Enhancing energy security in Malaysia: the challenges towards sustainable environment

E J M Sahid\textsuperscript{1}, C Ch Siang\textsuperscript{2} and L Y Peng\textsuperscript{3}

\textsuperscript{1,3} Institute of Energy Policy and Research (IEPRe), Universiti Tenaga Nasional
\textsuperscript{2} The Institute of Energy Economics, Japan (IEEJ)

\textsuperscript{1}E-Mail: endang@uniten.edu.my

Abstract. Energy is known as one of the essential ingredients for economic development and security of energy supply is crucial in ensuring continuous economic development of a country. Malaysia’s proven domestic oil reserves are estimated to last for another 25 years, while that of gas for another 39 years as of 2011. Despite the depleting indigenous energy resources, the primary energy demand has continued to grow robustly, at an annual rate of 6.3 percent per year from 1990 to 2010, while the primary energy import has grown 7.2\% per year and the primary energy export has grown at a slower rate of 1.9\% per year. This worrying trend is further compounded by the faster rate of primary oil import averaging 10.5\% per year while the primary energy export has shrunk at a rate of 1.4\% per year. This paper has identified two main concerns namely overdependence on fossil fuel and increasing energy import dependency in creating a precarious position towards energy self-sufficiency. The study will analyse the energy security of the country and explore possible options and challenges in enhancing the energy supply security toward sustainable environment.

1. Introduction
Energy is known as one of the essential ingredients for economic development and security of energy supply is crucial in ensuring continuous economic development of any particular country. Malaysia’s energy supply security has been thrust into the attention of energy industry players and policy makers in the recent years due to unrelenting energy demand and diminishing indigenous energy sources.

This paper will attempt to discuss on the energy security concerns of the country also explore the possible options and challenges in enhancing the energy supply security towards sustainable environment.

2. Policy Evolution
Energy policy for Malaysia could be grouped into two different period of formulation; the first period was from 1970 to 2000 and the second period was from 2001 to 2011. The period from 1970 to 2000 provides the earliest policies direction of the energy sector. Among the energy policies formulated during this period are National Petroleum Policy (1975), the National Energy Policy (1979), the National Depletion Policy (1980) and the Four-Fuel Diversification Policy (1981). The National Energy Policy outlined the three-pronged objectives namely; supply objective, utilization objective and environment objective. The Four-Fuel Diversification Policy was then introduced to complement the National Depletion Policy to ensure the security and reliability of energy supply.

The period between 2001 and 2011 focuses on the role of renewable energy sources as one of the energy mix and few policies has been introduced to emphasize on the green technology and environment aspects of energy development. Among the policies introduced are the Five-Fuel
Diversification Policy (2001), the National Green Technology Policy (2009), Renewable Energy Policy (2009) and the National Policy on Climate Change (2010). [5]

3. Energy Use Structure
Malaysia is well endowed with conventional energy sources as well renewable energy sources. Malaysia has the 14th largest gas reserve and 27th largest proven crude oil reserve in the world. As of January 2011, the total reserve of oil and gas is reported to be 19.9 billion barrels of oil equivalent, with 78 percent share of gas and 22 percent of oil. As for coal, Malaysia’s reserve is only 19.38 trillion tonnes which located in Sarawak [9].

Total final energy demand has tripled from 1990 to 2010, increasing from 14 Mtoe in 1990 to 43 Mtoe in 2010 (IEA 2012). The industry and transport sector accounted for the largest share in the total final energy demand at around 30 percent and 33 percent in 2010 respectively. Oil has accounted for a large portion of final energy demand albeit at a decreasing trends; oil share in the final energy demand was about 66 percent in 1990 reducing slightly to 57 percent in 2010. The high percentage share of oil demand was mainly from the transport sector which consumed around 60 percent of the total oil demand. The high demand of energy in the transport sector is due to high level of motorization mainly resulting from growing population, automobile dependent urban sprawl, subsidized transport fuels price, and promotion of automobile industry in the country.

Despite the introduction of the Five-Fuel Diversification Policy, Malaysia is still very dependent on fossil fuel as the major source energy supply. Oil and gas has contributed a major share of more than 80 percent of the primary energy supply from 1990 through to 2010. However, the share of oil and gas has decreased to about 74 percent in 2010. The share of coal in primary energy demand however, has experienced a slight increase from 6 percent in 1990 to 20 percent in 2010 [6].

Coal and gas dominates the electricity generation mix for Malaysia in the recent years. In 2011, 45 percent of Malaysia electricity is generated by coal and 43 percent of electricity is generated by gas [9]. The remaining is generated by hydro, fuel oil/diesel and biomass.

4. Energy Security and Challenges
There are various definition of energy security from literatures, such as ‘continuity of energy supplies relative to demand’ [10], ‘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’ [1]. For this study, the authors have used the definition specified by the Asia Pacific Energy Research Centre (APERC). APERC has identified three main elements of energy security, namely: physical aspect that are availability and accessibility of the resources; economic aspects that is the affordability of the resource acquisition and energy infrastructure; and environmental aspect of the resources namely acceptability of the resource supply.

The analysis on the historical trends of energy demand and supply shows that Malaysia’s energy supply security concerns are also due to the over-dependence on fossil-fuel which has in turn caused an increasing energy imports in order to fulfil the domestic demand.

