by cutting pollution. This is seen to increase not only cost-effectiveness but also flexibility in complying with the set environmental regulations.

By amending the 1987 Atmospheric Pollution Prevention and Control Act, which newly added SO₂ emissions from coal combustion as the regulated pollutant, China has since 1996 started levying the charges for SO₂ emissions in the so-called Two Control Zones based on the total quantity of emissions and at the rate of 0.20 Yuan/kilo of pollution equivalent (Qian and Zhang, 1998; Yu, 2006). As indicated in Table 6, since 1 July 2003, this charge was applied nationwide and the level of this charge was raised step by step. From 1 July 2005 onwards, the charge was applied at the level of 0.60 Yuan/kilo of pollution equivalent. The pollutants that are subject to pollution charges are broadened to include NO_x as well, which is charged at the rate of 0.60 Yuan/kilo of pollution equivalent since 1 July 2004 (SDPC et al., 2003). To help to meet the energy-saving and environmental control goals set for the 11th Five-Year Economic Plan, the Chinese government plans by three steps to double the charges for SO₂ emissions from

(footnote continued)

The corresponding figure for surface mines reaches as high as 95%. But their output only accounts for 4.5% of the national total production (He, 2006).

Table 7
Vehicle emission standards and the time to enter into force in China, ASEAN and European Union

	Euro I	Euro II	Euro III	Euro IV	Euro V
European Union	July 1992	January 1996	January 2000	January 2005	September 2009 (proposed)
China	April 2001	1 July 2004	1 July 2007	1 July 2010	
Beijing	1999	August 2002	30 December 2005	1st half of 2008	
India	2000	2005	2010		
ASEAN		December 2005 (targeted)		December 2010 (targeted)	
Indonesia		Early 2006	1st Q 2007	2012	
Malaysia		Mid 2006		2010	
Philippines		December 2006		2010	
Singapore		2005		Oct 2006 (diesel)	
Thailand			Early 2005	2010	
Vietnam		July 2007		2012	

Sources: Auto Fuel Committee of India (cited in Menon-Choudhary and Shukla, 2004), JAMA (2006), Wikipedia (2007), and Xinhuanet (2005, 2007a).

current level to 1.2 Yuan/kg of pollutant equivalent within the next 3 years (The State Council, 2007). Local governments are allowed to raise pollution charges above the national levels. Since 1999, Beijing levied charges 1.2 Yuan/kg of pollution equivalent for SO₂ emissions from coals of high sulfur content (SDPC et al., 2003). Jiangshu Province raised charges for SO₂ emissions from current level of 0.6 to 1.2 Yuan/kg of pollution equivalent from 1 July 2007 onwards, 3 years ahead of the national schedule (People Net, 2007; Sinanet, 2007).

No doubt, economic instruments such as pollution charges increase the costs of production, and thus provide positive incentives to abate emissions. However, these economic instruments do not work to their full potential, although they have a solid economic foundation. In theory, cost-conscious managers will generally tolerate pollution up to the point where the expected penalty for pollution becomes greater than the cost of controlling emissions. However, if the charges and fines are set too low as have been the case in many developing countries,³ many polluting companies see their compliance costs higher than the fines, and accordingly choose to pay the fines rather than to reduce their pollution. As discussed in Section 2, the low penalty is hardly a deterrent to environmental offenders in China. To change this situation, pollution charges should be raised to reflect the cost of abating pollution, and the fines for offenders should be set higher than the abatement cost. This two together will really create incentive for pollution reduction.

In addition to market-based environmental instruments, governments are exploring industrial policies to promote industrial upgrading and energy conservation. With surge in energy use in heavy industry, the Chinese government started levying export taxes from November 2006 on energy and resource-intensive products to discourage exports that rely heavily on energy and resources and to save scarce energy and resources. This includes a 5% export tax on oil, coal and coke, a 10% tax on non-ferrous metals, some minerals and 27 other iron and steel products, and a 15% tax charged on copper, nickel, aluminum and other metallurgical products. Simultaneously, imports tariffs on a range of items, including 26 energy and resource products such as oil, coal and aluminum were cut from their current levels of 3–6% to 0–3%. From July 2007, China's Ministry of Finance and the State Administration of Taxation (2007) eliminated or cut export tax rebates for 2831 exported items. This is considered as the boldest move to rein in exports since China joined the World Trade

Organization. Among the affected items, which account for 37% of all traded products, are 553 “highly energy-consuming, highly-polluting and resource-intensive products”, such as cement, fertilizer and non-ferrous metals, whose export tax rebates were completely eliminated. This policy will help to enhance energy efficiency and rationalize energy and resource-intensive sectors as well as to control soaring exports and deflate the ballooning trade surplus. In October 2007, China's Ministry of Commerce and the SEPA (2007) were in an unusual collaboration to jointly issue the antipollution circular. Targeted at its booming export industry, this new regulation would suspend the rights of those enterprises that don't meet their environmental obligations to engage foreign trade in the period of more than 1 year and less than 3 years. A significant portion of China's air pollution can be traced directly to the production of goods that are exported. In the Pearl River Delta, a major manufacturing region in Southern China, Streets et al. (2006) found that 37% of the total SO₂ emissions in the region, 28% of NO_x, 24% of particulate matter (PM), and 8% of volatile organic compounds (VOCs) are caused by export-related activities. In the city of Shenzhen alone, the regional leader in industrial development and trade, 75% of VOCs, 71% of PM, 91% of NO_x, and 89% of SO₂ emissions from the industrial sector were released in manufacturing of exported goods. Effectively implemented, this new policy will help polluting enterprises that export their products to pay attention to the environmental effects of their products and produce more environmentally friendly products.

3.3. Tougher emissions standards

Setting and enforcing emissions standards for mobile and stationary sources and for fuel quality are essential to control emissions and improve air quality, and at the same time provide an impetus for improvements in technology. Developing Asian countries that are facing acute air pollution problems have begun to adopt tougher European standards for both vehicles and fuel specifications. China has taken significant steps to control vehicle emissions. Following the phasing out of leaded gasoline nationwide in July 2000, China's SEPA requires all new light-duty vehicles sold after April 2001 to meet State Phase I (similar to Euro I) vehicle emission standards and after 1 July 2004 to meet State Phase II (similar to Euro II) standards across China. Beginning 1 July 2007, China started implementing State Phase III (similar to Euro III) vehicle emission standards, with State Phase IV (similar to Euro IV) vehicle emission standards scheduled to be introduced on 1 July 2010 (see Table 7). Pollution from State Phase III standards is 30% lower than that from State Phase II standards. Pollution from State Phase IV standards even goes

³ Even for the aforementioned case of Jiangshu Province, where the charges for SO₂ emissions at 1.2 Yuan/kg of pollution equivalent were levied from 1 July 2007 onwards, 3 years ahead of China's national schedule, this charge is still less than half of the real abatement cost, which is reported to be 3 Yuan/kg of pollution equivalent for abating SO₂ emissions from coal-fired power plants (Sinanet, 2007).

down below 60% of that from State Phase II standards (Xinhuanet, 2007b). Clearly, more stringent vehicle emission requirements by these new standards will help to reduce substantially the environmental stress in China.

