

## Energy Security in Malaysia: Magnitude and the Economic Effects<sup>#</sup>

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**Abstract:** The study applies key indicators of the energy security vulnerability index to examine the sensitivity and vulnerability of the Malaysian economy to energy supply disruptions and further test the potential impact of this energy supply disruption indicators on major economic indices such as the GDP and trade balance. The results from the analysis of the historical data and future projections of Malaysia's primary energy supply portfolios suggest that Malaysia exhibits a highly diversified energy portfolio with an inclination towards reduction if the present trend is not checked. The estimated vulnerability index also indicates that the direct impact of oil supply disruptions on the economy of Malaysia is high compared to coal. The dominance of gas in electricity generation also implies a relatively low carbon-free fuel portfolio. The implication is that Malaysia has been increasing GDP with less energy import dependency and more energy diversification but with less carbon-free portfolios – a case of environmentally non-sustainable growth.

Key words: Energy security, energy supply, GDP, sustainable growth

JEL classification: Q40, Q42

### 1. Introduction

Several events in recent time have made energy security a fundamental concept in global politics and have become a serious challenge for both researchers and national policymakers alike. Regrettably, there is hardly a generally accepted definition of energy security for the simple reason that the concept connotes different things to different nations. A considerable consensus views energy security as the capacity of a country to absorb or take the edge off some possible economic effects of energy supply disruptions and not trading such security for environmental damage. In the more advanced or developed countries of the world, energy security borders more on the reliability of supply, accessibility to sufficient amounts, affordability, and safety from supply interruptions.

Another issue affecting a general conceptualisation of energy security is the different level of energy resource endowments among nations even within the developed world where energy security emphasis depends, among other things, on whether the country in question is a net energy exporter or importer. In developing countries of the world however, the concern of energy security appears to be broader in scope due to the issue of the associated environmental concerns. This is particularly so as close to half of the inhabitants of these countries experience severe energy poverty resulting from their

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dependence on traditional fuels such as firewood, animal waste and crop residues for cooking and heating.

In today's world, several issues and challenges have added together to contribute to making energy security a global phenomenon.<sup>1</sup> Thus the major aspects of energy supply security can be examined from certain perspectives, ranging from economic through environmental to institutional points of view. To what extent can Malaysia internally accommodate some of the potential economic effects of energy supply disruptions without compromising the environmental acceptability of the fuel type? Is Malaysia's energy portfolio well diversified in terms of fuel type? These are the main questions to be answered in this study.

The government of Malaysia is determined to extend the country's stock of energy resources by restricting the total quantity of crude oil products and has continuously encouraged the country's national oil company – PETRONAS – to venture into energy related assets outside the shores of the country (APERC 2007). The massive growth in total primary energy demands raises great concerns about resource adequacy in the country. This, coupled with the rising total primary energy intensity in Malaysia and the level of reliance on energy from external sources, signifies high energy security challenges with a high tendency for severe and detrimental environmental consequences.<sup>2</sup> Mounting reliance on energy importation can inflict higher uncertainty and impose a greater burden on a growing economy like Malaysia. A major concern of this paper therefore rests on the need to provide considerable highlights of the magnitude and evaluate the likely effects of prospective disruption in the energy supply on the Malaysia economy.

In addition, oil supply security is increasingly put at risk by accessibility barriers, particularly geopolitical factors that continue to manifest in various forms like the inability of the non-OPEC supply failing to meet the ever increasing global demand. Though it may be difficult to forecast the timing of global oil peak onset with rational precision because of undependable reserves and resource estimates data, it is however essential for countries to take these risks seriously by assessing how prone their economies are to the risk.

Malaysia, like many other South-east Asian countries, is committed to designing a new model of economic growth which will exhibit high efficiency in energy use, replacing oil with coal, hydro and renewable energies to reduce the level of pollution (APERC 2007). However, the fresh risks to the global energy security system are impacting significantly on the price and accessibility of oil which amounts to a return of new threats on energy security concerns in the whole world.<sup>3</sup>

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<sup>1</sup> In definite terms, energy security involves quite a number of challenges which range from (i) accessibility to secure, varied and non-interrupted energy supply; (ii) lessening carbon dioxide emissions; (iii) running down of oil and growing fossil fuel prices; and (iv) increased usage of renewable energy sources.

<sup>2</sup> See Malaysia's Energy Balance (IEA 2012).

<sup>3</sup> These risks include fresh crisis from the Middle East and North African countries as well as high oil prices engineered by rapid economic development-led increase in demand for energy; national policy of countries and firms like PETRONAS to acquire huge stocks of resources; rising depletion of oil reserves in developed nations like the UK and the US; seemingly unending geopolitical risks in the world's foremost oil supply region – the Middle East – occasioned by restricted foreign ownership and rising cases of terrorism; and the environmental challenges of various obligations towards the reduction of GHG emissions.

Malaysia appears a good choice for this kind of study given the present energy situation in the country, particularly since coal supply is entirely imported and extra gas supply is already imported from the MTJDA (Malaysia-Thailand Joint Development Area) and Natuna regions (in Indonesia to Malaysia through Kerteh and Duyong) whereas alternative energy sources are too small to make a significant contribution to the country's energy mix. According to the Ministry of Energy, Green Technology and Water (2012), energy security is highly essential for Malaysia's socio-economic growth, particularly towards the country's vision of becoming a high income nation by 2020. However, faced with the possibility of becoming a net oil importer around 2015, the underlying concern in Malaysia with respect to its national energy security is how to ensure a continuous supply of fossil fuels at affordable prices as a result of depleting indigenous oil and gas resources.

