Chapter 7

Air Pollution and Regional Economic Integration in East Asia: Implications and Recommendations

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Key Messages

- Air pollution is worsening in the Asia-Pacific region along with continued strong economic growth, and could be aggravated by further economic integration.
- Air pollution standards and regulations have gradually strengthened in the region, but in many cases are still weaker than the WHO guidelines.
- Economic integration has not prevented stronger standards, but policymakers' fears about costs and trade competitiveness may have slowed the strengthening of stronger policies.
- Fears about competitiveness are not well founded since there is little evidence of a "race to the bottom" while there is evidence that stronger air pollution standards can promote exports to countries with higher standards.
- A co-benefit approach and better cost-benefit analysis can show that stronger air pollution regulations are economically beneficial, for example by reducing health costs and reducing crop damage from air pollution.
- Some countries, particularly developing ones, may lack capacity to establish or implement stronger air pollution policies and related measures such as monitoring.
- This chapter therefore recommends domestic air pollution policies be strengthened and harmonised particularly in the ASEAN Community, and concrete measures should be taken to develop effective implementation capacity.
- Expanded regional integration in Asia (further facilitation of trade and investment) should be conditioned on stronger domestic air pollution standards and regulations, stronger enforcement and implementation, and development of implementation capacity.
- Stronger international cooperation will therefore be key. Here, the European Convention on Long-range Transboundary Air Pollution (LRTAP) could act as a role model for a regional framework. This could be based on strengthening existing frameworks or creating a new one.

1. Introduction

This chapter explores the implications of increased regional economic integration for air pollution control in East Asia and offers recommendations on how to address them. Economic integration has gradually progressed in the region, mostly informal and market based, but also formal in the case of ASEAN. Recently, the pace of discussions on regional economic integration has picked up, especially regarding the Trans-Pacific Partnership (TPP), and the ASEAN Community is to be established in 2015.

The urgency of air pollution has significantly increased in recent years, and the situation is still serious despite national efforts and regional cooperation initiatives which have achieved some success. In 2010, CAI-Asia's survey of major cities concluded that "while some improvements in air quality have been achieved, levels of PM_{10} and SO_2 continue to exceed World Health Organization (WHO) air quality guidelines (AQG). There is not enough air quality data to assess $PM_{2.5}$ and ozone" (CAI-Asia 2010). Further, overall economic and social trends suggest that air pollution is likely to increase in developing Asia. Thus, any gains due to stronger policies may be offset by economic growth, energy consumption, and motorisation. WHO estimated that in 2012, globally, 4.3 million deaths were attributable to household air pollution and 3.7 million to ambient air pollution. Of these deaths, 77% from household air pollution (3.31 million), as well as 70% from ambient air pollution (2.6 million) occurred in the Western Pacific or Southeast Asia (WHO 2014).

There are two major perspectives on the relationship between the environment and economic integration. One warns of the danger that economic integration may weaken environmental standards, while the other argues that there is little evidence for this, and suggests that economic integration could even strengthen standards in some cases (Frankel 2009, Copeland and Taylor 2004, Levinson and Taylor 2008, Poelhekke and van der Ploeg 2012, Vogel 1999, Saikawa 2013, List and Co 2000).

This chapter takes a closer look at the implications of potential increased economic integration for air pollution issues in East Asia. It also considers how air pollution policies might be affected, and what measures could both reduce potential negative effects and encourage positive effects. Actual air pollution trends in East Asia are not covered in detail, as many studies have done this already (e.g., Kurokawa et al. 2013), but levels of air pollution are compared against the specific standards set by each country to provide inter-country comparisons of standard attainment.

This chapter recommends linking increased regional integration in East Asia with stricter domestic air pollution standards and regulations as well as bolstered enforcement and implementation of existing ones. At a minimum, safeguards should be established to ensure negotiations do not undermine existing environment related international agreements and domestic measures.

Two major obstacles to these recommendations are addressed by this chapter. First, there are fears over costs and negative impacts on trade competitiveness. This chapter argues that these fears are often misplaced, and benefits – both economic and health related – are often overlooked. Second, many countries have insufficient capacity for implementation and also insufficient scientific capacity.

To address the first obstacle, this chapter attempts to explain why stronger air pollution policies are not likely to undermine competitiveness. It also recommends that detailed cost-benefit analysis should be supported by a co-benefits approach that links air pollution measures to economic development, green jobs, and energy security, and

also links cost reduction or sharing measures with climate change mitigation measures. These can provide compelling incentives for taking stronger action. Both obstacles can be addressed by strengthening the international cooperation framework to support and help to coordinate these efforts, including related capacity building. Coordination would increase the cost effectiveness of stricter measures and ease concerns about trade competitiveness. Ideally, air pollution standards and enforcement should be strengthened regardless of any trends in regional integration. However, the recent attention to regional integration initiatives provides an opportunity to consider more carefully the fears of potential effects on trade competitiveness.

Europe has already experienced these issues, especially fears about the effects of air pollution countermeasures on trade and economic competitiveness, which were successfully addressed in the Convention on Long Range Transboundary Air Pollution (LRTAP). This chapter therefore briefly reviews LRTAP's experience and how it differs from East Asia's situation, to draw some policy implications.

The rest of this chapter is organised as follows. Section 2 reviews existing air pollution standards in the region, section 3 explores the implications of recent trends in economic integration for air pollution, section 4 compares the situation in East Asia with Europe's LRTAP, and section 5 concludes with some policy recommendations.

2. Existing Air Pollution Policies and Standards in East Asia

This section presents selected information on standards related to ambient air quality, light and heavy duty vehicle emissions, fuel, vehicle fuel economy, and the state of air quality monitoring in Asia. It also summarises major policy trends in China. It does not discuss stationary sources, which are also very important, since reliable and easily comparable national data is not available.

The information presented here does not provide a comprehensive picture of the situation, due to the difficulty of obtaining accurate and comparable information. Some of the information was obtained from Clean Air Asia (formerly CAI-Asia) (e.g., CAI-Asia 2010, 2011; CAA 2014) and the ASEAN Secretariat (2009), but there are many limitations such as missing data, limited comparability, and lack of disaggregated data (Patdu and deLeon 2012). This chapter uses the latest available data from CAA and other specialised networks.

Ambient air quality standards

Ambient air quality standards for many East Asian countries are summarised in Table 7.1 below, and the number of these countries meeting WHO guidelines is indicated in Table 7.2. Most of this information was compiled from CAI-Asia (2010) and Clean Air Asia (2014), although the Chinese standards were updated (Lin and Elder 2014). Data was updated to 2014 as much as possible.

The WHO recommendations and EU and US standards are included for reference. WHO also has Interim Targets for some developing countries that cannot meet the guidelines. In Asia, some countries follow the WHO guidelines for some pollutants but more countries follow the weaker interim targets for developing countries. Notably, both China and India have adopted the stronger WHO guidelines for NO_2 and Ozone for certain designated areas. Other countries have adopted standards with reference to the US or Japan. As of 2014, only Afghanistan and Myanmar lacked ambient standards while Brunei Darussalam had standards only for PM_{10} and not for other air pollutants. Following

increased media attention, several countries adopted $PM_{2.5}$ standards after 2010. Eleven countries had no annual lead standards as of 2010 (but could have standards for other time periods; e.g., Thailand has a monthly lead standard of 1.5 µg/m^3). These differences make it difficult to accurately compare standards.

Table 7.1 Ambient air quality standards for selected Asian and non-Asian countries and WHO guidelines (µg/m^3)