New vehicles that do not comply with the new standards cannot be sold in China. Clearly, vehicle emission standards in China have become increasingly stringent over time, and while China still lags behind the European Union regarding the schedule of the emissions requirements for new vehicles, its gap with the EU requirements is gradually reduced from about 9 years in 2001 to 5½ years in 2010. With the population of registered vehicles reaching to 148 million by the end of March 2007 in China (Xinhuanet, 2007b) and continuing its explosive growth, and the emissions from vehicles as the main source of air pollution in many Chinese cities, these cities have been proactive in controlling vehicle emissions. With the largest population of registered vehicles in China (Xinhuanet, 2005),⁴ Beijing took the lead. China's capital started a pilot program to stop sales of leaded gasoline by July 1997, 3 years ahead of the nationwide ban, and enforced State Phase II standards 2 years ahead of the national schedule. By enforcing State Phase III standards 1½ years ahead of the national schedule and speeding up the eliminating of existing vehicles with lower standards, total pollution from vehicles in Beijing is estimated to be cut by 20% by 2008, compared with current level of pollution (Xinhuanet, 2005). As commitments to the Green Olympic Games, Beijing introduced State Phase IV fuel standards on 1 January 2008 and is scheduled to introduce State Phase IV vehicle emission standards in the first half of 2008, prior to the Beijing Olympic Games on 8 August 2008 (Xinhuanet, 2007a).

In terms of vehicle emission regulations, India and most ASEAN (Association of Southeast Asian Nations) countries are at about the same levels as China, but, as indicated in Table 7, their time schedules to implement these regulations somewhat lag behind China. Based on the Auto Fuel Committee appointed by the Government of India (cited in Menon-Choudhary and Shukla, 2004), India implemented Euro I and Euro II vehicle emission standards for the entire country in 2000 and 2005, respectively. Euro III standards are set to be implemented nationwide in 2010. Most ASEAN countries are examining the harmonization of fuel quality and vehicle emissions standards. The time schedule to ban leaded gasoline and introduce Euro II emission standards with the corresponding fuel properties was targeted at the end of 2005, while Euro IV standards are currently envisioned to be implemented by all ASEAN countries by 2010 except for Indonesia and Vietnam that set 2012 as their implementation date (JAMA, 2006). As indicated in Table 7, except for Singapore and Thailand, all other ASEAN countries did not meet their 2005 target set for the introduction of Euro II vehicle emission standards. This delay raises the question of whether the ASEAN will be able to introduce Euro IV standards under the specified timeframe.

The introduction of stringent vehicle emission standards has led to significant benefits. The Auto Fuel Committee of India estimates significant reductions in annual health costs with the implementation of Euro II in 2001, Euro III in 2005 and Euro IV vehicle emission standards targeted in 2010 in Delhi. As shown in Table 8, annual health costs reduce as emission norms become more stringent. The costs can be reduced further if all vehicles meet the new standards, which are applicable only for new vehicles and do not apply to vehicles already on the roads.

⁴ It took 48 years for the population of registered vehicles in Beijing reached to one million in February 1997 from 2300 in the early 1950s. It took 6½ years to reach two millions in August 2003. But it took only 3 years and 9 months to reach three millions on 27 May 2007, much quicker than what experts expected (Xinhuanet, 2007c).

Table 8

Annual health costs with pre Euro and Euro vehicle emission standards in Delhi (in crores at 2000–2001 prices)

	Pre Euro	Euro II	Euro III	Euro IV
Annual health costs	228	30	22	15

Source: Auto Fuel Committee of India (cited in Menon-Choudhary and Shukla, 2004).

To motivate auto manufacturers to produce more environmentally friendly vehicles, the State Administration of Taxation and the Ministry of Finance in China have cut consumption tax bill by 30% for those manufacturers whose products have met State Phases II, III and IV emission standards ahead of the national schedules.

Along with setting and enforcing progressively stringent emissions standards for vehicles, many cities in Asian countries have shifted vehicle fleets to cleaner fuels to significantly reduce pollution from vehicles. In 1999, China introduced the National Clean Vehicle Action Plan to promote the use of alternative fuels, in particular compressed natural gas (CNG) and liquefied petroleum gas (LPG), for urban bus and taxi industries firstly. This Plan was piloted in the 12 Chinese demonstration cities. Now, CNG and LPG vehicles account for a large portion of urban buses and taxis in China. For example, by the end of 2006, 27 gas stations to fill LPG had been established in Guangzhou, and 6400 buses and 16,000 taxis had made use of LPG, accounting for 80% and 100% of their corresponding total numbers in this Chinese mega-city (Wang, 2007). Delhi faced severe air pollution, about 70% from vehicle emissions. To control vehicle emissions, the Supreme Court directive in 1998 called for the introduction of CNG as a fuel for all public transport in Delhi. This led to the implementation of CNG program. Now Delhi boasts of the world's largest fleet of over 15,000 CNG buses, with substantial benefits for air quality (Hatwal, 2004).

Growing Asian cities are implementing demand-side traffic management measures to reduce congestion and urban air pollution. These cities are prioritizing public transport and are promoting efficient public transport systems, such as dedicated-lane bus rapid transit (BRT) systems. Bangkok, Jakarta, Taipei, Beijing, and Hangzhou (China) are among the Asian cities that have a BRT network in operation to complement their existing public transport systems and reduce traffic congestion. Clearly, these constructed BRT systems are beginning to make a useful contribution to improving public transportation and urban air quality in the cities of their operation. But to make dramatic improvements, much more BRT systems need to be constructed in Asian cities. While such prospect of dramatic increases remains to be seen, there are encouraging signs that other Asian cities have begun very seriously to examine the potential of BRT systems in improving public transportation and urban air quality.

3.4. Increasing energy efficiency and the use of clean energy

As the standards of living improve, just like other parts of the world, there is increasing demand for electronic appliances, comfortable living space and the associated heating and cooling services, and vehicles in Asia as well. This will put great pressure on energy demand and at the same time, provides an opportunity to increase energy efficiency through improved demand-side management. To encourage investments in energy efficiency improvements and accelerate energy efficiency gains on the demand side, many Asian countries have designed and promulgated efficiency standards for appliances and industrial equipments,

building codes and new vehicle fuel economy standards, coupled with appropriate energy-pricing policies (World Bank, 2006; IEA, 2006a). This way of improving energy efficiency is the cheapest, fastest and most effective way to address environmental concerns in the short term. In the meantime, improved energy efficiency increases overall air quality, reduces greenhouse gas emissions and improves energy security. Given that many developing Asian countries suffer frequently from energy shortages, increasing energy efficiency reduces the need to invest in energy-supply infrastructures but brings energy needs and supplies into balance. Moreover, because many Asian economies are exports oriented, reducing energy use through greater efficiency will reduce energy costs and thus enhance their international competitiveness. There are encouraging signs that Asian countries are taking unprecedented efforts to improve energy efficiency.