## 2. Energy Situation in Malaysia

### 2.1 Energy and Economic Growth

Figure 1 shows the annual trend of per capita GDP in real terms from 1980 to 2009. It is clear that there has been an expanding trend in the nation's output data with considerable proof of a sustained growth profile. This has been translated into appreciable living standards as indicated by the increase in per capita income. There are instances of evident fluctuations in the trend of the per capita real GDP in the mid-1980s as well as between 1996 and 2002. Nevertheless, the standard of living has been improving subsequently. By all counts, Malaysia is a growing economy which simply points to the likelihood that its energy consumption may continuously be on the rise based on the

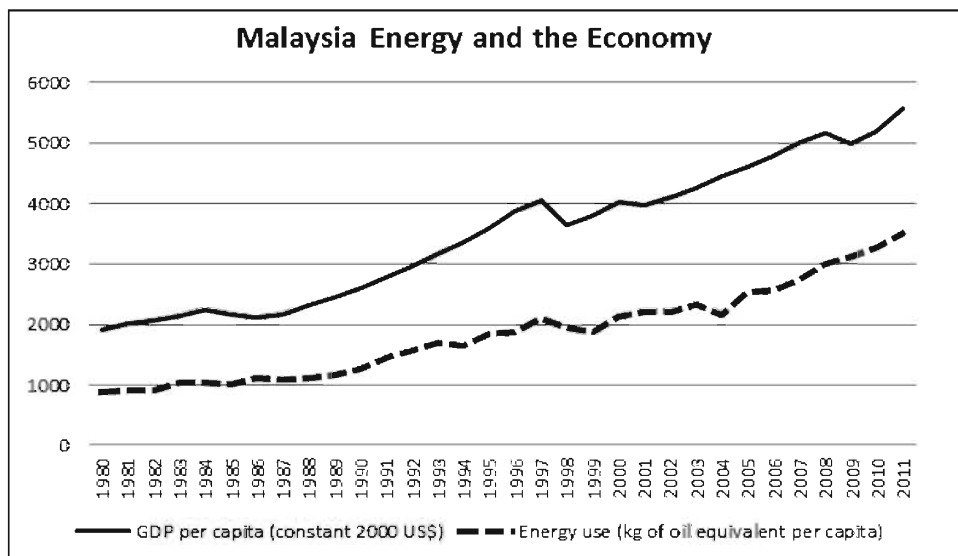


Figure 1. Malaysia - real GDP and energy use per capita (1980–2011)

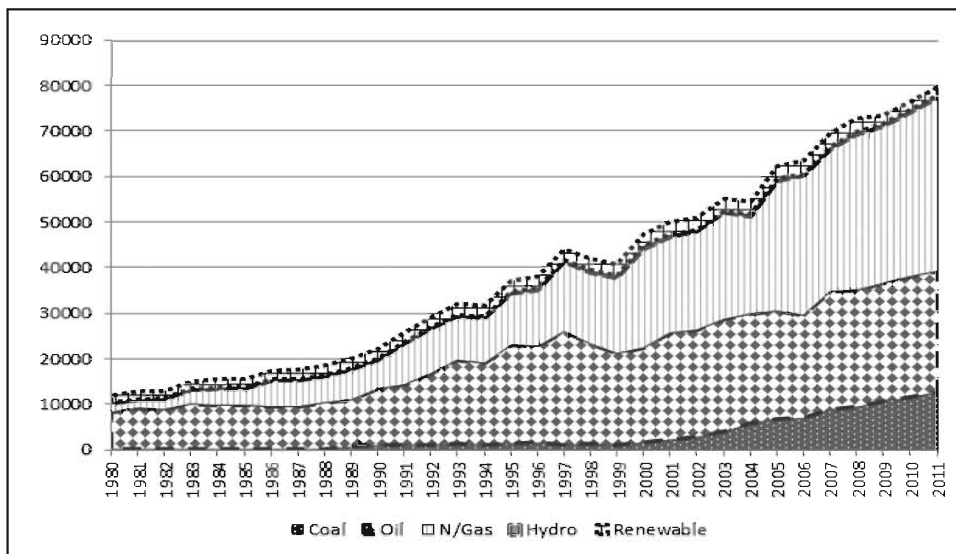
Source: Author, using WDI data (2012)

contention that further growth in economic activities usually brings about higher energy use.

A careful look at the trend displayed in the graph shows that per capita energy use rose by about 1250kg of oil equivalent between 1991 and 2005 alone. This approximates to a 100 per cent increase in energy use while per capital GDP increased by about 25 per cent during the same period. The issue of whether the rise in energy use is attributable to growth in output or that the expanding output resulted from growing energy use can best be answered by a causality test – a task that falls outside the scope of the present investigation.

Figure 1 also provides a picture of Malaysia’s energy use between 1980 and 2009. As expected, there has been a steady rise in energy use per capita with significant fluctuations in trends over the years. In the early 1980s, the picture was relatively stable but began to exhibit signs of fluctuations from 1993. In fact, the picture exhibits incessant yearly variations in per capita energy use from 1990 onwards, than in any other period.