Country	$PM_{2.5}$		PM_{10}		TSP		SO_2			NO_2			O_3		CO		Pb
	24-Hr	Annual	24-Hr	Annual	24-Hr	Annual	1-Hr	24-Hr	Annual	1-Hr	24-Hr	Annual	1-Hr	8-Hr	1-Hr	8-Hr	Annual
Afghanistan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bangladesh	65	15	150	50	-	-	-	365	80	-	-	100	235	157	40	10	0.5
Bhutan	-	-	100	60	200	140	-	80	60	-	80	60			4	2	-
Brunei Darussalam	-	-	150	50	-	-	-	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	500	300	500	300	100	300	100	-	200	-	40	20	-
China: Gr. I	35	15	50	40	150	50	150	50	20	120	80	40	160	100	10	-	1
China: Gr. II	150	70	150	70	500	150	500	150	60	240	80	40	200	160	10	-	1
China: Gr. III	-	-	250	150	-	-	-	250	100	-	120	80	200	-	20	-	1
Hong Kong, China	75	35	100	50	-	-	-	125	-	200	-	40	-	160	30	10	-
India*	60	40	100	60	-	-	-	80	50	-	80	40	180	100	4	2	0.5
India**	60	40	100	60	-	-	-	80	20	-	80	30	180	100	4	2	0.5
Indonesia	65	15	150	-	230	90	900	365	60	400	150	100	235	-	30	-	1
Japan	35	15			100	-	262	105		-	75-113		118	-	-	23	-
Lao PDR	-	-	120	50	330	100	780	300	100	320	-	-	200	-	-	30	10.26
Malaysia	-	-	150	50	260	90	350	105	-	320	10	-	200	120	35	10	-
Mongolia	50	25	150	50	150	100	-	30	10	85	40	30	-	100	30	10	-
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nepal	-	-	120	-	230	-	-	70	50	-	80	40	-	-	-	10	0.5
Pakistan	35	15	150	120	500	360	-	120	80	-	30	40	-	-	-	10	5
Philippines	50	75	150	60	230	90	-	180	80	-	150	-	140	60	35	10	1
Rep. of Korea	-	-	100	50	-	-	392	131	52	188	113	56	196	118	28.6	10.3	0.5
Singapore	35	15	150	-	-	-	-	365	80		-	100	-	147	40	10	-
Singapore 2020	37.5	15	50	20	-	-	-	50		200	-	40		100	30	10	-
Singapore L T targets	25	10	50	20	-	-	-	20		200	-	40		100	30	10	-
Sri Lanka	50	25	100	50	-	-	200	80	-	250	100	-	200	-	30	10	-
Thailand	50	25	120	50	330	100	780	300	100	320	-	57	200	140	34.2	10.3	-
Viet Nam	50	25	150	50	200	140	350	125	50	200	-	40	-	120	30	10	0.5
WHO IT-1	75	35	150	70	-	-	-	125	-	-	-	40	-	120	-	-	-
WHO IT-2	50	25	100	50	-	-	-	50	-	-	-	-	-	-	-	-	-
WHO IT-3	37.5	15	75	30	-	-	-	-	-	-	-	-	-	-	-	-	-
WHO AQG	25	10	50	20	-	-	-	20	-		200	40	-	100	30	10	0.5
EU	-	25	50	40	-	-	350	125	-	200	-	40	-	120	-	10	0.5
US	35	12	150	-	-	-	75 ppb	0.5 ppm 3h	-	100 ppb	188	100	-	147	40	10	0.15 3 mo av-

Sources: CAI Asia 2010, pp. 10, 12, and CAA 2014d, USEPA, EU. Data from China was updated from MEP cited in Lin and Elder 2014 (new standards for Grade I $PM_{2.5}$, and Ozone 8-Hr; and Grade II $PM_{2.5}$, PM_{10} annual, NO_2, Ozone 8-Hr.)

Each country's standards as of 2014 are compared to WHO guidelines and targets in Table 7.2 below, which shows that Asian standards are generally lower than WHO's guidelines for most pollutants, except for CO. No country met the WHO $PM_{2.5}$ guideline, but six countries were at or planned to reach the next strongest level, and nine countries had no standard. Singapore had the strongest standards, with 5 out of 6 pollutants meeting or planned to meet WHO recommendations. China and Mongolia recently adopted the highest standards for 4 of the 6 pollutants. Each country was classified as favourably as possible according to the highest guideline or target met by any one indicator, or in cases where a country has more than one type of standard. Strictly speaking, in a few cases, the standards are not technically comparable due to different specifications. However, use of this data appears to be the only way to make a rough international comparison without doing additional technical analysis or until countries harmonise their standards.

Table 7.2 Comparison of selected ambient standards in Asia with WHO guidelines and targets

Pollutant	No standard	Weaker than WHO IT-1	WHO IT-1	WHO IT-2	WHO IT-3	WHO AQG
$PM_{2.5}$	9	0	3	4	6	0
	Afghanistan, Bhutan, Brunei Darussalam, Cambodia, Lao PDR, Malaysia, Myanmar, Nepal, Rep. Korea	none	Hong Kong (China), India*, Philippines	Mongolia, Sri Lanka, Thailand, Viet Nam	Bangladesh*, China, Indonesia*, Japan, Pakistan, Singapore 2020	none
PM_{10}	4	0	9	7	0	2
	Afghanistan, Cambodia, Japan,*** Myanmar	none	Bangladesh, Brunei Darussalam, Indonesia*, Malaysia, Mongolia, Nepal*, Pakistan*, Philippines*, Viet Nam	Bhutan, Hong Kong (China), India*, Lao PDR*, Rep. Korea, Sri Lanka, Thailand*	none	China (I)*, Singapore (planned)
SO_2	3	8	8	1	0	2
	Afghanistan, Brunei Darussalam, Myanmar	Bangladesh, Bhutan, Cambodia, Indonesia, Lao PDR, Philippines, Rep. Korea, Thailand	Hong Kong (China), India, Japan, Malaysia, Nepal, Pakistan, Sri Lanka, Viet Nam	China (I)	none	Mongolia, Singapore (planned)
NO_2**	3	10	NA	NA	NA	9
	Afghanistan, Brunei Darussalam, Myanmar	Bangladesh, Bhutan, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Philippines, Sri Lanka, Thailand	none	none	none	China (I), Hong Kong (China), India*, Rep. Korea*, Mongolia, Nepal, Pakistan, Singapore, Viet Nam
O_3	5	4	8	NA	NA	5
	Afghanistan, Bhutan, Brunei Darussalam, Myanmar, Nepal	Cambodia, Indonesia, Lao PDR, Sri Lanka	Bangladesh, Hong Kong (China), Japan, Rep. Korea, Malaysia, Pakistan, Viet Nam, Thailand	none	none	China (I), India, Mongolia, Philippines, Singapore
CO	3	1	0	0	0	18
	Afghanistan, Brunei Darussalam, Myanmar	Japan, Lao PDR	none	none	none	Bangladesh, Bhutan, Cambodia, China, Hong Kong (China), India, Indonesia, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Rep. Korea, Singapore, Sri Lanka, Thailand, Viet Nam

Source: Based on Table 7.1 above. Figures indicate the number of countries adopting a specific level of standard for each pollutant.

* Each country was classified as favourably as possible according to the strictest guideline or target met by any one indicator, or in cases where a country has more than one type of standard.

** 5 countries have 24-hr. standards instead of annual standards; these were classified as annual standards in order to enable a rough comparison.

*** Japan has a standard for TSP instead of PM_{10}.

Emission standards for light duty vehicles

Emission standards for new light duty vehicles of selected Asian countries (and the EU and Australia for comparative purposes) planned as of 2014 are presented in Table 7.3 based on information up to 2014. The table, which excludes Japan, Myanmar, Mongolia, Lao PDR, and Cambodia, shows that a number of countries have advanced to Euro 4 but many are still at Euro 1 or 2. Countries should progress to Euro 5.

Table 7.3 Emission standards for new light duty vehicles of selected countries as of 2014

Country/Area	Year Adopted	2014 Standard	Future Plan/Notes
European Union	2014	Euro 6	Petrol
Australia	2013	Euro 5	Euro 6 by 2017
Hong Kong, China	2012	Euro 5	
Republic of Korea	2013	Standards 1-4	Euro 5 diesel
China (major cities**)	2013	China 4	China 5 by 2015
China (nationwide)	2011	China 4	China 5 by 2017
Taiwan	2011	US Tier 2 Bin 7	Equivalent to Euro 4
Singapore (gasoline)	2014	Euro 4	
Singapore (diesel)	2014	Euro 5	
India (entire country)	2010	Euro 3	Considering Euro 6 by 2021
India (some major cities)	2010	Euro 4	
Thailand	2012	Euro 4	
Malaysia (gasoline)	2011	Euro 3*	Considering Euro 4 by 2015
Malaysia (diesel)	2011	Euro 2*	Considering Euro 4 by 2015
Nepal	2012	Euro 3	
Philippines	2007	Euro 2	Euro 4 by 2015
Viet Nam	2007	Euro 2	Euro 4 by 2016, Euro 5 by 2021
Indonesia	2005	Euro 2	Considering Euro 4 by 2016
Bangladesh (main cities**)	1996	Euro 2	Considering E3/2014, E4/2019
Bangladesh (nationwide)	1996	Euro 2	Considering Euro 3 by 2019
Pakistan	2012	Euro 2	
Sri Lanka	2008	Euro 2	Considering Euro 4 by 2016

Source: Clean Air Asia 2014c, CAI-Asia 2011, based on information as of 2014.
* Tentative, ** China: Beijing, Shanghai, Guangzhou; Bangladesh: Dhaka & Chittagong

Emission standards for heavy duty vehicles

Table 7.4 Emission standards for new heavy duty vehicles of selected countries as of 2014

Country/Area	Year Adopted	2014 Standard	Future Plan/Notes
European Union	2013	Euro 6	
Australia (gasoline)	2003	Euro 5	
Australia (diesel)	2003	Euro 4	
Singapore	2014	Euro 5	
Hong Kong, China	2012	Euro 5	
Republic of Korea	2014	Euro 4	
China (major cities*)	2013	China 5	
China (nationwide)	2013	China 4	
Taiwan	2006	Euro 4	
India (entire country)	2010	Bharat 3	
India (selected major cities)	2010-12	Bharat 4	
Pakistan	2013	Pak 4	
Thailand	2006	Euro 3	
Nepal	2013	Euro 3	
Viet Nam	2006	Euro 3	Euro 4 by 2017
Indonesia	2013	Euro 4	In cities; Euro 2 elsewhere
Philippines	2008	Euro 2	
Malaysia	2003	Euro 1	Considering Euro 2 by 2013
Bangladesh	--	None	Considering Euro 2 by 2014

Source: Clean Air Asia 2014c.
* Beijing, Shanghai, and Guangzhou

Fuel standards

Stricter vehicle emission standards need to be combined with stricter fuel standards in order for the anti-pollution equipment to operate properly. Lack of availability of cleaner fuel is a major obstacle to stricter vehicle emission standards. Table 7.5 shows planned sulphur levels in diesel fuel in selected Asian countries in comparison with the EU, Japan, and the US. Nearly all of the Asian countries should improve, and some less developed countries still have very dirty fuel. CAI-Asia (2011) argues that cleaner fuels do not adversely affect the economy and provide economic benefits due to improved public health.