While China has been calling for energy saving since the early 1980s, this country has set for the first time the goal of cutting energy use per unit of GDP by 20% in its current Five-Year Economic Plan. While China achieved a quadrupling of its GDP with only a doubling of energy consumption between 1980 and 2000, as indicated in Fig. 4, China has experienced since 2001 faster energy consumption than economic growth (Zhang, 2005). Clearly, this is very challenging goal in light of the recent increase in energy intensity in China. Meeting this goal could cut China's energy use in 2010 by 10% below the baseline policy scenario (Lin et al., 2006). Because more low or zero-carbon energy is used by then, CO₂ emissions in China will be cut by at least 10% relative to its baseline policy scenario. Given that industry consumes about 70% of the country's total energy consumption (Zhang, 2003), this sector is crucial for China to meet its own set goal. This has led China to establish the "Top 1000 Enterprises Energy Conservation Action Program". This program covers 1008 enterprises in nine key energy-supply and consuming industrial subsectors, which together consumed 33% of the national total and 47% of industrial energy consumption in 2004. The program aims to save 100 million tons of coal equivalent (tce) cumulatively during the period 2006–2010, thus making a significant contribution to China's overall goal of 20% energy-intensity improvement (NDR, 2006a). For residential buildings, China has taken the three steps to improve energy efficiency. The first step requires a 30% cut in energy use relative to typical Chinese residential buildings designed in 1980–1981. Next, China requires that new buildings have to be 50% more efficient by 2010. Then, the third step is to increase the energy-saving goal to 65% for new buildings by 2020 (Lang, 2004; Zhang, 2005). Tianjin is the first metropolitan city in China to embark on reform for heat supply and charge. As indicated in Table 9, by the end of 2006, 73.49 million m² energy-efficient residential buildings were built in this city, accounting for 47.8% of the total residential buildings (Zheng and You, 2007). In Beijing, the building sector consumed 28% of its total energy use in 2004. By the end of 2004, 175.2 million m² energy-efficient residential buildings were built in China's capital, accounting for 65.1% of its total residential buildings. Of all these energy-efficient buildings, 37.1% met with the 30% more energy-efficient standards, while the remaining 62.9% met with the 50% more energy-efficient standards (see Table 9). Beijing plans that all new residential buildings have to meet with the 65% more energy-efficient standards by 2010, one decade ahead of the national schedule (BMCDR, 2006). In the transport sector, China has set even more stringent fuel economy standards for its rapidly growing passenger vehicle fleet than those in Australia, Canada, California, and the United States, although they are less stringent than those in Japan and the European Union (see Fig. 7). Implemented in the two phases, the standards classify vehicles into 16 weight classes, covering passenger cars, SUVs, and multi-purpose vans. Converted to the US CAFF (corporate average fuel

Table 9
Residential buildings by energy-efficient standards in Beijing and Tianjin, China

Region	Non-energy-efficient buildings (%)	Energy-efficient buildings in the first step (%)	Energy-efficient buildings in the second step (%)	Energy-efficient buildings in the third step (%)
Beijing by 2004	35	24	41	0
Tianjin by 2006	52	23	15	10

Sources: BMCDR (2006) and Zheng and You (2007).

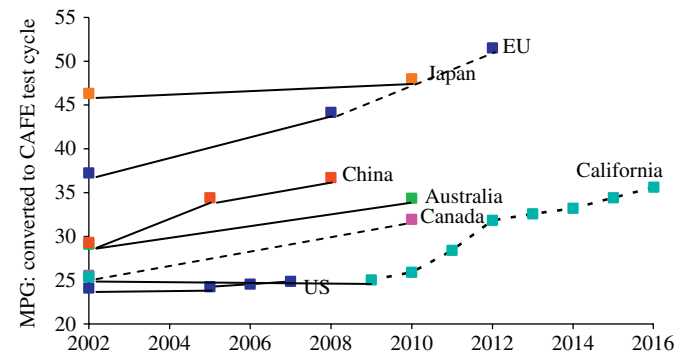


Fig. 7. Comparison of fuel economy standards for vehicles (dotted lines denote proposed standards; MPG—miles per gallon). Source: An and Sauer (2004).

economy) test cycle, the average fuel economy standards of new vehicles in China are projected to reach 36.7 miles/gallon in 2008 (An and Sauer, 2004).

Even Japan, one of the world's most efficient energy-consuming countries, which improved its overall energy efficiency by 37% over the period 1973–2003, sets the goal of further improving its energy efficiency by at least 30% by 2030, relative to its 2003 level (METI, 2006). As a policy measure, the country will speed up the introduction of the Top Runner Program. Such a Program identifies the most energy-efficient residential/office appliances and light-duty vehicles in each category and requires future models to meet a level of energy consumption close to the current (or expected future) best. This Program improves average energy efficiency by encouraging both improvements in the worst appliances/vehicles in terms of energy efficiency and continuous improvements in the best (The Government of Japan, 2002; IEA, 2006a).

However, from a long-term perspective, widespread use of clean energy is a real solution. As indicated in Table 10, the share of renewable energies (including traditional biomass) in the total primary energy supply in developing Asian countries in 2004 was very high (24%), compared with the OECD (6%) and the world average (14%). However, as indicated in Table 10, the share of hydropower and modern (or new) renewable energies (namely, solar, wind, geothermal, wave, and tidal energy) in total renewables is very low in developing Asian countries (9.4% in 2004), in comparison with the OECD (43.8%), although this share of modern renewable energies in the energy mix is growing. Over the past two decades, there have been clear downward trends of renewable energy costs, and these energy sources are becoming less and less costly (UNDP, 2004). However, they are still more costly than conventional sources, in some cases, even several times more costly than that from conventional sources. This limits the penetration of modern renewable energies.

Table 10

Share of renewables in the total primary energy supply and shares of hydropower and modern renewables in the total renewables in 2004 (%)

Country/ region	Share of renewables in the total primary energy supply	Share of hydropower in the total renewables	Share of modern renewables in the total renewables
OECD	6	32.7	11.1
United States	4	21.9	10.5
European Union 25	6	22.8	9.6
Japan	4	44.4	22.2
Developing Asia	24	7.1	2.3
China	16	12.0	0
India	38	3.2	0
World	14	16.4	3.9

Source: IEA (2006a).

Increasing this share not only enhances energy security, but also is environmentally friendly and conducive to good health. This has created a new impetus for encouraging the use of renewables. As indicated in Table 11, at least 47 economies including all 25 European Union countries have established some kind of policy targets for renewables. These targets are revised and strengthened over time. Developing Asian countries, such as China, India, Malaysia, Philippines, Pakistan, and Thailand are among the countries with national targets. For example, Pakistan plans to achieve a 10% share of total electricity generation through renewable energies by 2015 (REN21, 2007). China plans to look to alternative energy sources to meet up to 16% of the nation's energy needs by 2020 from its current level of about 8%.⁵ Philippines aims to double installation of generating capacity from renewable energy sources to approximately 4.7 GW to enable the country to be the largest geothermal energy producer in the world, the leading wind energy producer in Southeast Asia and to double its hydro capacity by 2013 (REN21, 2007).

For concerns about soaring energy demand and the corresponding pollution, there has been growing interest in biofuels, such as ethanol and biodiesel, as alternative fuels for transport. As indicated in Table 12, China and India are the world's third and fourth largest producers of ethanol, but their production were fairly stable over the past 3 years and are far behind the two dominant producers—Brazil and the US, which together produce about 70% of the world's total. China is embarking on a push into biofuels. As indicated in Table 13, ethanol production is currently about 3% of China's transport fuel use. This share of ethanol is the highest among the 21 APEC economies. China plans to increase its ethanol production to 5% of the country's transport fuel use by 2010 (Rank, 2006) and further to 10 million tons a year by 2020 (Zhang, 2007b). Other biofuels goals set in developing Asian countries include the Philippines' proposed 25% E10 blending fuel by 2010 and Thailand's 3% biodiesel target (REN21, 2007).

⁵ Let's look at the European Union, which is widely considered to be the world leader in renewable energy, to put China's renewable energy goals into perspective. The European Union aims at renewable energies meeting 12% of its primary energy by 2010 and 20% by 2020 from its current level of 6.5% (European Commission, 2007a,b). At first glance, the EU's goal of tripling the share of renewable energy from the current level to 20% by 2020 seems even more ambitious than China's renewable energy goal. But because energy demand in China grows at least three times faster than EU does, doubling renewable energy in China's total energy mix by 2020 requires that renewable energy in China grows at a rate of four times that the rate of the EU.