Figure 2 shows the fuel categorisation of energy consumption in Malaysia between 1980 and 2011. Gas has emerged as the dominant fuel since 2004 compared to oil, which previously accounted for the largest chunk. The first oil shock in 1973 caused by the Arab Oil Embargo led to a general shift away from oil. In 1981, Malaysia adopted the 4-fuel diversification strategy shortly after the second oil price shock in 1979 following the revolution in Iran and by 2001 the 5-fuel diversification strategy was introduced with the addition of renewable energy to the four main fuels of oil, hydro, gas and coal. At present, the four main fuels still dominate the electricity generation scene in Peninsular Malaysia. According to the EIA fact sheet, total energy consumption and total per capita energy consumption stood at 2.56 quadrillion Btu and 99.4 million Btu per person while energy intensity was 8 891 Btu USD2000 (PPP adjusted) in year 2006.



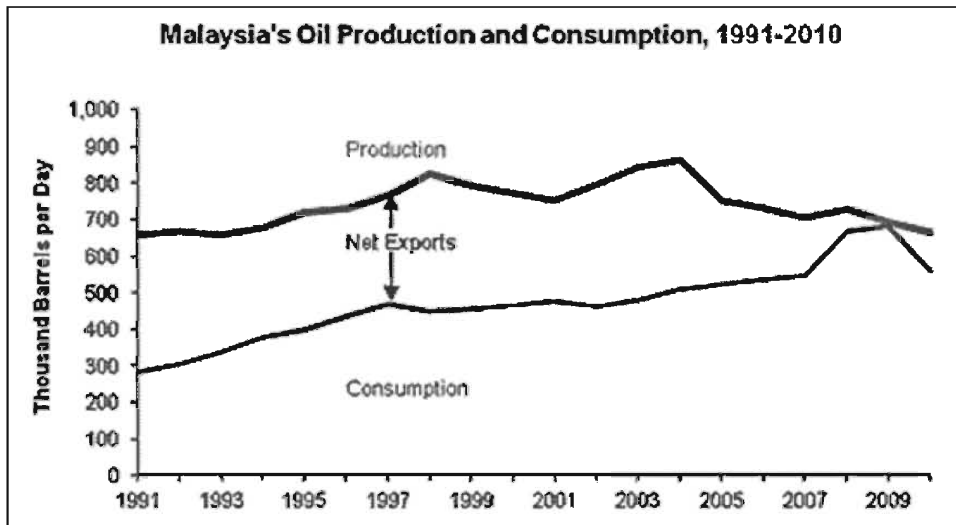
**Figure 2. Malaysia’s energy consumption by fuel type: 1980-2011 (in Mtoe)**  
 Source: Author, using IEA data, 2012

**2.2 Oil Production and Consumption**

Malaysia's total oil production in 2009 was 693,000 barrels per day (bbl/d) but crude oil alone accounted for about 83 per cent. Well over half of the total Malaysian oil production at present comes from the Tapis's oil field in offshore Peninsular Malaysia. It is imperative to note that Malaysia's oil production has been decreasing progressively ever since it reached a peak of 862,000 bbl per day in 2004 and this can be traced to its maturing offshore reservoirs. The rising consumption relative to production has also taken its toll on oil exports. As at 2009, exports were 157,000 bbl per day (Figure 3).

Since the country consumes the bulk of its production and domestic consumption has been increasing in the wake of falling production, the Malaysian government is focusing on opening up new investment opportunities by improving oil output from existing fields in addition to developing new fields in deep-water areas off the coasts of Sarawak and Sabah. To this end, Exxon-Mobil has invested an estimated gross amount of USD1 billion into an enhanced oil recovery project at the Tapis field off Terengganu which will commence in 2013. This is one of the seven mature-fields located off Peninsular Malaysia that ExxonMobil and PETRONAS have jointly agreed to develop as part of a 25-year production sharing contract that was sealed in June 2009.

The international energy markets have witnessed the greatest era of price fluctuations characterised by skyrocketing oil prices in recent years. The major cause is not unconnected with the turbulence in the Middle East. Though the upsurge in prices has resulted in a minimal fall in demand, it appears that price cannot on its own check the prevalence of expanding oil demand (BP Statistical Review of World Energy 2011). Many consuming nations whose economies depend increasingly on fossil fuel are emerging by the day. In Malaysia, the price of oil products until recently was highly subsidised and



**Figure 3. Malaysia's oil production and consumption**  
 Source: EIA country analysis briefs – Malaysia, 2012

partially controlled by the government at a point far lower than the international market and this has had severe implications for demand and investments in the oil refining industry and environmental degradation. The present situation therefore further compounds the tension between making energy affordable and the capitalist profit motives of private firms as well as the impacts of international product demands.

### 2.3. Energy Use and the Environment

The prevailing pattern of Malaysia's energy consumption together with the growing incidence of inefficient use of energy poses several challenges to the environment of the country. The effects of the growing incidence of sulphur dioxide (SO<sub>2</sub>) from coal combustion and carbon dioxide (CO<sub>2</sub>) arising from the heavy and rising consumption of hydrocarbon fuel contribute significantly to environmental pollution and global warming (Figure 4). In addition, the low level of efficiency in energy usage as indicated in Figure 5 attests to the magnitude of environmental pollution in a country where oil consumption accounts for about 85 per cent of energy consumption.