***Table 7.5* Standards for sulphur content of fuels in selected Asian countries, EU and US**

	Diesel Standard (ppm)	Petrol Standard (ppm)	Notes
EU	10		
US	10		
Japan	10	10	
Hong Kong, China	10	50	
Republic of Korea	50	10	
Singapore	50	50	10 ppm/ diesel by 2014
Taiwan	10	50	
Thailand	50	50	
China (nationwide)	50	50	10 ppm by 2017**
India (metros)	50		
India (nationwide)	350	150	
Nepal	350	150	
Bhutan	500	No info.	
Brunei Darussalam	500	1000	50 ppm by 2016**
Malaysia	500	500	50 ppm by 2016**
Philippines	500	500	50 ppm by 2016**
Sri Lanka*	500		Considering 50 ppm**
Viet Nam	500	500	50 ppm by 2018**
Cambodia	1500	1000	
Myanmar	2000	No info.	
Lao PDR	2500	500	
Indonesia	3500	500	
Bangladesh	5000	1000	
Mongolia	5000	No info.	
Pakistan	7000	No info.	

Sources: CAI-Asia 2011, UNEP 2014.
* Sources disagree. UNEP 2014 indicates 2000 ppm for diesel and 1000 ppm for petrol.
** Source does not indicate whether this refers to diesel or petrol or both.

Automobile fuel economy standards

No ASEAN country had automobile fuel economy standards as of 2010, although some countries took preliminary steps. Singapore had a voluntary labelling scheme, while Thailand had a fuel economy standard of 20 km/l for legally designated eco-cars eligible for tax incentives, but no required standards for all cars (50by50 and CAI-Asia 2010). As of 2014, Indonesia, like Thailand, offered tax incentives for eco-cars including a fuel economy requirement of 20 km/l (GFEI 2014). Overall, efforts to establish fuel economy standards in ASEAN countries are still in the early stages (GFEI 2014).

ASEAN countries have been taking some steps towards standards, and efforts are also being made on related voluntary vehicle labelling, fiscal/tax incentives and public information programmes. However, overall progress has been very slow, and the status as of 2014 is summarised in Table 7.6 below.

Table 7.6 ***Policy developments related to fuel economy in selected ASEAN countries***

Country	Fuel Economy Standards & Baseline Calculations	Type of Vehicles Covered	F.E. Vehicle Labelling	Fiscal/tax incentives	Public Information Programmes
Indonesia	Baseline calculations and cost-benefit analysis completed in 2012. Legal drafting of fuel efficiency policies and standards (km/l) underway.	Light-duty 2-wheelers	Voluntary based on conformity of production	Low Cost Green Car (LCGC) Programme	Eco-driving programmes, policy dialogues
Malaysia	National Automotive Policy 2014: Implementation of Energy-Efficient Vehicles (EEV) will be based on fuel consumption specification (l/100km) and carbon emission (gCO_2/km) will only be used once the EURO 4 fuel quality standard is introduced.	Light-duty 2-wheelers	None, but under discussion	Temporary import tax & excise duty exemption	Government developing Malaysia as regional hub for Energy Efficient Vehicles (EEVs)
Philippines	Baseline calculations underway and scheduled to be completed by Jan 2015. Introduction of standards planned under the proposed House Bill on National Energy Efficiency Conservation	Light-duty	Voluntary based on fuel economy runs	Senate proposing incentive bill	Eco-driving programmes and fuel economy runs
Thailand	Draft MEPS & HEPS (km/l) established for diesel and petrol vehicles in 2013 by DEDE – Ministry of Energy with Thailand Automotive Institute	Light-duty 2-wheelers	None	CO_2 taxation policy based on engine size	
Viet Nam	TCVN issued by the Ministry of Science and Technology: fuel consumption limits (l/100km) of passenger cars (Aug 2013) and for 2-wheelers (Sep 2014)	Light-duty 2-wheelers	Mandatory from Jan. 2015		

Source: Rono and Bakker 2014.

Efforts to promote fuel efficiency have been made by the Global Fuel Economy Initiative (GFEI), established in 2009, and its regional partner for Asia, Clean Air Asia (formerly CAI-Asia). In November 2013, the first ASEAN Clean Fuels and Vehicles Forum was organised by Clean Air Asia and The National Environment Agency of Singapore with support from various partners, including the United Nations Environment Programme (UNEP), GIZ, and the ASEAN Secretariat (CAA 2014). Participating ASEAN countries were Brunei Darussalam, Cambodia, Lao PDR, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam (Roño & Bathan 2013). Presentations by Thailand and Indonesia referenced national discussions on establishing standards, but the Forum reported no new standards.

The many potential benefits of stricter fuel efficiency standards in ASEAN countries, such as enhanced energy security, cost savings, air pollution and health are well documented (GFEI and CAI 2010, GFEI 2014). A cost-benefit analysis conducted for Indonesia identified significant cost savings for stricter fuel efficiency standards, especially when used in combination with other related policies (CAI 2012).

Despite these benefits, fuel efficiency standards have not been adopted in ASEAN countries, which is somewhat surprising since other air pollution policy measures such as emission standards have been accepted. According to Fabian (2010), fuel economy policies and measures are currently a lower priority than alternative fuels and emissions management, although it is unclear why. Challenges to introducing fuel economy standards include overlapping ministerial jurisdictions, fuel subsidies, resistance from car manufacturers, higher costs for more efficient cars, lack of consumer awareness, used car imports and the need for coordination with fuel and emission standards (Fabian 2010, GFEI 2014).

Regarding other countries in Asia, China, in contrast, has established fuel economy standards, which are currently at Phase III with a goal of reaching 6.9 l/100 km by 2015, compared with 7.34 l/100 km in 2012. It is now developing Phase IV standards to be set at 5 l/100 km. In Asia, therefore, concerns over competition from China are not very persuasive as a reason for other countries to delay fuel economy standards. Japan and the Republic of Korea also have standards while India does not (GFEI 2014).

Point Sources

No comparative information on emission standards for point sources such as power plants or other industries exists, even though many countries have these standards, including China (Lin and Elder 2014), India, Singapore (Energy Asia 2012), and Japan. For China, stricter emission restrictions for coal-fired power plants were a key element of a set of new air pollution policies adopted in the early 2010s (Lin and Elder 2014). These policies are comparable to those of developed countries, and are funded by higher electricity rates (Chinafaqs.org 2012).

Without reliable comparative information, it is difficult to know the extent of similarities and differences between countries, as well as the stringency of their standards. Countries should establish standards if they do not already exist, and existing standards may need strengthening. Uncertainties about the comparability of standards, may contribute to resistance to strengthening them due to concerns about competitiveness, especially in sectors such as power generation which affect trade-related industries.

Air Quality Monitoring

Monitoring is necessary in order to assess air quality and enforce and implement standards and regulations. However, according to a survey by Clean Air Asia (2014), monitoring is insufficient in many areas of Asia. A survey of 69 Asian cities in 17 countries, including at least seven megacities (Beijing, Delhi, Dhaka, Guangzhou, Manilia, Mumbai, Shanghai, and Tokyo), concluded that the majority (57% of all cities in the survey and 70% of cities in developing countries) lack adequate monitoring stations compared to EU guidelines. Moreover, "in more than half of the countries surveyed, not all of the pollutants with national standards are monitored by cities" (p.18). Quality control or assurance measures for air pollution monitoring were being implemented in 27 cities. Some developing countries had limited financial and human resources or technical capacity (p.28).

Budget estimates for capital costs of fixed monitoring stations ranged from 146,200 USD in Bangkok to 360,000 in Seoul, and operational costs per station ranged from 6,300 USD in Seoul to 27,200 in Bangkok. Overall network operation costs for consumables, parts, and repairs ranged from 117,592 USD in Ulaanbaatar, to 380,000 in Jakarta and 630,000 in Singapore (CAA 2014, p. 36). It is unclear why expanding monitoring networks would be

difficult with this range of costs, especially if a cost-benefit analysis were to be conducted. Cities or countries facing real financial constraints could still establish or add at least a small number of monitoring stations for a modest cost. External assistance could also be considered.