Table 11

Forty-seven economies with renewable energy targets

Country/ region	Target(s)
Australia	An additional 9.5 TWh of electricity annually by 2010 and thereafter adding the same amount annually until 2020
Brazil	3.3 GW added by 2006 from wind, biomass, small hydro; E20–E25 (current), 2% biodiesel target in 2008 and 5% biodiesel in 2013
Canada	3.5–15% of electricity in 4 provinces; other types of targets in 6 provinces
China	10% by 2010 and 16% by 2020 of primary energy, with 300 GW for hydro, 30 GW for wind power, 30 GW for biopower and 1.8 GW for solar PV, 300 million m ² for solar hot water, and 10 million tons of ethanol and 2 million tons of biodiesel produced by 2020
Chinese Taipei	3–5% of total energy and 10% of installed power capacity by 2010
Dominican rep.	500 MW wind power capacity by 2015
Egypt	3% of electricity by 2010
European Union 25	12% of primary energy by 2010 and 20% by 2020; 21% of electricity by 2010; biofuels: 5.75% of transport fuels by 2010, 8% by 2015 and 10% by 2020
India	10% of added electric power capacity during 2003–2012 (expected/planned)
Israel	2% of electricity by 2007; 5% of electricity by 2016
Japan	12.2 TWh, or 1.35% of electricity by 2010, excluding geothermal and large hydro (RPS)
Korea	7% of electricity by 2010, including large hydro, and 1.3 GW of grid-connected solar PV by 2011, including 100,000 homes (0.3 GW)
Malaysia	5% of electricity by 2005; 5% blending for biodiesel by 2008
Mali	15% of energy by 2020
New Zealand	30 PJ of added capacity (including heat and transport fuels) by 2012
Norway	7 TWh from heat and wind by 2010
Philippines	Double total renewable energy generating capacity to 4.7 GW and its hydro power capacity by 2013; 25% E10 blending fuel by 2010
Pakistan	10% of power generation by 2015
Singapore	50,000 m ² (~35 MWth) of solar thermal systems by 2012
South Africa	10 TWh added final energy by 2013
Switzerland	3.5 TWh from electricity and heat by 2010
Thailand	8% of total primary energy by 2011 (excluding traditional rural biomass); 3% biodiesel target by 2011
United States	5–30% of electricity in 18 states (including DC) by 2010–2012

Sources: REN21 (2005, 2006, 2007), Zhang (2007b), European Commission (2007a,b), Council of the European Union (2007), and MOEA Taiwan (2005).

To meet the renewable energy targets, Asian governments need to put in place policies and incentives favorable to the development of renewables. Currently, subsidies for fossil fuels are quite common in developing Asian countries, and the prices of fossil fuels seldom account for the full environmental and social costs of their production, distribution and use. These factors have been significant barriers to the penetration and commercialization of all renewable energies except large hydropower. Thus, governments need to abolish those subsidies and to internalize external costs to level the playing field. This is a helpful step in increasing the cost competitiveness of renewables, but not enough. Governments still need to provide additional support policies to promote widespread use of renewable energies. To date, at least 48 economies including 14 developing countries have some types of renewable energy promotion policies. Such policies include public research, development and demonstration programs, feed-in tariffs, renewable energy mandates, tax credits for investment/production, preferential loans, accelerated depreciation rates, technology-forcing regulations, reduction on import duty and export facilitation, consumer purchasing incentives and government green

Table 12
Annual world ethanol production by country (million gallons, all ethanol grades)

Country	2004	2005	2006
Brazil	3,989	4,227	4,491
United States	3,535	4,264	4,855
China	964	1,004	1,017
India	462	449	502
Russia	198	198	171
Thailand	74	79	93
Canada	61	61	153
Indonesia	44	45	45
Australia	33	33	39
Japan	31	30	30
Pakistan	26	24	24
Philippines	22	22	22
South Korea	22	17	16
Mexico	9	12	13
World total	10,770	12,150	13,489

Source: Renewable Fuels Association (2007).

Table 13
Transport fuel use and ethanol production in APEC in 2004 (kilo ton of oil equivalent)

Economy	Transport	Ethanol	Economy	Transport	Ethanol
Australia	27,781	69	New Zealand	5411	–
Brunei	371	–	PNG	374	–
Canada	50,154	128	Peru	3088	–
Chile	6641	–	Philippines	8673	46
China	67,531	2,022	Russia	41,063	–
Hong Kong	5626	–	Singapore	4224	–
Indonesia	20,952	92	Chinese Taipei	12,808	–
Japan	84,488	65	Thailand	21,107	155
Korea	32,572	46	United States	616,908	7,413
Malaysia	14,226	–	Vietnam	5561	–
Mexico	61,867	19	Total	1,091,426	10,055

Note: Ethanol in million gallons in Table 12 converted from million gallon into kilo ton of oil equivalent (ktoe) using the conversion factor of 2.097 ktoe/million gallon ($= 10^6$ gallon \times 84,000 Btu/gallon \times 1 ktoe/40,097 $\times 10^{-9}$ Btu).

Sources: Renewable Fuels Association (2007) for ethanol production and Bloyd (2007) for transport fuels.

purchasing preferences, green certificate trading, and competitive bidding. Feed-in tariff, which obliges the utilities to purchase electricity from renewable energy sources at a fixed rate, is the most common promotion policy. Since the US enacted a national feed-in law in 1978, at least 32 countries and 9 states/provinces had adopted such policies by early 2006, more than half of which have been enacted since 2002 (REN21, 2005, 2006). Feed-in tariffs, enacted in 1990, amended in 1998 and replaced with a new law in 2000, have been instrumental in making Germany the world leader. Starting from virtually no renewable energy industry in 1990, installed capacity of wind power in Germany increased more than 200-fold between 1991 and 2002, and PV capacity increased over 60-fold in a similar time frame (UNDP, 2004). India is the first developing country that established feed-in tariffs in 1993, followed by Sri Lanka, Thailand (for small power producers only), Brazil, Indonesia, Nicaragua, and China. Driven by a 2003 national law requiring new state-level policies, the six Indian states have adopted new feed-in tariffs. The state of Maharashtra also updated its 2003 wind power feed-in tariffs to apply to biomass, biogas, and small power generation (REN21, 2005, 2006). Feed-in tariffs took effect on 1 January 2006 in China. Contrary to the wide expectations, the standard feed-in tariff model did not apply to wind power (see Zhang (2005) for the reasons), only to biomass power. Biopower tariffs are set at

province-specific average desulfurized coal power tariff plus a subsidy of RMB 0.25/kWh. From 2010 onwards, the subsidy will decrease by 2% each year and will be cancelled completely after 15 years (NDRC, 2006b).