According to Malaysia's National Energy Balance 2010 (IEA 2012), Malaysia consumed roughly 13.52 million tonnes of diesel in 2008 and the transportation sector alone accounted for about 57 per cent of the total diesel consumption. Close to 80 per cent of total primary energy consumption in the world currently comes from fossil and other non-renewable fuel sources. This highly concentrated energy mix portends enormous

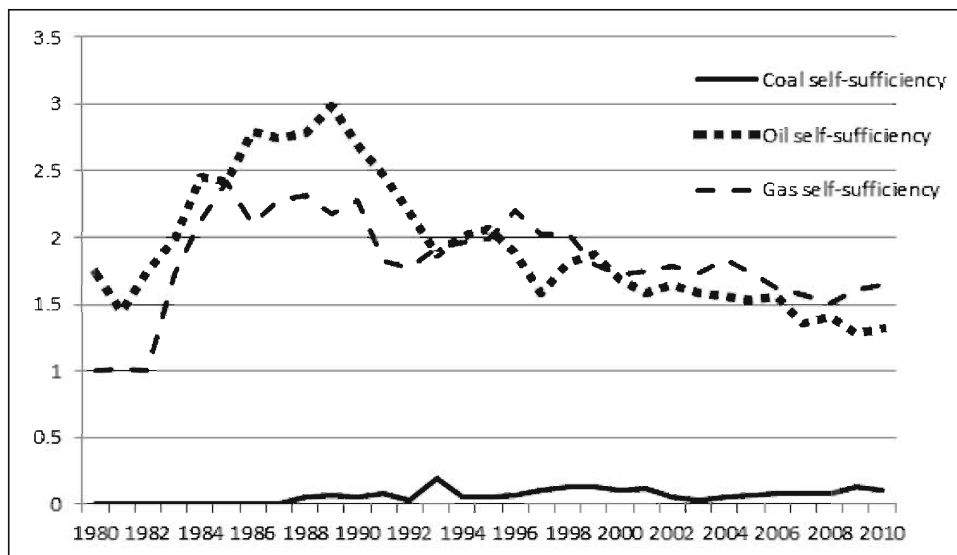
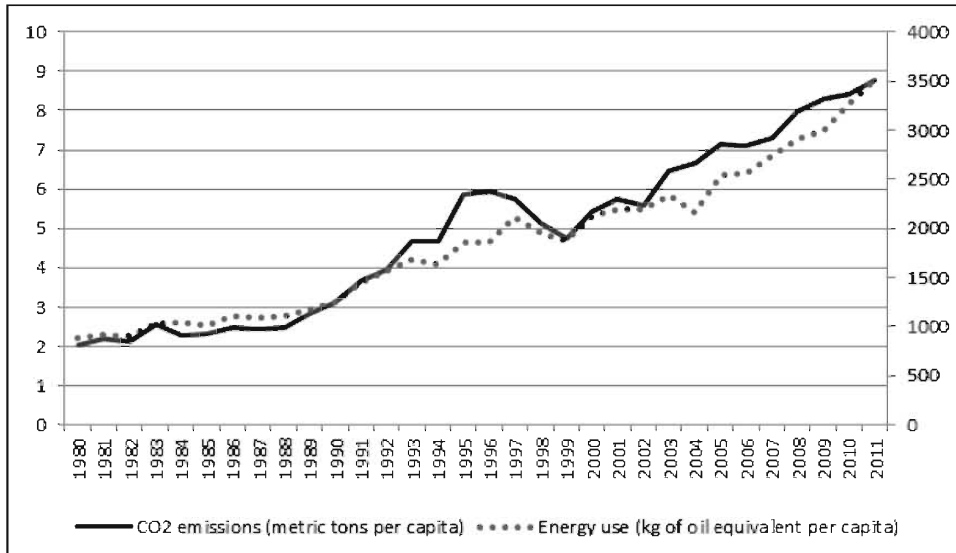


Figure 4. Malaysia's coal, oil and gas self-sufficiency. 1980-2010<sup>4</sup>  
 Source: IEA Energy Indicators, 2012

<sup>4</sup> Self-sufficiency is measured as the ratio of domestic production to total primary energy supply.



**Figure 5. Malaysia's CO<sub>2</sub> emissions and energy use per capita, 1980-2011**  
 Source: Author, using data from IEA(2012)

danger for CO<sub>2</sub> and green house gas emissions with possible severe impacts for global climate change.

### 3. Energy Security: Issues and Measurements

The concept of energy security is very distinct but quite often is misrepresented by energy independence. Though both energy independence and security may exhibit similar features for policy implications in a country, they are more often not mutually exclusive. The former connotes self-sufficiency or mere reduction of energy imports which might be of little significance for any country as long as there is security of supply. In fact, energy independence can be very costly to pursue given the enormous resources required for countries to be energy self-sufficient. Therefore, continuous reliance on imports to meet domestic energy requirements may be inevitable but does not automatically become irreconcilable with increasing energy security. What is important is for nations to maintain a varied energy portfolio characterised by well diversified fuel type and supply sources. In more specific terms, energy security can involve several issues which range from (i) accessibility to safe, diversified and non-interrupted energy supply; (ii) lessening carbon dioxide emissions; (iii) running down of oil reserves and the surge in fossil fuel prices; and (iv) increased usage of other less carbon-based energy sources like renewables.<sup>5</sup>

With the emergent dominance of oil in world energy amidst the incessant upsurge in oil prices together with waning oil discoveries and global low level of spare oil production

<sup>5</sup> Bielecki (2002) provides a detailed explanation of the concept of energy security.

capacity, it is imperative for nations to appraise their domestic energy resource endowments and that of the world in a bid to determine the future adequacy of oil supply. Closely related to this availability issue is the problem of accessibility which emphasises innate access to energy resources. Accessibility is the ability to secure the 'right to use' or access energy resources and guarantee sufficient energy supplies to meet anticipated growth in demand. Embodied in this are issues such as global geopolitics of oil and other technical cum geological challenges affecting access to energy resources.