China

China may be a major source of concerns in other countries about the possible effects of stronger air pollution policies on trade competitiveness, since it is involved in a significant share of global trade in a wide range of industries. This chapter argues that China's new and considerably strengthened air pollution policies give countries which are worried about trade competitiveness plenty of extra room to strengthen their own policies.

China comprehensively upgraded its air pollution policies during the 12th Five-year Plan period which began in 2011—the Air Pollution Action Plan issued by the State Council in September 2013 being the most recent. These policies cover five main areas (Lin and Elder 2014): 1) Reinforced standards and regulations; new pollution reduction targets, particularly in designated priority regions, covering a broad range of pollutants, including $PM_{2.5}$, ozone and volatile organic compounds (VOCs); phase-out of "Yellow Label" high polluting vehicles; 2) Expanded monitoring and public reporting of data; 3) Bolstered enforcement of pollution reduction targets which are newly linked to promotion of officials, and expanded use of environmental impact assessments (EIA); 4) A major policy push to promote renewable energy and energy efficiency; 5) A kind of environmental-industrial policy, aimed at promoting environmental protection industries and technologies, not just renewable energy and energy efficiency.

China's Environmental Protection Law was also strengthened in April 2014, which reinforces many of these trends, although the effectiveness of its implementation is unknown (van Rooij and Wang 2014, Economist 2014). Revisions to strengthen China's Air Pollution Control Law were under discussion as of late 2014 (Speegle 2014). Major proposed changes are summarised by Barbara Finamore (2014), although the basic direction is in line with the Air Pollution Action Plan described above.

These new policies have required some local governments and designated regions to formulate action plans to respond to severe pollution episodes. New plans in Beijing and Hebei Province include restrictions on vehicle use and temporary production shutdowns for factories and electric power generation plants (and require actual operation of anti-pollution equipment). These measures are said to be enforced fairly strictly.[1]

Overall trends in air pollution standards

Several major trends are suggested by this survey. 1) In some areas, such as ambient air quality standards and light vehicle emission standards, some East Asian countries have already established standards in line with or exceeding WHO recommendations or US standards; 2) Some countries have established standards, but not as strict as WHO or the US; 3) Some countries have weak standards, and a few appear to have no standards; 4) No ASEAN countries had vehicle fuel economy standards as of 2010—which is surprising given the obvious energy security and cost benefits of increased fuel efficiency; 5) No comparative information is available on other kinds of standards, such as industrial emissions standards or other air pollution policies.

Overall, the strength of air pollution standards in the countries in the region varies widely—from a complete lack of standards, to WHO-equivalent standards. Ambient and

mobile standards in many countries have been bolstered in recent years, with occasional reviews and amendments. For light- and heavy-duty vehicles, many countries have updated their standards very recently, as can be seen from Tables 7.3 and 7.4 above. This study only reviewed ambient and mobile standards and not standards for stationary sources, which may have a similar variability.

The fact that some countries have strict standards, and that standards are gradually strengthening in the region, indicates that economic integration itself does not necessarily prevent stricter ambient and mobile standards. Standards for stationary sources may be more affected by economic integration. However, in many cases standards still need to be strengthened and better enforced to address severe air pollution, and it is possible that economic integration may be restricting how high standards could strengthen. The next section analyses the air pollution implications of recent trends in trade liberalisation and economic integration in East Asia in more detail.

3. Air Pollution Concerns Regarding Recent Trends in Trade Liberalisation and Economic Integration

This section addresses the broad concerns regarding air pollution relating to recent trends in trade liberalisation and economic integration in East Asia. It does not try to quantify or evaluate the impacts since other factors, such as embodied trade in air pollution, similar to embodied trade in carbon, make it difficult to identify responsibility for emissions.

Generally, trade liberalisation and economic integration are presumed to increase economic growth, which then increases air pollution and other environmental problems (Copeland and Taylor 2003). Major anthropogenic sources of air pollution include fossil-fuel electric power plants, automobiles, and various industrial sectors, particularly petrochemicals and steel (UNEP 2012; Kurokawa, et al. 2013). Much air pollution is related to energy consumption. More trade also leads to more shipping and transport—by air, train, lorry, ship—which also causes more air pollution. Air pollution from ships is becoming serious due to an increasing number of vessels and the use of low quality fuel (Mueller, et. al. 2011).

Air pollution resulting from increased economic integration may contribute to existing regional transboundary air pollution problems in East Asia (Nagashima, et al. 2010, Chang 2012). Transboundary issues are addressed in existing international agreements such as the ASEAN Agreement on Transboundary Haze Pollution, the Acid Deposition Monitoring Network in East Asia (EANET), and international discussions such as the Air Pollution Policy Dialogue under the Tripartite Environment Ministers Meeting (TEMM) among China, the Republic of Korea, and Japan.[2]

General concerns about trade competitiveness and a potential race to the bottom

One of the main fears of economic integration is about the so-called 'race to the bottom', if industries move production out of countries with stricter air pollution regulations such as Japan or the Republic of Korea to those with weaker regulations. However, most research has not found significant evidence of this (Frankel 2009, Copeland and Taylor 2004), with some exceptions (see e.g., Levinson and Taylor 2008, Poelhekke and van der Ploeg 2012). Conversely, there is somewhat more evidence for a 'race to the top' (the 'California effect'), in which companies make their products more environmentally friendly in order to meet the requirements of large advanced export markets. Sometimes even developing countries, producing for export markets, raise their standards in order to

encourage domestic companies to develop the required export capabilities (Vogel 1999, Saikawa 2013). More research is needed to clarify the conditions causing races to the top or bottom.

A key limitation of existing research is that it tends to focus on the point of view of developed countries with high standards, which fear that industries and jobs may move to countries with lower standards.

This chapter argues that it is also necessary to explore the question from the point of view of developing countries which are considering whether to strengthen their environmental standards. According to the "race to the bottom" hypothesis, developing countries may worry about losing business to neighbours with lower standards, while the "race to the top" hypothesis suggests that raising their standards might help their industries to gain better access to advanced markets.

Many policymakers in developing countries may be unaware of the potential benefits of 'racing to the top' or the empirical evidence that the potential competitive benefits from 'racing to the bottom' may be limited. Therefore, this fear of losing trade competitiveness still may be a major obstacle to strengthening air pollution standards and enforcement, even if these fears are not well supported by empirical evidence.

In practice, many countries, especially developing ones, resist linking economic integration, particularly trade liberalisation, with stricter environmental measures (Chaytor 2009, OECD 2007). Agenda 21 cautions that "special factors affecting environment and trade policies in the developing countries [should be] borne in mind in the application of environmental standards, as well as in the use of any trade measures," and notes that "standards that are valid in the most advanced countries may be inappropriate and of unwarranted social cost for the developing countries."[3]

A key argument of this chapter is that policymakers' concerns about trade competitiveness are not well justified by the evidence, and may be economically counterproductive. To the extent that markets are characterised by a 'race to the top', countries which lag behind in strengthening their standards may find it difficult to develop exports in related industries. Likewise, if there is no race to the bottom (for example, if the costs of meeting environmental regulations are not very significant), then it may be difficult for countries to gain any competitive advantage by maintaining lower standards. Finally, even if trade competitiveness fears were valid, the fact is that major developing exporters like China have significantly strengthened their air pollution (and other environmental) standards. This provides some space for China's trade competitors to raise their own standards and still maintain or improve their trade competitiveness.

Air pollution and economic integration

Policymakers may still have concerns specifically related to air pollution regarding potential negative effects on competitiveness of stricter air pollution standards in the context of economic integration even thourgh large-scale quantitative studies have not found much evidence for this. Still, specific concerns related to air pollution might be difficult to detect using quantitative models relying on highly aggregated data.

Air pollution standards have gradually strengthened over time in many East Asian countries, as noted in the previous section, along with the gradual progress of economic integration in the region. Also, as can be seen from the survey of air pollution standards presented above, their stringency roughly (though not fully) correlates with levels of

economic development. Generally, least developed countries have the weakest (or no) standards, developed countries have the highest standards, and emerging economies are in the middle. Therefore, it cannot be said that economic integration necessarily stops the development of standards, or weakens them.

Nevertheless, progress on standards, especially in developing countries, has been slow, and generally these standards are weaker than the highest recommended WHO guidelines. Competitiveness concerns relating to economic integration may be delaying the adoption of stricter standards and maintaining a gap with standards in developed countries. For example, in Thailand, detailed cost-benefit analyses of proposed stricter air pollution standards were necessary in order to persuade policymakers to adopt them,[4] and despite this a gap with developed country standards still existed.