Renewable energy promotion policy is an essential ingredient in promoting the widespread use of renewable energies. But, the specific form and level of this support will clearly differ in design from technology to technology and from country to country, depending on the overall policy framework in place and the maturity and cost of each technology in each country. For example, Japan enacted renewable portfolio standard (RPS) law in 2003 to aim to the electricity generation from renewable energy sources to meet 1.35% of the national electricity supply by 2010. The Japanese government will follow up implementation of RPS for a period of 3 years after its introduction and, if necessary, will review the scheme for RPS. Every 4 years, the government will set annual indicators for the generation of electricity from new energy resources by electric retailers based on an 8-year time frame (REN21, 2007). For biomass energy, the Chinese government is deliberating a risk-sharing mechanism to encourage its development. Such a mechanism allows biomass energy companies to reserve risk funds before paying taxes during the period of oil price hikes. Those funds will be used to compensate losses and sustain their operations when oil prices plummet (Zhang, 2007b). For wind power, feed-in tariffs are only applied to small power producers in Thailand. Pakistan initiates limited feed-in tariffs and waives import duties for wind turbines to boost wind power development. In China, the central government has cut by half the value-added tax on wind power from the normal rate of 17% to 8.5%, has lowered the rate of duty on domestic investment in wind power to 6% in comparison with the normal rate of 23%, and has exempted duty on equipments imported for renewable energy technologies in joint venture. Some local governments provide even more favorable policies. For example, Inner Mongolia has levied the value-added tax of 6% on wind power (Zhang, 2007b). Since 2003, China has adopted the so-called Wind Power Concession Program as its primary strategy to further promote wind power development. This government-run program auctions off development rights for wind power projects of 100 MW or above for 25 years, which include a guaranteed tariff for the first 30,000 h, as well as concession operation agreements. Such on-grid tariff of wind power is decided through a competitive bidding process. To prevent irrational bidding that could endanger overall project quality and investor return, the Chinese government has lowered the weight of the grid tariff in the bidding assessment process and assigned more weight to other factors, such as local content, investment and financial ability, financial plan, and technical plan. In the first round of bidding in 2003, the tariff was the only criteria determining the winner. Those who offered the lowest grid tariff won. But, the weight of grid tariff in the overall bidding decision has been declining. It accounted for only 40% by the third round in 2005, and only 25% in the fifth round of bidding. With these modifications, the bidding tariff is now ranked as the second key criteria under a 100-point bidding evaluation system, after the 70% local content requirement that accounts for 35% in the current round of bidding. However, simply lowering the weight of the grid tariff in the bidding process is not the answer because that will simply increase the transaction costs. To lower transaction costs and at the same time ensure project quality, competitive bidding needs to be coupled with a mechanism that would hold bidders accountable for the implementation of project, robust technical standards for design and construction to avoid downward pricing pressure leading to substandard technology and implementation, and/or a floor price to prevent unrealistic low bids from jeopardizing the bidding process (Zhang, 2005).

3.5. The integration of environmental policies with economic and sectoral policies

Developing Asian countries are confronted with many other pressing social concerns, such as providing water and sanitation services to the urban poor, improving public transportation and other basic infrastructures, and reducing poverty as well as improving the environment. In this context, in order to address environmental issues effectively and achieve the maximal gains, environmental policies need to be integrated with economic policies, investment policies, energy policies, transportation policies, land-use policies, and other urban development policies. This will help countries view environmental policies as not just for tackling potential environmental threats *per se*, but as an integrated framework to tackle these aforementioned concerns, as well as a means of improving energy efficiency, reducing congestions, saving money, and setting pro-active policies to ensure sustainable development.

As far as minimizing environmental effect is concerned, it is even better to integrate environmental issues with economic and sectoral policies at the planning stage, rather than at the implementation stage. Strategic environmental assessment (SEA) is a useful tool to bridge the policy divide that separates those government institutions responsible for economic planning from those line industries in charge for environmental protection at the planning stage of any development activity (UNESCAP, 2006). SEA integrates environmental issues into the formulation of plans and programs, thus reducing their overall environmental impacts to a minimum. China and Korea have shown great interest in applying the SEA. Indeed, several provinces in China, including Inner Mongolia, have used the SEA in mapping out their 11th Five-Year Economic Plan running from 2006 to 2010.

3.6. Active engagement of the private sector

While governments determine the rules under which businesses act, set environmental goals and commit to international environmental agreements, they count on firms' full cooperation. After all, the firms themselves are entities that use natural resources, make products and emit pollution. Thus, a sustainable future for Asia is not possible without the active engagement of the private sector.

In the mean time, the private sector is facing growing market and public pressures for better environmental performance. As many Asian countries are based on export-oriented economies, globalization and the elimination of trade barriers between and inside countries are placing unprecedented pressures on even their domestic industries to maintain, if not lose, their competitive position through greater efficiency and responsible environmental management. As trade liberalization progresses, companies are facing ever-increasing pressures to be held accountable for their environmental behavior. Along with this market pressure, companies are facing growing public pressures, fueled by increasing environmental awareness, in particular from expanding middle class, and stronger civil societies.

All this provides unprecedented opportunity for environmental institutions in developing Asian countries to take advantage of the positive influences of globalization and public pressure to engage the private sector to improve its environmental performance. Ecolabelling is one that creatively harnesses the power of environmentally conscious consumers to promote higher levels of corporate environmental responsibility. By giving the consumer the choice of whether to buy a product contributing to environmental degradation or to buy more environmentally friendly alternative, this scheme aims to promote the production,

consumption, and disposal of more environmentally friendly products. Its voluntary nature makes ecolabelling an attractive alternative to costly regulatory measures. China, Indonesia, Japan, South Korea, and Thailand are among the Asian countries that have established the ecolabelling regimes.⁶ By supporting innovation in and purchasing environmentally preferable products and services, green government procurement is another way to change environmental behavior of producers. Among the OECD member countries, government procurement expenditures involve extremely diverse products and services and account for 8–25% of GDP (OECD, 2000). The potential for public purchasing decisions to affect the environment is therefore considerable.⁷

Corporate ratings and disclosure programs rely on non-regulatory forces to create incentives for (mainly industrial) facilities to improve environmental performance. Some environmental economists call disclosure programs the third wave in pollution control policy after the first two waves that are legal regulations and market-based instruments, respectively (Tietenberg, 1998). Such programs will motivate polluters to reduce emissions, even in developing countries where regulatory infrastructures are insufficiently developed or are subjected to corruption. Indonesia's National Pollution Control Agency conceived and launched a program in June 1995, called PROPER—Program for Pollution Control, Evaluation and Rating, for rating and publicly disclosing the environmental performance of Indonesian factories. The PROPER develops color-coded systems to rate corporate environmental performance. The results of the initial ratings are shared with the companies rated, with those of highly environmental performance publicly congratulated. By contrast, those companies that are rated below the average category are privately notified and then given time to improve their ratings. After the grace period is over, the second rating takes place. This time, their ratings are revealed to the public in the presence of the media, officials, and stakeholders. The pilot phase of the PROPER shows that the number of plants that failed to comply with the regulations had gone down from the two-thirds to less than half of the total. As a result, water pollution discharges from the 187 pilot plants rated fell by 40% (World Bank, 2000). Similarly, the companies under the EcoWatch program in the Philippines and Green Watch program in China, which are modeled on Indonesia's PROPER program with slight modifications, have dramatically changed their corporate environmental behavior. They together have sharply reduced their pollution (World Bank, 2000).

Investors in capital markets can also be an important ally, reacting to the disclosure of environmental performance related to the companies that they invest. Since 1989, the Ministry of the Environment (MOE) of Korea has published the Monthly Violations Report as news material distributed to media reporters. This Report is based on information gathered through monthly government inspections on about 10,000 air- and water-polluting facilities, and reports the names of companies that are in violation of environmental laws and regulations and the nature of enforcement actions by the MOE of Korea. Since November 2000, the Report is publicly disclosed through the ministry's official web site. Over the period from 1992 to 2002, a total of 3455 different facilities and a total of 7073 violation events appeared on a total of 113 violation lists published on a monthly basis, implying that some appeared more than once in such lists. The econometric study using Korean company level data found that companies appearing in this monthly listing of the violators

⁶ See the Global Ecolabelling Network web site at <http://gen.gr.jp>.