The basic concerns of energy affordability arise from the divergence between energy demand and supply which mostly results in major volatility in the price of oil. Fluctuations in oil prices create a sense of insecurity that obstructs prospective investment which often constitutes immense insecurity for future supply of energy. Countries need to ascertain that the upsurge in the price of energy does not hamper the level of economic performance. Lastly, as nations continue to gain increased awareness and place a high premium on environmental issues, the critical question will be how to diversify from carbon to non-fossil fuels in the energy portfolio and still guarantee secured energy resources. To this end, this paper will investigate the extent of diversification of the Malaysian primary energy portfolios and also assess vulnerability of the economy to energy supply disruption using the indicators presented below.<sup>6</sup>

### 3.1 Diversification of Primary Energy Demand (DOPE)

This is an adaptation of the Shannon bio-diversity Index that measures diversification in terms of abundance and equivalence of energy supply sources. A value near to zero implies that the economy is dependent on one energy source and a figure close to 100 implies that the economy's energy sources are consistently distributed among the main energy sources. A low value reveals a high risk of energy supply security. The index is computed as:

$$DOPE = Y / \ln N \tag{1}$$

$$Y = -\sum(X_i \ln X_i) \tag{2}$$

where

Y = Shannon's bio-diversity Index

X<sub>i</sub> = Share of primary energy supply (PES) of energy source (i) in total primary energy supply (TPES)

ln = Natural log; i = 1....N (N is the number of energy sources in use)

*Net-Energy Import Dependency (NEI)* is the 'energy import' adjusted version of the DOPE expressed as a percentage. The further the value from zero, the higher the economy's dependence on import sources to meet its PES and may reflect a higher risk of energy supply security. The net energy import dependency is computed as:

$$NEI = \{1 - (Z / DOPE)\} \tag{3}$$

$$Z = -\sum(a_i X_i * \ln X_i) \tag{4}$$

where

<sup>6</sup> The paper borrows from the methodological framework contained in the in Asia Pacific Energy Research Centre report (2007).



Z is the import reflective DOPE

$a_i = (1-k_i)$  and  $k_i$  is the share of net imports in PES of energy source  $i$ .

All other variables as defined above

**Net-Oil Import Dependency (NOI)** measures a country's net oil import dependency by taking cognisance of the oil imports and exports. This measure is important since its value is also adjusted for the consumption intensity of oil as a primary source of energy and is computed as:

$$NOI = \left( \frac{\text{net oil import}}{PES_{oil}} \right) * \left( \frac{PES_{oil}}{TPES} \right) \quad (5)$$

**Net-Coal Import Dependency (NCD)** measures a country's net coal import dependency by taking into consideration coal imports and exports and adjusting for coal consumption intensity as a primary source of energy. It is computed as:

$$NCD = \left( \frac{\text{net coal import}}{PES_{coal}} \right) * \left( \frac{PES_{coal}}{TPES} \right) \quad (6)$$

**Carbon-Free Fuel Portfolio (CFFP)** examines the environmental challenges linked to energy supply security. It examines the share of non-carbon fuels such as hydro, nuclear and renewables in a country's fuel portfolio. A higher percentage reflects a greater likely offset against potential environmental degradation to a country's energy supply security and it is computed as:

$$CFFP = (PES_{hydro} - PES_{renewable}) / TPES \quad (7)$$

In addition to the above measures of energy supply disruptions, the study investigates the vulnerability of the Malaysia economy to oil and coal price shocks using the vulnerability index measure expressed below<sup>7</sup>:

$$\left( \frac{NOI}{GDP} \right) = p * \left( \frac{\text{vol. of net oil imports}}{\text{Total oil use}} \right) * \left( \frac{\text{total oil use}}{\text{total energy use}} \right) * \left( \frac{\text{total energy use}}{GDP} \right) \quad (8)$$

where

$p$  is price of energy (coal and oil),

Net oil imports / total oil use = (1 - self-sufficiency in oil production)