According to a former Thai official, developing countries may agree to strengthen environmental standards but not to the same level as in developed countries. In his view, affordability for businesses and the government was the main reason, and that as countries become more developed they can better afford stricter standards.[5] Affordability in this context may be related to absolute costs and not international trade, but in the context of trade negotiations, affordability is clearly also related to trade competitiveness.

Another danger is that companies will export cheaper but higher-polluting products (such as automobiles) to countries with weaker air pollution regulations as they become wealthier through trade (Macias et. al. 2013). This has by and large happened in East Asia, which has seen a massive rise in car use and related pollution due to rising living standards, trade and economic growth. Many of these cars are higher polluting used cars imported from developed countries where they no longer meet more stringent emission regulations. To be sure, newer, less polluting cars would have been more expensive and there would have been fewer of them. In principle, as living standards increase along with economic growth, people become more prosperous and can afford cleaner cars.

Air pollution standards vary greatly in East Asia, and these differences may have already affected the relative economic competitiveness of the countries within it. As traditional trade and investment barriers are steadily reduced through economic integration, regulations in other areas, such as air pollution or environment, may exert increasing effects on trade. Thus economic liberalization may generate pressure on some countries to harmonize or narrow the differences between their air pollution regulations, and some may be reluctant to strengthen them, as discussed below in the discussion on Europe. Moreover, harmonisation should always be in the direction of stricter rather than weaker policies.

Least developed countries with minimal or no air pollution regulations

The most serious problem may be the least developed or developing countries like Myanmar or Afghanistan, which have minimal or no air pollution regulations, thus making them susceptible to low cost/high polluting technologies and imported products (e.g., cars). For example, in Myanmar, the institutional framework for environmental regulation was strengthened in 2011 through the new Environmental Conservation Department within the newly upgraded Ministry of Environmental Conservation and Forestry (previously the Ministry of Forestry). Nevertheless, the country still had no air quality standards as of 2013 (Environmental Conservation Department, Myanmar 2013) even though the Environmental Conservation Law of 2012 granted authority to the government to develop them (Hlaing, Patdu, and Capadocia 2014). Myanmar also lacks a national air quality monitoring programme. Past ad hoc monitoring has indicated that levels of PM_{10} are above WHO guidelines and among the highest in Southeast Asia

(Hlaing, Patdu, and Capadocia 2014). While current air pollution may be mainly due to mobile sources, economic development may mean industrial and area sources are likely to become significant (Hlaing, Patdu, and Capadocia 2014). Myanmar also has no comprehensive inventory of air pollutants, despite having one for greenhouse gases (Hlaing, Patdu, and Capadocia 2014). Myanmar, Afghanistan and DPR Korea were the only Asian countries still using leaded gasoline as of April 2014.[6] Implementation of economic integration should be conditioned on the establishment of minimum air pollution and other environmental standards, as well as effective implementation and reporting mechanisms. Of course, minimum standards and implementation mechanisms should be established even in the absence of economic integration initiatives.

Cross-border electricity trade

This is an important sector-related issue. Here the fear surrounds the possible location of new power plants using low cost/high polluting technologies in nearby countries with weaker regulations. One example is Thailand, which plans to expand imports of electricity from power plants built in neighbouring countries, including China and Lao PDR (Power Insider 2013, Cleanbiz.asia 2013). In 2011, Thailand imported 10.8 gigawatts from Malaysia and Lao PDR (US Energy Information Administration 2013). A 4,000 megawatt coal-fired power plant to export electricity to Thailand was planned in Myanmar's Dawei Special Economic Zone before being cancelled due to environmental concerns in January 2012 (Robinson 2012). Although Thailand imports some electricity from large scale hydropower plants, other adverse environmental and socioeconomic impacts besides air pollution may result, especially on international rivers like the Mekong.

On the positive side, regional integration of electricity markets could expand the use of renewable energy, since expansion of the scale of the grid could compensate for the intermittent nature of major renewable energy sources, thereby increasing its physical potential (Romero, Elder, and Bhattacharya 2010). In addition, expanded economic integration in the form of increased trade in renewable energy equipment could also facilitate greater adoption of renewable energy (Moinuddin and Bhattacharya 2013).

Link between climate and air pollution

The link between climate and air pollution (e.g. UNEP 2011, Akimoto et al. 2012) is an important new issue that will also be influenced by increased economic integration. It is increasingly recognized that air and climate pollution are caused by many of the same sources, and that significant cost savings (sometimes called "co-benefits") can be achieved by managing them in an integrated way (Asian Co-benefits Partnership 2014). However, just as with air pollution, most governments worry about the effects of climate countermeasures on economic and trade competitiveness (e.g., Cosbey and Tarasofsky 2007). Thus, if further economic integration leads to a race to the bottom in responses to climate change as well as air pollution countermeasures, the cost savings and other co-benefits to an integrated approach will be lost.

Direct negative effects of air pollution

Air pollution itself has direct negative effects on economic competitiveness. For example, in Beijing some companies have difficulties attracting foreign staff (Bloomberg.com 2014), and even some Chinese citizens try to move to less polluted areas (Cendrowski 2013). The competitiveness of Hong Kong's financial sector is also being eroded as firms move to Singapore in search of cleaner air (Financial Times 2006). There is increasing evidence that air pollution damages agricultural crops (Nawadha, et. al., 2012, 2013).

Environmental safeguards in trade agreements

Since the 1980s, the importance of incorporating environmental safeguards in trade agreements has been recognised in the OECD (e.g., Kamal and Imai 2003, IISD and UNEP-DTIE 2005, OECD 2007), but it has not been a priority in East Asia. The EU has made some efforts to incorporate provisions related to environment and sustainable development in its negotiations with ASEAN countries (Cuyvers 2013). A study by Yanai (2014) on environmental provisions in Japan's regional trade agreements with developing countries concluded that although all of the agreements had environmental provisions, such provisions are typically small in number and lack environmental chapters or side agreements. Yanai recommends Japan to incorporate environmental assessments into regional trade agreements in order to avoid environmental problems resulting from them. It is not clear whether environmental or sustainability provisions will be incorporated into the negotiations on the TPP (this point relates to all environmental issues, not just air pollution).

4. International cooperation on air pollution in the context of economic integration in Europe

This section compares the experiences of East Asia and Europe, since Europe faced similar issues regarding the links between economic integration, air pollution, and trade and economic competitiveness. Some may be sceptical about the value of such a comparison because the differences between the two regions – economic, cultural, historical – are thought to be very great, and Europe's system is very advanced. This chapter argues that the comparison should start not with the present situation in Europe, but rather at the beginning of the European countries' efforts to address transboundary air pollution. This was during the era of the Cold War's epic conflict between capitalism and communism which threatened to engulf the earth in a nuclear war; security conditions in East Asia today seem much less serious. During the Cold War, there were very large differences among the European countries (and also between the US and the USSR/Russia) in political systems, cultures, and economic development, although perhaps not as pronounced as the differences in East Asia.

Ultimately, cooperation on air pollution and economic integration was successful in Europe despite many unfavourable conditions. The cornerstone is the Convention on Long-range Transboundary Air Pollution (LRTAP) which came into effect in 1979. Transboundary air pollution became an international issue in the early 1970s, and it took a few years to arrive at the initial LRTAP agreement in 1979, which was a very general agreement without specific commitments among the West European countries, the US, Canada and the former Soviet Union and its allies in East Europe. Over time LRTAP added several conventions requiring reductions of specific air pollutants. LRTAP's current form is the Gothenburg Protocol, adopted in 1999, which uses an integrated approach simultaneously addressing a range of pollutants and effects. Overall, LRTAP evolved gradually over 20 years overcoming many obstacles.

Initially, Britain and West Germany, two of the major sources of transboundary air pollution, were reluctant to agree to the treaty, mainly due to concerns about economic competitiveness, especially for automobile producers. West Germany changed its position in favour of the treaty after its auto producers developed advanced pollution reduction technology, and it saw the opportunity to gain a comparative advantage through stricter air pollution regulations throughout Europe. Eventually, both West Germany and Britain also recognized that air pollution was damaging their own ecosystems. In Germany in

particular, extensive publicity surrounding widespread forest damage was important (Boehmer-Christansen 2000, Sprinz and Wahl 2000).

The Gothenburg Protocol directly addressed concerns about stricter air pollution measures on trade competitiveness and on costs in general. Its innovative feature was differentiated targets negotiated based on a modelling system that calculated cost-optimised reduction strategies, instead of the previously used system of percentage reduction targets, which had resulted in wide disparities in abatement costs among the member countries. The Gothenburg Protocol resulted in steadily stricter air pollution control measures, and is generally considered to be one of the more effective multilateral environmental agreements. The Gothenburg Protocol was successful in part because its differentiated targets helped overcome concerns over costs (particularly for the smaller and less advanced countries of eastern and southern Europe). In addition, there were large investments in capacity building to help less advanced countries to meet their targets.