⁷ See Zhang and Assunção (2004) for further discussion on ecolabelling and green government procurement and concerns about their potential trade effects.

of Korean environmental laws and regulations suffered a reduction in market value of their publicly traded equities. Investors react negatively to the disclosure of such information either for moral reasons or because they believe that those offending companies will face higher clean-up costs and therefore will be less competitive. The average reduction in market value is estimated to be 9.7% (Dasgupta et al., 2004; Hong, 2005). This average reduction in market value is much higher than results obtained in developed countries (Canada and the United States), but of a similar order of magnitude as results obtained in other developing countries (Argentina, Chile, Mexico, and the Philippines) (Dasgupta et al., 2001). Moreover, the larger or wider the coverage of the events by newspapers, the larger the reduction in market value, reaching 38% for those events covered by 5 or more newspapers (Dasgupta et al., 2004; Hong, 2005).

This clearly demonstrates the power of public information, if communities and capital markets are properly informed. Therefore, environmental regulators in developing Asian countries should explicitly harness the public pressure and market forces by introducing public disclosure programs. As demonstrated in China, Indonesia, the Philippines, and South Korea, such programs have created incentives for companies to improve their corporate environmental performance, and are considered as a viable option to complement or supplement traditional enforcement channel of fines and penalties.

Drawing the support of financial institutions is also one avenue to promote improved corporate environmental performance. From April 2007, China's SEPA works with the People's Bank of China, China's central bank, on a new credit-evaluation system under which companies' environmental compliance records are incorporated into the bank's credit-evaluation system. This information will serve as a reference for commercial banks' consideration of whether or not to provide loans. The bank could turn down requests for loans from firms with poor environmental records (Zhang, 2007a,d). Clearly, this concerted action by the central bank and the SEPA is expected not only to reduce the risks borne by commercial banks, but also to encourage companies to think about more about the environmental effect of their operation and self-discipline their environmental behavior. In August 2007, the SEPA (2007) also clearly stipulated that highly polluting enterprises are subject to its auditing of their environmental records in case these enterprises want to list shares in the Chinese stock markets or get re-financed. China Securities Regulation Commission will incorporate information on their environmental auditing into its decision on whether or not to allow these enterprises to be listed or get re-financed.

4. Regional responses

To address environmental pollution of a cross-border or global nature, it is much more effective for the neighboring countries concerned or all of the countries to act collectively than just acting on its own. To focus only on one or the other, the local or the cross-border pollution sources, will be less effective than acting on both together. Clearly, regional responses serve as a complement, not a substitute for, national responses.

The deteriorating air quality in Hong Kong was one of the most contentious issues in the vote for Hong Kong's chief executive in 2007. The study examining the primary source of the air pollution, local or cross-border, indicates that, while Hong Kong's air pollution is primarily caused locally rather than cross-border pollution from its neighboring heavily industrialized Chinese province of Guangdong, regional sources can influence this territory's air quality on 36% of the time during the year (Lau

et al., 2007). So, Hong Kong needs to rely on the two legs to avoid the air pollution problem worsening before it gets better. Hong Kong should take urgent action on its own to reduce emissions from local vehicles, marine traffic, and power plants. In the meantime, Hong Kong needs to establish an agreement with its neighboring Guangdong to undertake a joint study to locate the source of emissions and then take concerted efforts together to remedy the situation. Acting on both together is much effective than focusing only on one or the other.

A program called Asian Brown Cloud has been initiated with support from the UNEP. The main aim of the first phase of this program is to study the impact of the Asian haze on a number of parameters, including monsoon change, water balance, agriculture, and health. Scientists plan to establish a network of ground-based monitoring stations throughout Asia to study the composition and seasonal pattern of the haze. The UNEP has pledged to facilitate the continued research program and, in the longer-term, to help coordinate policy responses to address the problem (UNEP, 2002).

As a response to the 1997 fire event in Indonesia, the ASEAN and the Asian Development Bank (ADB) developed a Regional Haze Action Plan. In 2002, ASEAN adopted the Agreement on Transboundary Haze Pollution.⁸ This Agreement is aimed to prevent and monitor transboundary haze pollution as a result of land and/or forest fires and to control sources of fires. Moreover, in recognition of the importance of cities in improving environmental sustainability, the ASEAN adopted the Framework for Environmentally Sustainable Cities. This Framework aims to address environmental sustainability challenges in the areas of clean air, water, and land. Specifically, for example, in the area of clean air, the Framework is to achieve ASEAN's long-term goal of maintaining good ambient air quality to safeguard public health by addressing emissions from both stationary sources and mobile sources (ASEAN, 2003).

To cope with increasing impact of acid rain, as the first step in joint regional initiative in East Asia, the Acid Deposition Monitoring Network in East Asia (EANET) was established and starts its activities on a regular basis from January 2001. The EANET aims to create a common understanding of the state of the acid deposition problems in East Asia, to provide useful inputs for decision-making at local, national and regional levels aimed at preventing or reducing adverse impacts on the environment caused by acid deposition, and to contribute to cooperation on the issues related to acid deposition among the participating countries. Since 2001, the data reports on the acid deposition in the East Asian region have been published annually and made available on the web site of the network.⁹ In South Asia, the Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects, was adopted by the eight South Asian countries in 1998 (UNEP, 2002).

Dust and sandstorms are plaguing Northeast Asia nearly five times as often as they were in the 1950s. Sandstorms that originate in the dry regions of Mongolia and the Northern China plain hit Beijing every spring and then move eastward toward South Korea and Japan (UNEP, 2004, 2005). To deal with dust and sandstorms, governments of the region are working together with the ADB and several United Nations organizations in monitoring and early warning. A joint project has been set up to create an initial institutional framework and a master plan to guide regional cooperation to control dust and sand storms in Northeast Asia (UNEP, 2004).

⁸ Available at the ASEAN Secretariat's web site at <http://www.aseansec.org/6086.htm>.

⁹ See the EANET web site at <http://www.eanet.cc>.

Table 14
Pipeline of CDM projects at the validation stage or beyond (as of 11 June 2008)

Region	CDM projects at validation or beyond		Projected certified emission reductions by 2012	
	Number	%	Million tons CO ₂	%
Latin America	702	20.1	392.0	14.8
Asia and Pacific	2646	75.6	2107.3	79.8
Europe and Central Asia	38	1.1	19.9	0.8
Sub-Saharan Africa	49	1.4	67.0	2.5
North Africa & Middle-East	63	1.8	53.7	2.0
Total	3498	100.0	2639.7	100.0

Source: UNEP Risoe Center (2008).