Total oil use / total energy use = dependence on oil as energy source

Total energy use / GDP = energy intensity

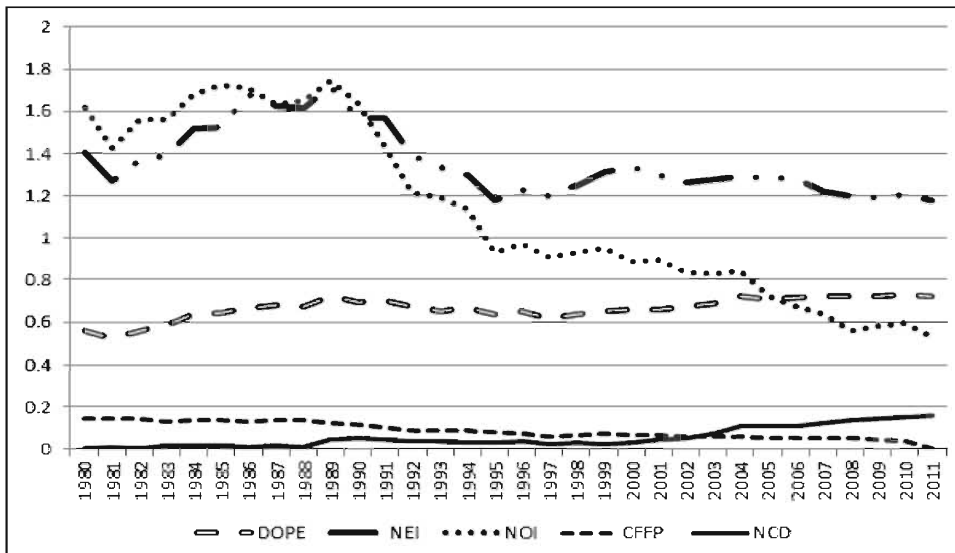
Oil intensity = oil use / GDP = oil dependence x energy intensity

## 4. Empirical Analysis

### 4.1 Magnitude of Energy Supply Disruptions in Malaysia

An analysis of the magnitude of energy supply security indices for Malaysia is presented here in two parts. The first part examines the present historical data for 1980 to 2011 while the second analyses Malaysia's energy security statistics based on the 'business as usual' scenario using the trend of the last ten-year data and makes future projections.

<sup>7</sup> See Bacon and Mattar (2005) for more details about the vulnerability index.



**Figure 6. Malaysia's energy security indicators (1980-2011)**

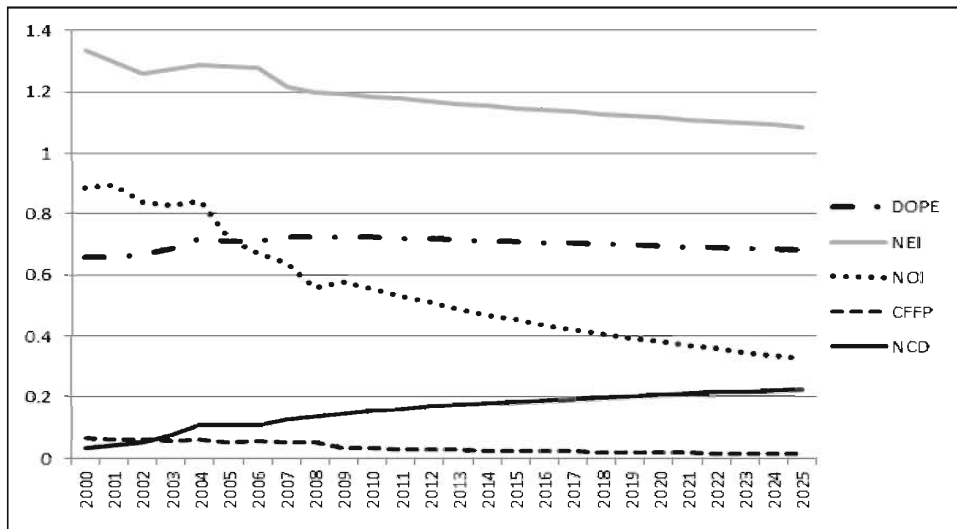
Source: Author computations using IEA 2012 data

Figure 6 shows that the DOPE index rose from about 56 per cent in 1980 to about 72 per cent in 1989 and declined progressively thereafter until 2004 when it returned to 72 per cent and remained in that region till 2011. While this is above the common benchmark of 50, below which countries are defined as dependent on few source of energy to meet demand, the fluctuations and the inability to improve on the value is a bad signal. Nonetheless, the results indicate that Malaysia had a lesser energy supply security risk and is less vulnerable to changes occurring in the erratic energy markets.

The NEI captures the effect of import dependency on energy demand portfolios and indicates the level of TPES dependency and is weighted by the consumption intensity of each energy type. The energy import fell from 1.7 in 1989 to less than 1.2 in 1995 and increased marginally till 2011. Though NOI of Malaysia has been declining since 1990, the analysis shows the highest level of fluctuation compared to other indices (Figure 6). In fact, the net NCD began to surface around year 2000 and has been rising marginally. Generally, Malaysia relies primarily more on domestic resources particularly gas to meet her primary energy demand.

The CFFP shows Malaysia's progress in diversifying towards alternative fuel sources through an increase in the amount of renewable and other non-fossil fuels in the energy mix. The analysis confirms that Malaysia's CFFP has been relatively low but grew marginally from 1998. This may not be unconnected with the fact that gas has been the dominant fuel for electricity generation in Malaysia. The importance of this indicator cannot be over emphasised as the search to ease GHG emissions and the crusade for fuel

