ENERGY-RELATED GREENHOUSE-GAS EMISSIONS IN THE *ASEAN*: A DECOMPOSITION ANALYSIS

Suwin Sandu*, Deepak Sharma and Ronnakorn Vaiyavuth
Centre for Energy Policy
University of Technology, Sydney
Tel: + 61 2 9514 2437
Email: Suwin.Sandu@uts.edu.au

Overview

The Association of Southeast Asian Nations (ASEAN) is one of the most dynamic and diverse regions in the world. The region comprises of ten countries. These countries have contrasting energy demand profiles, levels of access to modern energy services, and energy resource endowments. The energy demand in the region has grown appreciably over the past four decades, driven essentially by high economic growth, underpinned by increased urbanisation and industrialisation. This has resulted in increased greenhouse-gas emissions, at an average rate of 6.4% per year over the period 1971-2008. The corresponding annual average increases in population, energy consumption, and economic growth are 1.9%, 4.5% and 5.5% per year, respectively. A large proportion (approximately 60%) of these emissions have come from fossil-fuel combustion (WRI 2011).

Despite large growth in energy consumption, energy consumption per capita in the region (2.2 tonnes oil equivalent) is considerably lower than other developed world. Moreover, almost 30% of population in the region still do not have access to electricity (IEA 2009). With expected increases in population (by 30% by 2050; UN 2011), coupled with ever increasing urbanisation and industrialisation, energy demand is expected to increase substantially. Unless there is a fundamental changes in the patterns of economic production and fuel-mix, the greenhouse-gas emissions are expected to grow significantly in the years to come. For example, according to the IEA (2009), the region's share of global emissions could reach 5% in 2030; currently this share is around 3%.

Such an increase in emissions is likely to have implications for the development of regional climate policies. Although the region is currently not bound by any international agreement to lower its emission, the pressure to do so is likely to arise soon. For example, according to IPCC, average global emissions need to be reduced to 50% of 1990 emissions level by 2050 in order to contain the temperature at 2°C; this is equivalent to limiting emission at around 1.2 million tonnes per person. The current regional per capita emission level (2 million tonnes) has already exceeded this target level.

In order to design an effective climate policies that is in accord with the regional diversity as well as economic and population outlooks, it is important to understand how greenhouse-gas emissions for each country in the region has evolved in the past. Understanding this evolution also means that any potential challenges for designing appropriate policies can be identified and steps taken to address these challenges.

Against this backdrop, this paper analyses the historical development in CO_2 emissions for the ASEAN countries over the past four decades. Specifically, this paper decomposes the change in CO_2 emissions in order to analyse the relationship between the underlying factors that drive emission growth.

Method

This paper uses the Logarithmic-Mean Divisia Index (LMDI) method proposed by Ang and Liu (2001) to decompose historical change in CO_2 emissions for nine ASEAN countries (all except Laos). This method has various advantages over other index decomposition methods (Ang 2004). Many studies have employed LMDI method to analyse factors underlying CO_2 emission growth for various countries or groups of countries. However, these studies disentangle the sources of emissions growth into at the most five factors. This paper extends the number of factors considered by decomposing annual change in CO_2 emissions into seven underlying factors, namely, those associated with *population* growth, growth in per capita income (*affluence*), changes in the sectoral composition of output (*structure*), changes in sectoral energy intensity (*end-use efficiency*), changes in sectoral *fuel-mix*, changes in efficiency of transforming primary energy into final energy (*conversion efficiency*), and changes in CO_2 intensity of primary energy (*carbon intensity*).

Preliminary Results

The key results are as follows (also summarized in the table below):

- The level of affluence is by far the largest contributor to emissions growth in most countries (except for Brunei), followed by population. The recent global economic recession does not seem to have impacted the growth in emissions from the ASEAN. In addition, as the majority of countries in the region are still classified as either low income or lower-middle income countries (World Bank 2011), the potential of increasing affluence to contribute to future growth in emissions is significant.
- The production structures for most countries (except Brunei and Singapore) have increasingly become concentrated towards energy-intensive industry sector over the study period. These trends follow the pattern of economic development as suggested by Medlock III (2009). Besides Singapore, no country has so far shown any inclination to move away from the industry sector, which suggests that emissions would continue to increase.
- The region has achieved energy efficiency gains at both end-use and conversion levels. Brunei and Thailand are exceptions to this. End-use energy intensity for the whole region declined over most of the period, except during the 1990s. Lower energy prices during that period could be a reason for such an increase in energy intensity.
- Fossil fuels have increasingly become the dominant fuel source in the region despite recent global environmental pressures. The share of fossil fuels has consistently increased in all countries, which has led to increased CO_2 emissions. Reversing this trend will be a challenging task.
- Changes in carbon intensity of sectoral primary energy use shows mixed results. While it has led to reduced emissions in Brunei, Myanmar, Philippines, Thailand and Vietnam, emissions in Malaysia, Indonesia and Singapore have increased.

