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Energy security in ASEAN: A quantitative approach for sustainable energy policy

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HIGHLIGHTS

- We investigate energy security in ASEAN across four dimensions.
- Energy security in ASEAN has mostly regressed from 2005–2010.
- Future cooperative agreements will help ASEAN improve energy security.

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ABSTRACT

We investigate energy security of the Association of Southeast Asian Nations (ASEAN) under the 4-A's framework. The ASEAN Economic Community (AEC) agreement launched in 2015 renewed a regional focus on energy security and sustainability. We employ an analytic framework to quantitatively assess progress in different categories including availability, acceptability, affordability, and applicability. Key metrics include the documentation of CO₂ emissions, energy access measures, and energy supply reserves from 2005–2010. We identify relevant energy indicators using high quality historical data from the IEA and World Bank. We find that ASEAN made little progress toward establishing energy security in the previous five-year planning period (2005–2010) as it regressed in most categories except applicability. Therefore, we suggest that increased development of renewable energy and energy efficiency technologies would move ASEAN in a positive direction toward achieving energy security and sustainable energy policy goals.

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1. Introduction

The ten members of the Association of Southeast Asian Nations (ASEAN) – along with China and India – now exert major influence within the global energy system in terms of energy consumption and production (IEA, 2013a). ASEAN's projected GDP growth likely will surpass the world's average growth of advanced economies by 2020 (IMF, 2014). Although some member countries have increased coal, oil, and natural gas exports, the demand for energy in ASEAN countries rapidly continues to rise, posing major challenges for the region's energy security.

ASEAN's regional energy cooperation activities, marked by the

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creation of the ASEAN Economic Community (AEC) in 2015, set energy security and sustainability as major goals for advancing the energy sector and economy. Energy indicators are useful measures to quantitatively monitor progress toward achieving these goals. Since ASEAN's energy picture could change drastically depending on future resources and technologies, developing representative measures of progress to reflect the transition toward sustainability and energy security becomes increasingly important. This paper constructs a set of indicators to quantify ASEAN energy security in four areas – availability, applicability, acceptability, and affordability and uses the indicators to track the trends of each indicator between 2005 and 2010. We group each indicator together under their respective “A” categories and analyze progress by using a rhombus plot to measure changes in overall energy security and each energy security dimension between 2005 and 2012. The results highlight the declining status of energy security from 2008 to

Table 1
Definitions of energy security.

Energy security definitions	Sources
“The physical availability of supplies to satisfy demand at a given price”	International Energy Agency IEA (2001)
“Energy security means ensuring countries can sustainably produce and use energy at reasonable cost in order to:	World Bank (2005)
– Facilitate economic growth and, through this, poverty reduction; and	
– Directly improve the quality of peoples’ lives by broadening access to modern energy services”	
“The ability of an economy to guarantee the availability of energy resource supply in a sustainable and timely manner with the energy price being at a level that will not adversely affect the economic performance of the economy.”	APERC (2007)
“Four main elements [of energy security include] the availability of energy to an economy, accessibility, costs, and environmental sustainability.”	Kruyt et al. (2009)
“Energy security consists of four interconnected criteria or dimensions: availability, affordability, efficiency, and environmental stewardship. Availability refers to diversifying the fuels used to provide energy services as well as the location of facilities using those fuels, promoting energy systems that can recover quickly from attack or disruption, and minimizing dependence on foreign suppliers. Affordability refers to providing energy services that are affordable for consumers and minimizing price volatility. Efficiency involves improving the performance of energy equipment and altering consumer attitudes. Stewardship consists of protecting the natural environment, communities and future generations.”	Sovacool and Brown (2009)
“The uninterrupted availability of energy sources at an affordable price”	International Energy Agency (IEA, 2011)
“Securing the amount of energy required for people’s life, economic, and social activities, defense and other purposes for acceptable prices.”	Koyama and Kutani (2012)
“The energy security of developing countries refers to “enough energy supply (quantity and quality) to meet all requirements at all time of all citizens in affordable and stable price, and it also leads to sustain economic performance and poverty alleviation, better quality of life without harming the environment.”	Martchamodol and Kumar (2012)