A major difference between Europe and East Asia is the much greater level of economic integration of the EU. Joining the EU was a high priority for the less developed European countries after the end of the Cold War, as it unlocked the door to preferential trade access to the EU market, something that led prospective member countries to make concessions on many aspects of their domestic policies (Moravcsik and Vachudova 2003), including harmonisation with the higher EU environmental standards and regulations. Joining LRTAP, which provided technical assistance and capacity building to members needing it, was an effective way to smooth the adoption and implementation of stricter air pollution policies. The EU did not require full adoption of all standards all at once, and in some cases allowed a phase-in period (see Carius, von Hofmeyer, and Bar 1999).

In general, over time, as steadily advancing European integration reduced formal trade and investment barriers, the trade effects of other policy areas, such as the environment, became more visible. This in turn led to pressures to harmonise these policy areas within the EU in order to reduce any trade distortions (see e.g., Barnes and Barnes 1999, Jordan 2002). Thus, the EU countries jointly strengthened their domestic air pollution policies in a coordinated way through LRTAP in a series of steps (Sliggers and Kakebeeke 2004).

Certainly, East Asia is different in some important aspects—no 'community' exists, and no leading countries with large markets are advocating such a community to be underpinned by stricter environmental standards. The ASEAN 'Community', which is still in its initial stages, is focused on trade and investment liberalisation, and it has no concrete plans to strengthen or harmonise environmental policies.[7] Moreover, as the pace and degree liberalisation are not very ambitious, member countries may have not yet felt much economic pressure to harmonise other policy areas, such as the environment, although this could still happen in the future if liberalisation becomes more ambitious. Therefore, currently, unlike in Europe where the creation of the EU generated powerful incentives to strengthen environmental policies and their implementation, in ASEAN and East Asia more broadly, there are no similar driving forces or leading countries.

Nevertheless, the LRTAP experience still has important implications for East Asia. First, to the extent that economic integration does progress, it will create internal economic pressures for harmonization within ASEAN itself, just as it did in Europe. However, since economic integration has not progressed very far in East Asia, these pressures may not have been felt much there yet. Second, the most important implication is the desirability of LRTAP-style differentiated reduction targets, based on national circumstances, which prioritise cost effectiveness using an agreed integrated model. The legally binding aspect is less important. Even with voluntary targets instead of a binding agreement, a mutually

agreed integrated model could still help countries to devise the most cost effective reduction measures. Third, LRTAP demonstrates the critical importance of capacity building to implement and meet standards, and the role of international cooperation via the LRTAP framework, which will be key for developing countries that lack even sufficient air pollution monitoring capacity.

5. Recommendations

This section makes seven recommendations: 1) Strengthen air pollution standards — the evidence suggests that this may strengthen rather than undermine economic competitiveness; 2) Promote more cost-benefit analysis of stronger air pollution countermeasures (which may also reduce fears over costs and competitiveness); 3 and 4) Enable implementation through expanded data monitoring and capacity building; 5) Promote a co-benefit approach to link air pollution with other issues, thereby reducing costs and increasing the benefits from air pollution countermeasures; 6) Enhance the above recommendations 1–4 by strengthening international cooperation frameworks; 7) Conduct sustainability assessments of economic integration initiatives as a structural measure to enhance coherence between environment and development (this applies more broadly, not just to air pollution), and prevent environmental problems from economic integration to avoid having to 'clean up' later.

Recommendation 1: Strengthen and harmonise or coordinate domestic air pollution standards and regulations, and strengthen implementation of existing ones

This recommendation is particularly aimed at the countries forming the ASEAN Community in 2015, but also other countries involved in international negotiations to expand economic integration. At least, standards should be strengthened, even if they cannot be harmonised or coordinated.

This chapter argues that for countries concerned about trade competitiveness, there is still room to strengthen standards, since China, as well as ASEAN's major export markets in Europe, North America, and Japan have already strengthened various standards. Harmonised, coordinated standards would minimise potential negative effects on trade competitiveness. Recommending stronger standards is not really new, but it has not been followed sufficiently. Therefore, the recommendation bears repeating, especially in the context of new initiatives such as TPP for which the probability of environmental safeguards is unclear.

Ideally, strengthened air pollution standards and commitments to implement existing ones should be incorporated into future agreements to promote economic integration. The degree and timing of strengthening could be differentiated among countries, similar to the LRTAP's Gothenburg Protocol. The US, EU, and other OECD countries now incorporate environment-related provisions into regional trade and economic partnership agreements (Chaytor 2009). Examples in East Asia include the EU (Cuyvers 2013) and US FTAs with the Republic of Korea.

Regarding the capacity to establish and implement new standards, a staged phase-in process coupled with capacity building might be necessary, especialy for newly developing countries. More advanced emerging economies like China countries may already have some capacity in major metropolitan areas like Beijing, Shanghai, and Guangzhou, but may still need additional capacity, especially outside of these areas.

Conventional Cost-Benefit Calculations

Conventional cost-benefit analysis shows that the benefits of reducing air pollution significantly outweigh the costs, regardless of economic integration. WHO has documented the enormous toll from disease from air pollution (WHO 2014a and 2014b): "Globally, 4.3 million deaths were attributable to household air pollution (HAP) in 2012, almost all in low and middle income (LMI) countries. The South East Asian and Western Pacific regions bear most of the burden with 1.69 and 1.62 million deaths, respectively" (WHO 2014a p. 1). The annual death rate has been increasing since the 2000s, although this may be partly due to better evidence of the causes of death. Moreover, "Globally, 3.7 million deaths were attributable to ambient air pollution (AAP) in 2012. About 88% of these deaths occur in low- and middle-income (LMI) countries, which represent 82% of the world population. The Western Pacific and South East Asian regions bear most of the burden with 1.67 million and 936,000 deaths, respectively" (WHO 2014b, p. 1). Therefore, in total, about 8 million people died from air pollution in 2012. East Asian megacities are particularly suffering from hazardous levels of air pollution. This information is well known, but so far it has failed to persuade policymakers strengthen air pollution standards to the strongest WHO-recommended levels and effectively implement them.

Addressing Competitiveness Concerns

This section argues that competitiveness concerns are not well founded. The exports of many ASEAN countries (e.g., cars and car parts) already need to meet advanced environmental standards established in their major export markets. Moreover, many companies in ASEAN countries are either foreign-owned, or members of global production networks, so they have access to advanced environmental technology. There is no good reason for these countries not to adopt similar standards for products sold in their domestic markets. During the 1997 Asian economic crisis, Thailand's car-related industries benefited from higher emission standards, which enabled them to reduce their reliance on depressed domestic markets and focus more on exports sales, since export markets required higher standards.[8]

One recent quantitative study on automobiles (Saikawa 2013) found a trend for developing countries to strengthen their auto emission standards in order to strengthen trade competitiveness and enter export markets with higher environmental standards. Moreover, countries that strengthened their standards tended to increase their exports. Saikawa also observed that developing countries targeting advanced export markets also consider raising domestic standards to avoid putting exporting firms at a disadvantage in domestic markets.

In contrast, lower domestic air pollution standards can undermine long term economic competitiveness due to the higher production costs and divided management focus resulting from maintaining two production lines to meet different domestic and foreign standards. Michael Porter (1990) argued in his *Competitive Advantage of Nations* that longer term competitive advantage is more sustainable by using a product differentiation strategy rather than focusing on short term cost competitiveness.

Companies do not always understand their self-interest correctly. The classic case is the Japanese response to the US decision to delay the introduction of stringent air pollution regulations on automobiles in the 1970s. The Government of Japan had raised its own standards in parallel with the US in order to encourage its domestic producers to develop the capability to produce cars which could be exported to and sold in the US. When the US delayed the introduction of the regulations, the Japanese auto producers urged the

Japanese government to delay its own regulations. However, the government refused, and as a result, the Japanese auto producers were well positioned to make strong advances in the US market when the regulations were finally introduced (see Pharr and Badaracco 1986; Sagara 2013). Likewise, the desire to strengthen international competitiveness of China's automakers was one of the factors behind the country's decision to strengthen its air pollution standards for automobiles (Oliver, et. al. 2009, Saikawa 2013). This decision was taken despite domestic opposition from many Chinese domestic firms, but received support from those possessing the relevant technologies. In this case, the Government of China understood that adopting the stricter standards would facilitate the technological upgrading of the industry as a whole (Saikawa 2013).

The other major argument against strengthening air pollution standards is that people in the least developed countries might favour higher polluting used cars over cars with more advanced pollution controls due to affordability and poverty reduction issues. The results of this path are well known, with many megacities choking in hazardous smog. Newly developing countries should try to leapfrog over this dirty phase of traditional economic development, via improving public transportation for example. At a minimum, standards should be set to allow imports of only less polluting cars, as newer, cleaner cars are not necessarily more expensive than older and more polluting ones. Prices are also affected by demand and supply, not just the cost of specific car components.