		Average annual change in energy-related CO_2 emissions								
		Brunei	Cambodia	Indonesia	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
CO_2 emissions	**Mt**	**0.18**	**0.25**	**9.74**	**4.54**	**0.19**	**1.33**	**1.03**	**5.73**	**3.73**
	(%)	***(5.2)***	***(9.6)***	***(7.7)***	***(7.4)***	***(2.6)***	***(3.1)***	***(5.6)***	***(7.2)***	***(8.1)***
Population	Mt	0.10	0.05	2.31	1.44	0.09	1.04	0.63	1.08	0.61
	(%)	*(3.8)*	*(3.2)*	*(4.1)*	*(4.6)*	*(1.5)*	*(2.7)*	*(4.4)*	*(3.3)*	*(2.6)*
Affluence	Mt	-0.04	0.19	5.40	2.34	0.30	0.74	1.04	3.61	2.32
	(%)	*(-14.5)*	*(8.1)*	*(6.1)*	*(5.7)*	*(3.4)*	*(2.1)*	*(5.6)*	*(6.0)*	*(6.3)*
Structure	Mt	-0.02	0.02	0.85	0.26	0.04	0.22	-0.17	0.15	0.26
	(%)	*(-1.4)*	*(1.1)*	*(2.2)*	*(1.5)*	*(0.8)*	*(0.8)*	*(-1.9)*	*(0.7)*	*(1.3)*
End-use efficiency	Mt	0.13	-0.01	-1.21	-0.08	-0.19	-1.30	0.11	0.05	-0.90
	(%)	*(4.4)*	*(-0.7)*	*(-2.8)*	*(-0.8)*	*(-2.6)*	*(-3.1)*	*(1.4)*	*(0.3)*	*(-3.5)*
Fuel-mix	Mt	0.01	0.06	2.54	0.65	0.01	0.66	0.00	1.25	1.82
	(%)	*(0.8)*	*(3.5)*	*(4.3)*	*(2.9)*	*(0.1)*	*(2.0)*	*(0.0)*	*(3.6)*	*(5.5)*
Conversion efficiency	Mt	0.01	-0.06	-0.64	-0.43	-0.04	0.02	-0.66	0.11	-0.29
	(%)	*(0.5)*	*(-6.9)*	*(-7.2)*	*(-2.2)*	*(-1.1)*	*(0.1)*	*(-4.5)*	*(0.6)*	*(-2.1)*
Carbon intensity	Mt	-0.01	-0.00	0.48	0.37	-0.01	-0.05	0.07	-0.52	-0.09
	(%)	*(-1.2)*	*(-0.0)*	*(1.4)*	*(2.0)*	*(-0.2)*	*(-0.2)*	*(1.0)*	*(-2.0)*	*(-0.5)*

References

Ang, B.W. and Liu, F.L., 2001. A new energy decomposition method: perfect in decomposition and consistent in aggregation, *Energy*, Vol. 26, pp. 537-548.

Ang, B.W., 2004. Decomposition analysis for policymaking in energy: which is the preferred method? *Energy Policy*, Vol. 32, pp. 1131-1139.

IEA (International Energy Agency), 2009. *World Energy Outlook 2009*, Organisation for Economic Co-operation and Development, Paris.

– –, 2010. *CO_2 Emissions from Fossil Fuel Combustion 2010 edition*, Organisation for Economic Co-operation and Development, Paris.

Medlock III, K.B., 2009. *Energy Demand Theory*, in J. Evans and L.C. Hunt (eds.) International Handbook on the Economics of Energy, Edward Elgar.

UN (United Nations), 2011. *World Population Prospects*, http://esa.un.org/unpd/wpp/index.htm.

World Bank, 2011. *World Development Indicators*, http://data.worldbank.org/indicator.

WRI (World Resources Institute), 2011. *Climate Analysis Indicators Tool (CAIT) Version 8.0*, Washington DC.