## Energy Security in Malaysia: Magnitude and the Economic Effects



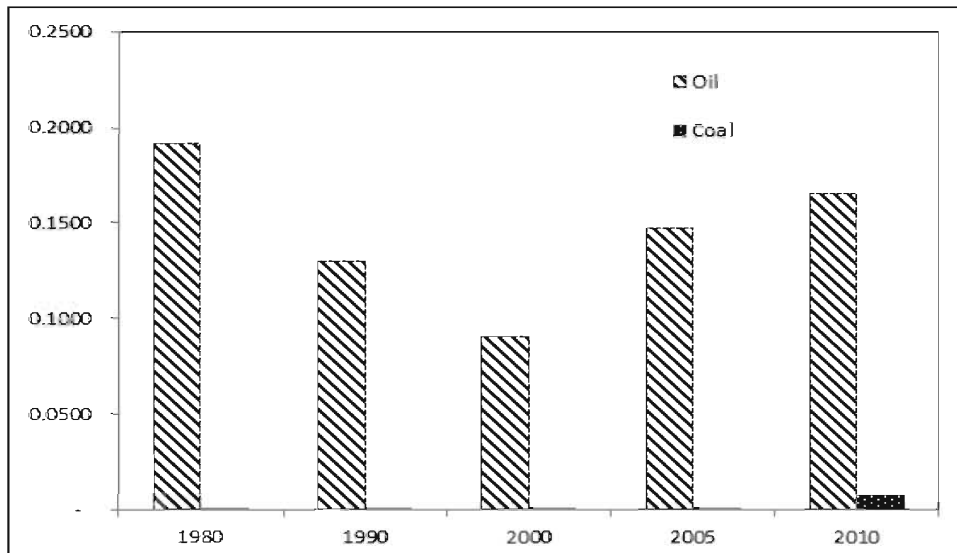
**Figure 7. Malaysia's energy security indicators (2000-2025)**  
 Source: Author calculation based on "business-as-usual" (BAU) forecast

switching in favour of less carbon-intensive fuel mix continues to draw increasing public concern. More so, there is a high affinity for nations to switch to their abundantly endowed energy sources in a bid to reduce the likely effects of supply disruptions and insecurity.

Figure 7 presents the future projections of the energy security indicators. The degree of a mixture of DOPE show a continuous marginal decline from about 73 in 2008 to about 68 in 2025. What this suggests is that Malaysia will exhibit the tendency to maintain a less diversified energy portfolio if the present trend is not put to check. The net energy import dependence projections were relatively stable from 2011 to 2025 implying that the country may not likely achieve meaningful reduction in the present level of energy dependence. In fact, IAEA (2008)<sup>8</sup> reported that extra gas supply has already been imported from the Joint Development Area while the coal supply relies on 100 per cent imported crude oil and that production in offshore Terengganu is probably insufficient to meet Peninsular Malaysia's consumption of oil products. Moreover, alternative energy sources are too small to make a significant contribution to Malaysia's energy mix.

The intensity of net oil import dependence show signs of significant decline in the future as shown in the figure. The index of the comparative share of carbon-free fuels in Malaysia's energy portfolio (CFFP) markedly indicates a constant decline from 2008 to 2025 implying that the country will likely use more fossil fuels to meet its energy needs.

<sup>8</sup> See the report of IAEA Workshop on *Steps for Conducting Nuclear Power Plant Technology Assessment* IAEA, Vienna, November 2008



**Figure 8. Vulnerability of Malaysia's economy to supply disruptions (1980-2010)**

Source: Author computations using IEA 2012 data

#### 4.2 Vulnerability of Malaysia's Economy to Energy Prices

From a macroeconomic perspective, the vulnerability of a net energy importing country is measured by the ratio of the value of net energy imports to GDP. The higher this ratio, the larger the fall in GDP that is required to offset a rise in energy prices. The impact of the energy price shock is calculated as the index of vulnerability multiplied by the percentage increase in oil prices. The vulnerability of the Malaysia economy to oil and coal for 1980, 1990, 2000, 2005 and 2010 were calculated using the methodology discussed in Section 3 and is presented Figure 8.

The calculations show that the Malaysian economy is much more vulnerable to oil price. Oil vulnerability ratio which stood at 0.192 in 1980 decreased from 0.1295 in 1990 to 0.091 in year 2000 but increased to 0.147 and 0.1655 in 2005 and 2010 respectively. Despite the drop in net oil imports volume by about 4 per cent in 2010 compared with the 2005, the rise in crude oil price by about 34 per cent in the period accounted for higher vulnerability in 2010. Though the vulnerability index for coal shows that the Malaysia economy is less vulnerable to coal supply disruptions, the trend shows that vulnerability to coal supply disruptions is beginning to increase. Malaysia's vulnerability to coal disruptions between 1990 and 2005 was within an insignificant range of 0.0001 and 0.0009. However, this has increased marginally to about 0.008 by 2010. In all, the country is less vulnerable to coal compared to oil (Figure 8).

The study further forecasted the primary energy supply for Malaysia based on the 'business-as-usual' (BAU) scenario where it is assumed that the past trend in PES will continue to 2025. The BAU forecast shows that if the current trend is anything to go by,

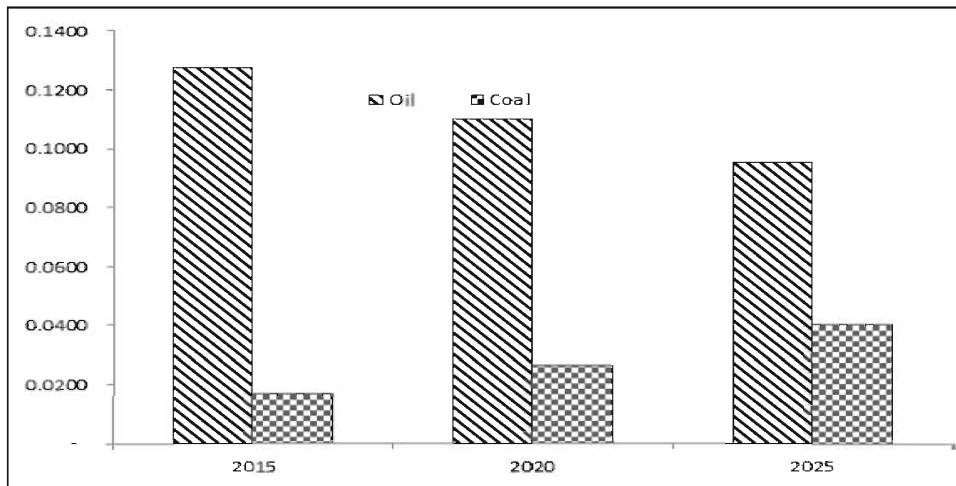


Figure 9. Vulnerability forecast - BAU (2011-2025 )