2010. ASEAN as a region has progressed within the Applicability dimension, reflecting continuous improvement in the adoption of renewable energy technologies and a reduction in energy intensity. However, ASEAN, on aggregate, also backtracked in the three other dimensions of energy security, including Availability, Affordability, and Acceptability. We provide policy recommendations for applying an indicator-based approach to the ASEAN context developed from our analysis.

Concepts of energy security have evolved over time to encompass diverse dimensions, including energy supply adequacy, efficiency, reasonable prices, environmental protection, international relations, and institutional dimensions (Yao and Chang, 2014). Table 1 highlights these evolving definitions of energy security. Some early definitions of energy security represented purely economic and energy-related measures (Vera and Langlois, 2007). Critics of such energy indicators have pushed increasingly for attention to societal inequality while developing energy indicators for specific regions (Kemmler and Spreng, 2007). As a result of a lack of unifying definition, there is also a lack of a unifying methodology for energy security assessment. Existing methodologies differ significantly in their coverage of elements of energy security and levels of details in the form of choices of indicators. Martchamodol and Kumar (2013) comprehensively review 15 sets of indicators used for energy security assessments and found that the choice of indicators remains context-specific. Depending on the issues of energy security to be addressed and the view of the indicator developer, the sets of energy security indicators can include as few as 5 indicators (APERC, 2007) or as many as 372 indicators (Sovacool and Mukherjee, 2011). Based on their comprehensive list of 372 indicators for energy security, Sovacool and Mukherjee (2011) suggest that the choice of indicators analyzed can be reduced to 20 indicators, taking into account data availability. Defining energy security often remains dynamic and contextual with increasing scope (Ang et al., 2015). In seeking a balance between being as comprehensive as possible (by including a large number of indicators) and being pragmatic given data scarcity, we draw upon Yao and Chang (2014) which uses fewer dimensions yet retains a meaningful rigorous evaluation of energy security.

2. Energy status of ASEAN countries

2.1. Reserves, production, and consumption in ASEAN countries

ASEAN’s dependence on fossil fuels for energy in the electricity and transportation sectors remains prevalent throughout the region due to increased production capacity and infrastructural path dependence. By 2010, the region produced nearly 450 million metric tonnes of coal and this amount continues to rise. Declining reserves of coal and natural gas combined with increased consumption and production will threaten energy security and sustainability within the region. The consumption of fossil fuels and renewables has increased significantly over the past decade, but the lack of resources has shifted attention toward reducing sectoral energy intensity and overall consumption. Despite recent discoveries of vast oil reserves in the South China Sea that could expand near-term capacity, the regional resource base cannot sustain high levels of consumption without increasing imports. However, developing regional interconnections in the power sector could begin to alleviate energy surpluses in energy poor countries and facilitate smarter, more efficient energy trade, while reducing overall consumption.

2.2. ASEAN integration plan and targets

ASEAN countries adopted a vision on energy cooperation in 1997. ASEAN Vision 2020 called for an “ASEAN partnership in dynamic development aimed at forging closer economic integration within the region.” The vision also highlighted the need for improved energy cooperation through electric grid interconnection arrangements and natural gas pipelines across the region along with the promotion of energy efficiency, conservation, and renewable energy. In 1999, ASEAN formulated an ASEAN Plan of Action for Energy Cooperation (APAEC) 1999–2004 and subsequently updated versions for 2004–2009 and 2010–2015. The 2004–2009 APAEC plan focused on cooperative activities such as engaging in cross-country energy dialogues, developing partnerships, promoting energy security, and creating responsive policies to progressively enhance market reforms.

The stated objective of the latest version, which runs from 2010–2015, is “to enhance energy security, accessibility and

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