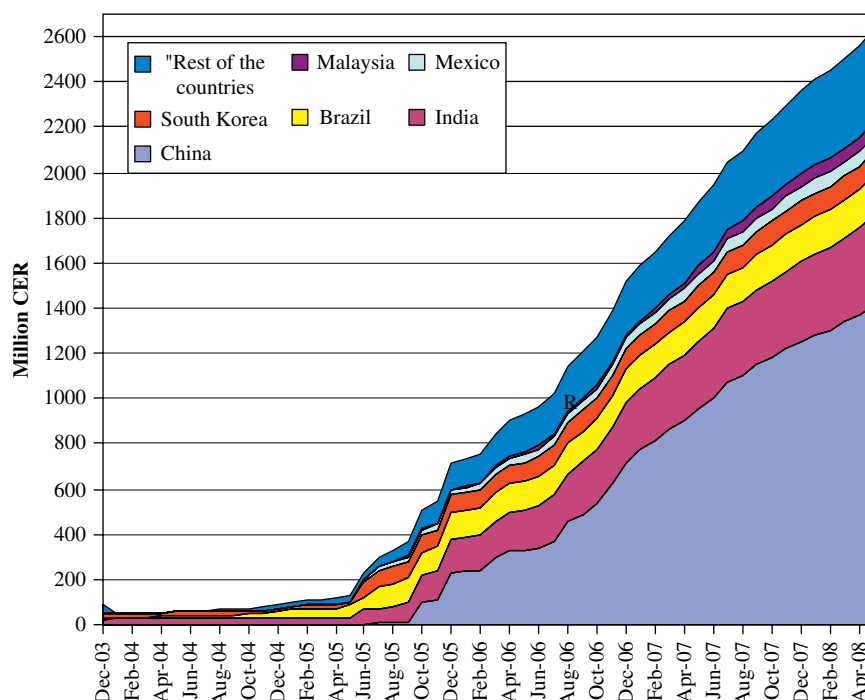


Fig. 8. Growth of total expected accumulated certified emission reductions (CERs) by 2012 (as of 11 June 2008). Source: UNEP Risoe Center (2008).

Asian countries are working together with the rest of the world to combat global climate change under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Asia is the largest host of clean development mechanism (CDM) projects that are registered, in the process of registration and at the public validation stage, accounting for about 76% of the world's total (Table 14). With 1252 CDM projects at the public validation stage or beyond, China tops the share in the world's total, which increases significantly from 2.7% in August 2005 to 35.8%. If operated as planned, all these currently known CDM projects in China are projected to generate reduction of 1415 million tons of carbon dioxide equivalents by 2012, accounting for 53.6% of the world's total estimated carbon credits by 2012 (Zhang, 2006b; UNEP Risoe Center, 2008).¹⁰ To put into perspective, this amount of the total emissions reductions by 2012 is more than the current greenhouse gas emissions of Germany

and the Netherlands combined (or that of the United Kingdom and Italy combined), and corresponds to about 30% of the total emissions in the European Union 25. Coupled with India—the world's second largest supplier of carbon credits, the two Asian giants are responsible for over two-thirds of the world's expected entire emissions reductions by 2012, with China well positioned to be the largest supplier of carbon credits (Fig. 8). In addition, multilateral cooperation on climate control is taking place in this region. Noticeable example is the Asia Pacific Partnership for Clean Development and Climate. This partnership does not incorporate legally binding commitments or targets to reduce greenhouse gas emissions, but aims to promote and create an enabling environment for development, diffusion, deployment and transfer of existing and emerging low or zero emission technologies. It established the eight public-private sector task forces to address the challenges of air pollution, energy security, and climate change in a way that is designed to promote economic development and reduce poverty. The six countries represent almost half of world GDP, energy consumption, greenhouse gas emissions, and population. Given the scale of this group and that technology is a critical ingredient in a climate policy package,

¹⁰ This is very in line with the economic model-based estimates of Zhang (1999, 2000, 2001, 2004), which show that about 60% of the total CDM flows in 2010 go to China.

theoretically speaking, the partnership has the potential to make a significant impact.¹¹

To build synergies between economic growth and environmental sustainability, the 5th Ministerial Conference on Environment and Development in Asia and the Pacific adopted the Ministerial Declaration on Environment and Development in Asia and the Pacific. This Declaration calls upon the Asia Pacific countries to seek to improve environmental sustainability, while addressing poverty by reducing the pressure of unsustainable economic growth on the environment and improving environmental performance. This Ministerial Conference also adopted the Regional Implementation Plan for the Sustainable Development in the Asia and the Pacific 2006–2010. This Plan provides a framework for action to address the key constraints to sustainable development in the context of the needs and priorities of the region (UNESCAP, 2005).

Multilateral development banks (MDBs) can play a vital role in promoting clean energy, thus reducing environmental pollution associated with production and use of energy. Clean energy, including renewable energy and energy efficiency, can contribute significantly to achieving the Millennium Development Goals. They offer the double dividend, meeting the energy needs for sustained growth while at the same time preserving the environment. For years, MDBs have been criticized for funding conventional energy projects like coal-fired power plants while largely ignoring energy efficiency and renewable energy. This situation is changing. At the 2004 World Renewable Energies Conference, the World Bank announced that it planned to increase its spending on clean energy by an average of 20% per year between 2005 and 2009. From July 2005 to June 2006, the Bank committed US\$490 million to energy efficiency and US\$190 million to renewable energy projects. This total of the US\$680 million was an increase of 48% over the commitments a year ago. Since 1990, the World Bank Group commitments to renewable energy and efficiency have exceeded US\$10 billion, with each dollar leveraging another three dollars from other private and public sources (Cundy, 2006). The ADB is also active in this area. Its Energy Policy emphasizes the acceleration of the widespread application of renewable energy and energy efficiency in its developing member countries. This focus was strengthened in ADB's Energy Policy Review of 2000. As part of its committed efforts in the area of clean energy, the ADB launched the Regional Technical Assistance for the Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement to facilitate investment in renewable and energy efficiency in this region (Zhang and Maruyama, 2001). The Bank increased its annual spending on clean energy to \$1 billion in 2007 (Casey, 2007). Its Energy Efficiency Initiative expands the ADB's investment in projects that help developing Asian countries change their patterns of energy use and move towards a low carbon economy. The Carbon Market Initiative (CMI) is another concrete effort to deepen the ADB's commitment to clean energy and climate change mitigation. The CMI provides co-financing to develop emissions reduction projects under the CDM, leverages debt financing and fills host country financing gaps (Rhode and Nicholls, 2006). As part of the CMI, the Asia Pacific Carbon Fund (APCF) is designated to provide up-front funding against the purchase of an estimated 25–50% of future carbon credits expected from CDM projects (ADB, 2007a). It is the feature of paying its invested capital upfront that makes the APCF different from other carbon funds. As a result, the APCF helps projects close

their financing gap and increases the number of clean energy and energy efficiency projects in Asia. By the time when the acceptance of participation to the APCF was closed on 30 June 2007, it raised \$151.8 million from the seven European countries to help develop clean energy projects in the Asia Pacific region and at the same time to help these European countries involved to achieve their carbon emission reduction commitments under the Kyoto Protocol (ADB, 2007b).

Regional cooperation is useful in mitigating potential environmental impacts of foreign direct investment (FDI). FDI is increasingly concentrated in just a few countries, intensifying competition for investment and thereby possibly lowering environmental standards in competing countries. Unlike carbon financing whereby carbon credits are created, which have to be scrutinized and issued by the CDM Executive Board against a set of sustainable development criteria (Zhang, 2006a,b), FDI arrangements between countries are governed primarily by bilateral investment treaties. So, cooperation through regional economic cooperation secretariats, such as ASEAN, and the resulting policy coherence among countries could help countries to reduce the likelihood of weakening environmental standards to attract FDI.