Source: Author calculation based on 'business-as-usual' (BAU) forecast

Table 1. Correlation matrix of PCGDP and energy security indices

	PCGDP	NEI	DOPE	CFFP
PCGDP	1.000000	-0.724881	0.596550	-0.959268
NEI	-0.724881	1.000000	0.069846	0.715899
DOPE	0.596550	0.069846	1.000000	-0.574525
CFFP	-0.959268	0.715899	-0.574525	1.000000

Malaysia’s oil vulnerability could reduce to 0.0095 by 2025. It must be emphasised that the ratio is very sensitive to GDP growth and price increases. Coal vulnerability would increase from 0.008 to 0.0403 by 2030 (Figure 9).

#### 4.3. Effects of Energy Supply Disruptions in Malaysia

To further examine the possible effects of energy supply disruption in Malaysia, the association between the security indices and per capita GDP on the one hand and per capita CO<sub>2</sub> emission on the other is studied. The correlation matrix results appear quite revealing as NEI and the CFFP have very high negative correlation with per capita GDP (PCGDP) while the DOPE is positively correlated with PCGDP. The implication is that Malaysia has been increasing her GDP with less energy import dependency and more energy diversification but with less of carbon-free portfolios – a case of environmentally non-sustainable growth (Table 1).

Table 2 also show that per capita CO<sub>2</sub> emission has a very strong negative association with CFFP, confirming that less carbon-free fuel portfolios have resulted in high per capita CO<sub>2</sub> emission in Malaysia.

**Table 2.** Correlation matrix of PCCO<sub>2</sub> emission and energy security indices

	PCCO <sub>2</sub> e	NEI	DOPE	CFFP
PCCO <sub>2</sub> e	1.000000	0.585791	-0.743812	-0.968099
NEI	0.585791	1.000000	0.069846	-0.574525
DOPE	-0.743812	0.069846	1.000000	0.715899
CFFP	-0.968099	-0.574525	0.715899	1.000000

Notes: PCCO<sub>2</sub> I - Per Capita Carbon Dioxide; PCCO<sub>2</sub>e - Per Capita Carbon Dioxide Emission.

## 5. Conclusion and Recommendations

Though it may sometimes be easier to advocate diversification of energy supply sources to enhance energy security for a country like Malaysia<sup>9</sup>, the degree of this diversification will depend on the country's interests and the accessibility of affordable resources and technological knowhow. Implementation can be very costly but alternative energy can still be competitive if its qualitative advantages – sustainability and renewability – are taken into account. Above all, policy commitment by the government is advocated to (i) ensure smooth operation of any renewable energy programme, (ii) pledge financial support to assist R&D for technology development and market creation for immature technologies, and (iii) provide budget stability all through the project life-time.

Malaysia is currently the largest producer and exporter of crude palm oil in the world using about 60 per cent of agricultural land in Malaysia for the cultivation of palm oil trees; from 2005, it has been producing about 14.96 million tonnes of crude palm oil – close to half of the world's palm oil production. Given the present search for environmental friendly alternative fuels in the international scene due to the depletion of fossil fuels and emerging concerns over global warming, bio-fuel from oil palm offers an option to address these concerns. As the largest producer of crude palm oil, it is expected that Malaysia has explored the possibility of producing biodiesel from palm oil for both the domestic and international markets given the increasing energy demand, the rapid depletion of domestic fossil fuel reserves and increasing environmental awareness.

Malaysia has considered quite a number of other approaches to curb dependence on fossil fuels. This ranges from the development of renewable resources through the pursuit of regional co-operation with neighbouring economies to capacity building efforts in energy efficiency and renewable energy. With the expectation that the prices of oil, gas and coal are expected to remain relatively high, Malaysia cannot ignore nuclear energy. Nuclear power has to be viewed as a credible alternative source of energy particularly because it is a proven, viable and competitive base load power source. If the country decides to go for nuclear power, it might be starting late compared to Indonesia, Vietnam

<sup>9</sup> According to IEA, Malaysia is a country striving for rapid industrialisation towards a developed nation status by 2020. However, available statistics indicate that the country will exhaust the national fossil fuel reserves in 30 to 40 years and become a net oil importer from 2040.

and Thailand. This provides an opportunity for Malaysia to learn from them and other countries such as France, Korea and Japan before embarking on the journey.

The steps taken so far by the government of Malaysia to develop biodiesel from palm oil are helping to enhance the economy's energy security. Energy security can be enhanced if dependence on petroleum diesel is reduced, CPO price in the world market is stabilised and an environmentally friendly alternative fuel is developed to displace a significant amount of imported diesel thereby increasing energy security.

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