The same could be said of electric power in the context of expanding energy access. Developing countries should use cleaner power generation from the beginning, rather than the traditional model of building large-scale dirty power plants first and then cleaning up later. Renewable energy sources are the most desirable, but if fossil fuels are used, then at least advanced pollution reduction equipment should also be required. Setting high product standards for electrical goods is also important, as this reduces power consumption and costs, and increases energy security. Again, these suggestions are not new, but they also have not been widely implemented. Economic integration presents a useful opportunity to repeat these suggestions, and address some arguments for not implementing them, such as possible concerns about costs and trade competitiveness.

China is one of the main focuses of trade competitiveness worries. However, it is no longer a valid reason for other developing countries to delay strengthening standards, since China has already strengthened its own standards and committed significant resources to their implementation. Moreover, this is part of China's new energy and industrial policy which prioritises energy efficiency and renewable energy, not just as environmental policy, but also to promote new industries, technologies and create jobs. Newly developing countries thus have space to strengthen their standards, invest in cleaner technologies, and leapfrog the dirty stages of development. Contrary to the old conventional thinking, countries that adopt outdated, inefficient, and highly polluting technologies may be endangering rather than supporting their long run economic competitiveness.

Africa illustrates the dangers of insufficient or absence of standards. There have been recent reports of global auto manufacturers selling new cars without any pollution equipment in countries without any regulations (Chakanyuka 2014; Tsiko 2015),[9] cars that are even more polluting than older ones. Newly developing countries in Asia need to avoid this.

Recommendation 2: Promote cost-benefit analysis of stronger air pollution countermeasures

Cost-benefit analysis can demonstrate that the benefits of stronger air pollution countermeasures may significantly outweigh the costs (e.g., US Environmental Protection Agency 2011), as well as clarify the potential effects on economic competitiveness. Recent research shows that the actual costs of air pollution are much higher than previously thought (e.g., CAI-Asia 2011 regarding fuel standards), while the costs of air pollution reduction measures are often significantly lower than estimates by business. Concepts of economic development are also evolving. Cleaner production can reduce waste and costs while creating more jobs. Greener goods and services and environmental industries can be more technologically advanced and more advantageous in terms of job creation than some traditional industries. Whether detailed studies of developing countries exist is unknown, but in the US, studies have estimated employment effects (Heintz, Garrett-Peltier, and Zipperer 2011), for example the Natural Resources Defence Council (Yeh, Johnson, and Hawkins 2014) estimated that a carbon pollution standard for electric power plants could create 274,000 jobs in the US by 2020. Effective cost-benefit analysis studies require reliable, high quality data, which could be facilitated through international organisations and cooperation frameworks. Co-benefits, discussed below, should also be incorporated into the analysis.

Recommendation 3: Strengthen data collection, sharing, and analysis

Better and more easily obtained data will help persuade governments and other stakeholders to strengthen air pollution standards and policies. As mentioned above, efforts have been made by Clean Air Asia, the ASEAN Secretariat, and others, but cooperation through a more specialised, technical organisation or framework with good governmental connections may be needed to access official policy and monitoring data. In Europe this is done by LRTAP and the bodies beneath it such as the European Monitoring and Evaluation Programme (EMEP). LRTAP also provides capacity assistance to countries needing it, and conducts integrated modelling to support the Treaty.

East Asia thus should have a framework similar to LRTAP. Among existing frameworks, EANET could be one option since it has the widest geographic scope and established monitoring network, although its scope would need to be significantly expanded with additional functions beyond monitoring and coverage of additional pollutants. ASEAN is another theoretical possibility since it could request information from its members, but other organisations, such as EANET, might be better candidates since the ASEAN Secretariat lacks technical and human resources. Initially, NGOs and research institutes may need to augment information collection and compilation via external funding. Efforts to develop this kind of system have been attempted in Northeast Asia through the project on Long-Range Transboundary Air Pollutants in Northeast Asia (LTP) and the Northeast Asian Subregional Programme for Environmental Cooperation (NEASPEC), but these efforts are limited in geographic scope. Creation of a new organization or framework could be the best option. The new Joint Forum on Clean Air in Asia and the Pacific, proposed at a consultation meeting in Sri Lanka in November 2014, could also help strengthen synergies among the various existing international cooperation frameworks dealing with air pollution in the region and help to reach an agreement on the best way forward.[10] UNEP should also play a coordinating role since it has experience with various air pollution cooperation frameworks.

Recommendation 4: Capacity building to strengthen domestic air pollution measures

Some countries may not have sufficient capacity to establish and implement stricter air pollution standards and regulations, especially newly developing countries. This requires technically skilled human resources and monitoring equipment, as well as assistance in policy development. Still, this is not just a matter of technical capacity; governments need to be motivated to build it.

Developing capacity may take some time, and international organisations, universities, and NGOs may need to help. This assistance should be incorporated into any related trade and investment agreements, or could be arranged separately in an air pollution cooperation mechanism. For LRTAP, this assistance is handled by the EMEP, and is used for monitoring, creating and maintaining emissions inventories, and modelling. The original concept for EANET was based on EMEP, but EANET faces significant limitations in its scope, funding, and human resources. Additional capacity building in the region is very much needed.

Recommendation 5: Promote a co-benefits approach

A co-benefits approach emphasises the additional benefits that can be achieved with air pollution reduction measures. There are two major perspectives which focus on economic development co-benefits and climate change mitigation co-benefits, respectively.

Economic development co-benefits are concrete examples of synergies between the environment and the economy, and fit well with the green economy concept promoted at Rio+20. This idea can be seen in China's Air Pollution Action Plan of September 2013 and various 12th Five-year Plans related to air pollution, which include a variety of industrial policy measures to eliminate high-polluting outdated production capacity and regulate where highly polluting industries are located. The Blue Sky Science and Technology Project is a Special Five-year Plan, implemented jointly by the Ministry of Science and Technology and Ministry of Environmental Protection, which aims to develop new environment-related technologies and calls for new projects worth 100 billion RMB (about 16 billion USD) (Lin and Elder 2014). Renewable energy and energy efficiency, which also address energy security and job creation, are high priorities in China's economic development strategy.

Technically skilled jobs are directly created by the development and implementation of stricter air pollution control measures. Governments need trained human resources to develop policies, operate monitoring equipment, and conduct inspections. Businesses need personnel to operate pollution equipment, monitor compliance with regulations, and design cleaner production processes. These should be considered green jobs.

More narrowly focused co-benefits between air pollution and climate mitigation measures are now a global priority (UNEP 2011) and the focus of a major international initiative, the Climate and Clean Air Coalition, to promote related efforts (Climate and Clean Air Coalition 2013). Some major air pollutants are also greenhouse gasses, and many of the sources of both air pollution and climate change are similar, such as automobiles and electric power generated by fossil fuels. Therefore, some air pollution reduction measures also reduce GHG emissions, so there are significant cost efficiencies from the simultaneous reduction of air pollution and GHGs. Moreover, some air pollutants such as SO_X have a cooling effect, so an integrated approach to air pollution and climate change (sometimes called co-control) also improves the policy effectiveness by avoiding policies mutually offsetting each other. Overall, the co-benefits approach can deliver multiple

benefits and enhance the cost-effectiveness of air and climate policies (Asian Co-benefit Partnership 2014), as well as economic co-benefits, especially jobs (Zusman 2012, Puppim De Oliveira 2013)—which are all high priorities for policymakers and stakeholders.

Recommendation 6: Strengthen the international cooperation framework for air pollution

More international cooperation would help countries to strengthen and harmonise their air pollution standards and regulations. This is important in the context of the development of the ASEAN Community and eventually a broader Asian community, following in the footsteps of the EU. Trade and investment liberalisation creates strong economic pressures to harmonise policies in other areas, particularly the environment, and many countries may lack the capacity to develop and implement stricter air pollution standards and regulations. Here again, the LRTAP could be a useful model. Its major advantages include differentiation of targets according to level of development, emphasis on capacity building, and use of an integrated approach to enhance overall effectiveness by accounting for the interactions between different pollutants and environmental effects. Taken together, these approaches enhance cost effectiveness. Although LRTAP is a legally binding treaty, an Asian version does not need to be. The benefits could still be realised under a voluntary framework (Elder, et. al, 2013).

A number of air pollution cooperation frameworks already exist in Asia. Only two include Southeast Asia: EANET and the ASEAN Transboundary Haze Agreement. In Northeast Asia there are three frameworks: the Tripartite Environment Ministers Meeting among China, Japan, and the Republic of Korea (TEMM), the Joint Research Project on Long-Range Transboundary Air Pollutants in Northeast Asia (LTP), and the North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC). In South Asia there is the Male Declaration. However, except for the Male Declaration, their focuses are very limited (Elder 2013), and they do not focus on harmonization of standards, or capacity building for policy development or implementation. None of these frameworks is linked to economic or trade related frameworks.