5. Conclusions

Asia has been heavily dependent on dirty-burning coal to fuel its rapidly growing economy. This coal dominance in the energy mix in developing Asia and inefficiencies in production and use of energy and resources, combined with rapid urbanization and motorization, have led to unprecedented environmental consequences. This situation would worsen because Asia needs to continue its rapid economic growth in order to alleviate the poverty of the two-thirds of the world's poor living in the region. This will further place tremendous pressures on the environment unless vigorous and effective policies are put in place. The good news is that the Asian governments have endorsed an environmentally sustainable economic growth patterns aimed at reducing the pressure of unsustainable economic growth on the environment and improving environmental performance. Along this line, there are encouraging signs that Asian countries are taking unprecedented efforts. To achieve a more sustainable future for Asia, the region needs to further strengthen cooperation at national, local and regional levels, and to have the right policy mix to ensure continuing economic growth without compromising its limited ecological-carrying capacity and environmental quality.

Having the right economic policies is crucial because it sends clear signals to both producers and consumers of energy. This region needs to get rid of energy subsidies, which have been reduced over time but still exist in a number of countries, in order to provide incentives for efficient fuel use and adoption of clean technologies. But removing such subsidies is but a first step in getting the energy prices right. Further steps include incorporating the costs of resources themselves to reflect their scarcity and internalizing the costs of externalities. Market-based instruments are common ways to internalize externality costs into the market prices. Many Asian countries have traditionally relied on rigid command-and-control approaches. With the poor environmental performance of such approaches and the cost and complexity associated with their implementation, an increasing number of countries in this region are implementing market-based policy instruments. The latter are seen to increase not only cost-effectiveness but also flexibility in complying with the set environmental regulations. In addition, governments need to explore industrial policies to promote industrial upgrading and energy conservation.

¹¹ Based on the current information available, my judgment is that this partnership can contribute the overall efforts, but whether it is going to deliver any substantial outcomes as Australian and the US governments claim remains to be seen. See Zhang (2007c) for further discussion on the partnership.

There should be better coordination between the central and local governments within countries. Confronted with the rising costs of environmental degradation associated with rapid economic growth, the central governments in Asian countries have gradually recognized that the conventional path of encouraging economic growth at the expense of the environment has to be changed. Accordingly, they set environmental goals and environmental performance requirements. However, environmental ministries or equivalent agencies in the region are often ill-equipped either to enforce existing regulations or to design, implement, monitor, inspect and enforce new effective environmental policies to fulfill their tasks. As a result, poor compliance and weak enforcement are common in this region. Correcting such a problem requires a major investment in strengthening the institutions of environmental governance to ensure that they have the adequate institutional, financial, and technical capabilities to do the job. This is a necessary step, but not enough. We also need the full participation of all stakeholders in protecting the environment. In this regard, local government's cooperation is crucial to the overall outcomes. The China case examined clearly exemplifies that there is a clear need to carefully examine those objective and subjective factors that lead to the lack of local official's cooperation on the environment, and to provide right incentives to get their cooperation.

Regulatory policies have a key role to play in reducing emissions. Setting and enforcing emissions standards for mobile and stationary sources and for fuel quality are essential to control emissions and improve air quality, and at the same time provide an impetus for improvements in technology. Developing Asian countries that are facing acute air pollution problems have adopted progressively stringent European standards for both vehicles and fuel specifications over time. This has led to improvements in vehicle technologies and exhaust systems. Many cities in Asian countries have shifted vehicle fleets to cleaner fuels to significantly reduce pollution from vehicles. Through prioritizing public transport and promoting efficient public transport systems, growing Asian cities are also implementing demand-side traffic management measures to reduce congestion and urban air pollution.

Developing Asian countries are confronted with many other pressing social concerns. In this context, in order to address environmental issues effectively and achieve the maximal gains, environmental policies need to be integrated with economic policies, investment policies, energy policies, transportation policies, land-use policies, and other urban development policies. This will help countries view environmental policies as not just for tackling potential environmental threats *per se*, but as an integrated framework to tackle these aforementioned concerns, as well as a means of improving energy efficiency, reducing congestions, saving money, and setting pro-active policies to ensure sustainable development. Moreover, to minimize environmental effects, such an integration needs to be in place at the planning stage, rather than at the implementation stage.

Asian countries also need to further design and promulgate efficiency standards for appliances and industrial equipments, building codes and new vehicle fuel economy standards. Improved energy efficiency increases overall air quality, reduces greenhouse gas emissions and improves energy security. Given that many developing Asian countries suffer frequently from energy shortages, increasing energy efficiency will reduce the need to invest in energy-supply infrastructures but will bring energy needs and supplies into balance. Moreover, because many Asian economies are exports oriented, reducing energy use through greater efficiency will reduce energy costs and thus enhance their international competitiveness. There are encouraging signs that Asian countries are taking unprecedented efforts to

improve energy efficiency. However, from a long-term perspective, widespread use of clean energy is a real solution. In comparison with the OECD, the share of renewable energies (including traditional biomass) in the total primary energy supply in developing Asian countries is very high, but their share of hydropower and modern renewable energies in total renewables is very low, although this share of modern renewable energies in the energy mix is growing in developing Asian countries. Increasing this share not only enhances energy security, but also is environmentally friendly and conducive to good health. Many Asian countries have established national targets for renewable energies. These targets are revised and strengthened over time. To meet the targets, governments need to put in place policies and incentives favorable to the widespread use of renewable energies. However, the specific form and level of this support will clearly differ in design from technology to technology and from country to country, depending on the overall policy framework in place and the maturity and cost of each technology in each country.

Multilateral development banks can play a vital role in promoting clean energy, thus reducing environmental pollution associated with production and use of energy. For years, they have been criticized for funding conventional energy projects like coal-fired power plants while largely ignoring energy efficiency and renewable energy. There are encouraging signs that this situation is changing, but such a change is not at the pace and on the scale that we need. Multilateral development banks need to further strengthen their financial commitments to and technical support for accelerating such a change.

The CDM is an innovative mechanism built into the Kyoto Protocol. Initially, Asia lagged behind Latin America in the CDM market. But thanks to the increasing number of CDM projects in China and India, Asia is now the largest host of CDM projects. While the CDM has emerged as a financing mechanism to mitigate greenhouse gas emissions as the implementation of CDM projects has progressed, it still does not work to full potential scale. To that end, change needs to take place both at national and international levels. At the national level, for those developing Asian countries that have not truly benefited from the CDM, they need to put in place clear institutional structures, streamlined and transparent CDM procedures and sound governance of clearer lines of responsibility and functions to facilitate the smooth implementation of CDM projects in their countries. At the international level, post-Kyoto climate negotiations need to reform the CDM to overcome its current structural limitations and to make it accommodate those players and types of small projects that have been left out to date. When taken together and combined, they will help to expand the number and geographical reach of the CDM, thus spreading its benefits to more countries.

The active engagement of the private sector is essential for success, not simply because the expected investment requirements are too massive for the public sector. After all, the firms themselves are entities that use natural resources, make products and emit pollution. Thus, a sustainable future for Asia is not possible without the active engagement of the private sector. Environmental institutions in developing Asian countries need to take advantage of the positive influences of globalization and public pressure to engage the private sector to promote long-lasting, improved corporate energy-saving and environmental performance.

It should be kept in mind that broad economic reforms can also help to reduce pollution and save energy. As many Asian countries are based on export-oriented economies, greater openness to trade and the elimination of trade barriers between and inside countries can enhance incentives for companies to adopt more efficient and environmentally friendly technologies. As trade

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