4.1. Over-dependency to Fossil Fuel.
The share of fossil fuels in the primary energy supply has remained around 90 percent from 1990 through to 2010. This highly dependency of fossil fuels coupled with the dwindling domestic fossil fuel reserves constraint will definitely force Malaysia to import more fossil fuel at high market price where the fuel price is volatile if thorough fuel mix diversification is not carefully consider.

For power generation sector, concerns are towards energy supply security for the fuels for the power plants. As stated in section above, more than 80 percent of electricity is produced using coal and natural gas with almost equal share among the two fuels. However, the declining domestic gas production and over stretching of supply system has led to frequent supply interruptions in the power generation industry. As for coal, almost all of the coals used in the power plants are imported.
Coal is imported mainly from South Africa, Australia and Indonesia. The amount of imported coal has increased steadily for Peninsular Malaysia, increasing from 11.9 million tonnes in 2009 to 19.2 million tonnes in 2011 [9]. In term of price, coal is subjected to market forces. The prices of coals even though has been stable for decades have increased beyond 2003 and surged to a new level due to the increase of global demand of the fuel source.

4.2. Increasing dependence on energy imports
Increasing demand for fossil fuels, coupled with the depleting domestic fossil fuel reserves, is expected to result in increasing the country’s net import. The total final energy demand has grown at a fast rate of 5.8 percent per year, increasing from 14 Mtoe in 1990 to 43 Mtoe in 2010. To fulfill the demand the primary energy import has grown at a fast rate of average 7.2 percent per year while the primary energy export has grown at a slow rate 1.9 percent per year.

Malaysia’s is showing vulnerability on its energy security particularly due to increasing dependency on oil import and compounded by the nature of oil market and contract that normally allow for greater price volatility. Oil production has remain almost constant from 1990 to 2010 at 0.2 percent average growth rate per year, on the other hand the oil primary demand has grown at a fast rate of 4.8 percent per year from 1990 to 2010. In order to fulfill the demand the primary oil import has grown at a fast rate of average 10.5 percent per year while the primary energy export has shrink at a rate of 1.4 percent per year [6].

5. Towards Sustainable Future
The strategic options to achieve sustainable energy development could also further enhance energy supply security. The options are could be segregated into four main segments namely:

i. Diversifying sources of energy supply.
By intensifying indigenous gas and hydro resources development, securing more gas from foreign sources, strengthening and expanding supply infrastructures to facilitate regional interconnection and exploring and building capacity for the nuclear options.

ii. Reducing carbon content of energy.
By developing centralized renewable energy, study on the low carbon electricity such as application of carbon capture and storage system at coal-based power plants, and increasing use of alternate fuels and cleaner source of energy for transport sector.

iii. Efficient utilisation of energy for low carbon growth.
By enhancing energy efficiency (EE) in the residential and commercial sector, reducing demand for personalised modes of transport and increasing share of public transport, planned public transport scheme, promoting cogeneration in industrial facilities and tackling energy inefficiency in Small Medium Enterprise (SMEs)

iv. Facilitating low-carbon industries and service development to promote economic growth.
By manufacturing of high energy efficiency products such as LEDs lights, promoting energy efficiency products and developing new energy industries.

6. Conclusion
This study has identified two major issues concerning energy supply security in Malaysia, namely over-dependency to fossil fuel and increasing of energy import dependency. This paper discussed the evolution of energy policies, the recent energy demand trend, energy security and challenges and subsequently relevant strategic options towards achieving sustainable energy development which could also enhance energy supply security for the country.

7. Acknowledgement
The authors are grateful to Energy Commission’s Chair in Energy Economics Grant 0109001 IEPR which has supported the study. The authors also appreciative to the Institute of Energy Policy and Research (IEPRe) for sharing the necessary information required for the study. Any of the opinions,
findings and conclusions expressed in this paper are those of the authors and do not necessarily reflect
the views of the Energy Commission, IEPRe nor IEEJ.

References
[1] Asia Pacific Energy Research Centre, Japan 2007 A Quest for Energy Security in the 21st Century: Resources and Constraints, 2007 Asia Pacific Energy Research Centre.
[2] Chua S C & Oh T H 2010 Review on Malaysia’s national energy developments: Key policies, agencies, programmes and international involvements Renewable and Sustainable Energy Reviews 14 2916-2925
[3] Department of Statistics 2011 Malaysia Economic Statistics - Time Series, 2011 Putrajaya, Department of Statistics
[4] Economic Transformation Programme - A Roadmap for Malaysia Putrajaya, Prime Minister’s Department
[5] Endang J M S, Dr Tan C S, Dr. Leong Y P 2012 Sustainable Energy Development- A case study for Malaysia 16th International Conference on ISO & TQM 2012. Vaxjo Sweden, July 2012
[6] International Energy Agency 2012 Energy Balance for Non-OECD Countries – 2012 Edition International Energy Agency
[7] Ministry of Energy, Green Technology and Water 2010 National Renewable Energy Policy & Action Plan 2010 Putrajaya, Kementerian Tenaga, Teknologi Hijau dan Air
[8] Ong H C, Mahlia T M I, Masjuki H H 2011 A review on energy scenario and sustainable energy in Malaysia Renewable and Sustainable Energy Reviews 15(1) 639–47.
[9] UNITEN 2012 Proceedings for National Energy Security Conference 2012
[10] Winzer 2011 Conceptualizing Energy Security EPRG Working Paper. University of Cambridge