Theoretically, EANET might have the greatest potential among the existing frameworks, since its membership is broader, giving it more potential in terms of capacity building. Originally it was considered to have some potential to be a prototype East Asian LRTAP. However, EANET's current scope is too limited and would need to be significantly expanded to include more pollutants, modelling, coordination of policy harmonisation, and capacity building. Moreover, EANET's Intergovernmental Meeting has not been able to agree on expanding its scope, so its future form is currently unclear. The other options would be to enhance coordination among existing frameworks, or simply to create a new framework. These options could be explored by the proposed Joint Forum on Clean Air in Asia and the Pacific, mentioned above.

Recommendation 7: Sustainability assessment of international negotiations on regional economic integration

This chapter recommends that sustainability impact assessments should be conducted for international negotiations on economic integration to identify and overcome potential impacts. This should be done before and during negotiations, not just after the negotiations have been completed, so that potential impacts can be identified and minimised before the agreement is finalised. Of course, any assessment should include environmental issues in general, not just air pollution.

This recommendation is not new but it is not typically implemented in East Asian countries. Since the 1990s, such assessments have been recommended to analyse trade-related environmental issues in the context of specific trade negotiations (UNEP 2001, Abaza 2007). According to the OECD, environmental assessments have become "a critical tool for anticipating and managing the environmental impacts" of regional trade agreements (OECD 2007, p. 56). These assessments are required by the EU, the US, Canada and New Zealand, some of which involve multi-stakeholder participation. The EU conducts broader "Sustainability Impact Assessments" going beyond just environmental issues to include assessments of social and economic impacts (European Commission 2006) and capacity development needs. However, the author is not aware of any assessments have been conducted on recent major economic integration initiatives relating to East Asia such as TPP or the ASEAN Community. To be sure, conducting these assessments may be difficult, especially for some developing countries, and capacity building may be required, or they may need to be outsourced.

Limitations

It is important to recognise that stricter standards and other environmental safeguards related to negotiations on economic integration will not necessarily solve air pollution problems by themselves. Compliance and enforcement are also essential, but efforts might not be sufficient. In some cases such as air pollution in China where air pollution standards have been steadily increased (particularly in Beijing), gains from stronger standards or better technologies may be offset by continued economic growth and increases in overall consumption.

6. Conclusion

Air pollution is worsening in the Asia-Pacific region along with continued strong economic growth, and could be aggravated by further economic integration. Concerns over competitiveness may not have created pressures for a race to the bottom or weakened existing air pollution regulations or cooperation as generally feared. Nevertheless, competitiveness concerns may have fostered hesitation to strengthen standards and other air pollution policies and contributed to their slow progress.

This chapter recommends that domestic air pollution policies should be strengthened and harmonised or coordinated, particularly in the ASEAN Community. Some countries, particularly newly developing ones, may not have sufficient capacity to establish or implement stricter air pollution policies and related measures such as monitoring.

International cooperation will be important, which could be based on a voluntary LRTAP-type framework. This framework could be based on strengthening and coordinating existing frameworks, or creating a new one.

Concerns over economic and trade competitiveness persist. This chapter argues that this traditional thinking about environmental protection and trade competitiveness, specifically for air pollution, is counterproductive and instead is likely to harm competitiveness as well as the air environment. Much research has concluded that environmental regulations are generally not the main factor influencing business decisions, with other factors such as wages and infrastructure playing bigger roles (Frankel 2009, Copeland and Taylor 2004). Other research shows how stricter regulations can spur competitiveness and catalyse a shift towards a more advanced industrial structure (Porter 1990; Porter and Van der Linde 1995, Levinson and Taylor 2008), and that air pollution

imposes huge economic burdens (for example, WHO 2014a, WHO 2014b). This chapter thus argues that stricter standards and implementation are economically beneficial.

For countries still concerned about trade competitiveness, this chapter argues that the space to strengthen air pollution regulations has significantly expanded, even under the traditional way of thinking. China is the focus of many countries' concerns about trade competitiveness. However, China has already acted unilaterally to strengthen air pollution measures (Lin and Elder 2014). Therefore, countries worried about trade competitiveness have lost one of the main reasons to avoid strengthening air pollution measures. Moreover, many Asian countries already manufacture products such as auto parts to global standards for export. Countries which retain weaker air pollution standards will hurt the competitiveness of their auto-related manufacturing sectors by dividing the attention of local firms between the local and export markets.

China's encouraging unilateral actions show that the traditional modes of thinking may be changing. The World Bank and China's former State Environmental Protection Administration estimated the total cost of air and water pollution at 5.8% of GDP (World Bank and SEPA 2007); this is evidence that China's government is recognizing the costs of air pollution. Recent research has demonstrated evidence of health and crop damage (e.g., Nawahda et al. 2012, 2013). Newly developing countries should avoid the traditional pollute first and clean up later path to industrialisation, and instead 'leapfrog' to more advanced, cleaner development. This is likely to lead to stronger competitiveness and lower costs in the long run.

In the long run, the path followed by East Asia could follow a similar trajectory as the EU and LRTAP, despite the many differences between the two regions. As traditional trade and investment barriers are lowered, the trade effects of domestic policies will be felt more strongly, and East Asian countries will face increasing pressure to harmonise or narrow the differences between these policies. This harmonization should be in a stricter rather than more lax direction. LRTAP promoted harmonisation, as EU air pollution directives were developed around the same time, as well as coordination with non-EU countries. Less developed non-EU countries in Eastern and Southern Europe were motivated to join LRTAP and adopt stricter air pollution standards, despite concerns about trade competitiveness, by their strong desire to join the EU. This situation was made possible by the fact that leading EU member countries required new members to adopt the higher EU/LRTAP standards. In East Asia, there are no countries which currently play this leading role. This chapter recommends that developed countries such as Japan, the Republic of Korea, and Singapore should take the lead in linking stricter environmental standards (including air pollution) to regional economic integration. China should also join the leading countries, since it has already strengthened its own standards ahead of other countries in the region

Further progress on trade and investment liberalisation agreements should be preconditioned on the establishment of minimum national standards for air pollution (and other environmental issues) as well as a concrete plan for the development of implementation capacity in developing countries, to avoid a potential race to the bottom. Economic integration should be used to promote the leapfrogging model.

It is also important to remember that LRTAP was established at the peak of the Cold War. The establishment of LRTAP was not blocked by the Cold War conflict, but rather LRTAP itself was intended as a means to promote détente and reduced tensions (a "security" co-benefit). International cooperation on air pollution in East Asia should be considered in a similar way.

The political climate now favours higher prioritisation of air pollution reduction measures due to increasing concerns about air pollution's high costs. Many developing countries in Asia have already adopted and strengthened air pollution standards, especially ambient standards and auto emissions standards. These efforts should be accelerated to avoid economic development overtaking the progress of standards and control measures. In some areas, standards should be newly established such as for fuel efficiency and emissions from industrial processes.

In conclusion, now may be a favourable time to link the air pollution issue to the accelerating trends of trade liberalization and economic integration. It is hoped that this chapter can further encourage policymakers and suggest to them that it is now politically feasible and economically desirable to adopt much stricter measures and coordinate them through international cooperation.

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Notes

1. Interviews with Chinese air pollution experts in Beijing in March, 2014.
2. Joint Communique, the 16th Tripartite Environment Ministers Meeting Among Korea, China and Japan, 28-29 April 2014, Daegu, Republic of Korea.
3. United Nations Conference on Environment and Development, Rio de Janerio, Brazil, *Agenda 21*, 3 to 14 June, 1992, paragraph 2.22g. https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf
4. Personal communication with former senior official of Thailand's Pollution Control Department, September 2014.
5. Personal communication with former senior official of Thailand's Pollution Control Department, September 2014.
6. According to the website of UNEP's Partnership for Clean Fuels and Vehicles, "Status of leaded gasoline phase-out in the Asia-Pacific region April 2014," accessed July 28, 2014.
7. In 1997, ASEAN set a goal to "achieve an ambient air quality below 100 Pollutant Standards Index (PSI), adjusted wherever appropriate, by the year 2010 with priority on urban and industrialized areas." (Sunchindah 1998) It is not clear whether this goal has been achieved. Clearly, as discussed above, ASEAN standards for specific air pollutants have not been harmonised.
8. Personal communication with former senior official of Thailand's Pollution Control Department, December 2014.
9. Author's discussions with African air pollution researchers at the 16th International Union of Air Pollution Prevention and Environmental Protection Association (IUAPPA) Congress at Cape Town, South Africa, 29 September-4 October 2014.
10. Chair's Summary, Consultation Meeting of the Joint Forum on Clean Air in Asia and the Pacific and the Fifth Governmental Meeting on Urban Air Quality in Asia, Colombo, Sri Lanka, 17-18 November 2014. Available at http://cleanairasia.org/portal/sites/default/files/agenda/meeting_report_of_consultation_for_joint_forum_and_5th_govt_meeting_feb2015.pdf.

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