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**ABSTRACT:**

With the new era of industrialization and urbanization, the use of renewable energy is a solution to resolve the impacts of current dependency on fossil based fuels and hike in fuel prices in the world. The rapid economic development in recent years has led to the energy increase demand in Malaysia and the situation is expected to grow in the near future. The country energy sector is heavily dependent on fossil based fuels for electrical energy generation. Currently wind energy systems are swiftly gaining recognition as one of the best sources of renewable energy because of its emission free characteristics. This paper reviews the recent scenario and the future expected energy situation in Malaysia. Wind energy resources assessment and potential in Malaysia is also discussed.

**Key words:** Malaysia, Energy, Wind, Wind Speed, Energy Density, Wind Potential

**1. INTRODUCTION**

Malaysia is a two separate boundary country located in Southeast Asia which comprises of Peninsular, Sabah and Sarawak. The country is located in the equatorial zone in between  $3^{\circ} 10'$  in the north of latitude and  $101^{\circ} 42'$  in the east of longitude. Because of this, the country is generally hot and humid with the average mean daily temperature ranges from  $20^{\circ}\text{C}$ - $27^{\circ}\text{C}$ . The country has tropical weather which is influenced by monsoonal climate namely northeast monsoon which start from September to March, southwest monsoon blow between May to mid September and shorter monsoon in April and October [1-2].

Malaysia has a land area of  $329,847 \text{ km}^2$  with thirteen states, and its mean elevations of about 300m. The country has a population concentration with a density of 86 people per square kilometer. It has a population of 29,695,233 as at 2010 house population census [3]. The country is known to be newly industrial developed nation and it has been maintaining a GDP growth over 5% for the past few decade and a significant percentage of GDP, about 40% is the output of higher value added manufacturing sector. However, the service sector's contribution to GDP is about 50% which is creating a strong foundation for the future growth of the country in the near future [4].

The country energy demand is forecasted to growth annually at the rate of 3.5% to reach 146.7Mtoe in 2030, which is 2.6% increase from 2002. Among the fossil fuels, coal is projected to grow at the fastest rate of 9.7 percent per year, followed by natural gas at 2.9 percent and oil at 2.7 percent.

Coal demand will increase substantially to meet the rising electricity demand, accounting for 93 percent of the total incremental coal demand of 31.2 Mtoe [5].

The energy consumption in Malaysia is becoming a subject of interest nowadays given the fact that the Malaysia's electricity consumption per capita is the second highest among the five ASEAN founding nation as shown in table 1. With the rapid industrial development in Malaysia the primary energy consumption was 38.9 Mtoe in 2005, the projected ultimate consumption is expected to reach 98.7 Mtoe in 2030 [6-7]. However, the

transport sector will grow fast during the next 25 years with the annual growth projected at 5.3%. The industrial sector and other sectors like residential, commercial and agricultural sectors will grow at an annual rate of 4.8% and 4.2% respectively, and this indicate that to achieve the country energy need oil will still remain the most used fuel and may probably grow at 4.7% per annum and renewable energy sources will be the least used resource for energy need and will have a growth rate of 1.5% [8].

**Table 1: Electricity per capita Consumption in ASEAN (KWh per capita) [6]**

| Country     | 1980     | 1990     | 2000     | 2006     |
|-------------|----------|----------|----------|----------|
| Malaysia    | 670.25   | 1,178.07 | 2,742.82 | 3,387.60 |
| Singapore   | 2,781.31 | 4,859.86 | 7,575.41 | 8,520.02 |
| Indonesia   | 44.37    | 161.37   | 400.36   | 529.72   |
| Thailand    | 291.26   | 708.13   | 1,462.14 | 1,984.33 |
| Philippines | 367.90   | 352.73   | 501.29   | 572.28   |

Due to rapid development in population, urbanization, industrialization and extensive uses of fossil based fuel, Malaysia can expect a very large growth in energy demand. Malaysia is endowed with renewable energy sources such as hydro, tidal, solar and wind. These potentials are promising in the short term in the country; they can also serve as a solution to the future energy problems. Among the source of renewable energy in Malaysia, wind energy has the most prospects in the near future. The main reason that smoothen the progress of wind energy is climatic changes that seriously threaten the world, which will lead to the world temperature increase to 58<sup>0</sup>C during the next ten decades [9]. This paper appraises the energy production-consumption, demand and wind energy potential in the country and presented the results in figures and tabular form.

## 2. RECENT ENERGY SITUATION IN MALAYSIA

Malaysia primary energy sources include natural gas, coal, oil, biomass although renewable energy sources such as solar, wind, geothermal, tidal and hydro are currently being exploited. According to Malaysia Economic Planning Unit (EPU), there is an estimated 2.5 trillion gas and 5.9 billion barrel of oil reserves that will last 39 and 25 years respectively [10]. The value of energy production in Malaysia was 89,693 as of 2009. However for the past 38 years this indicator reached a maximum value of 93,118 in 2008 and a minimum value of 4,770 in 1997 as shown in figure 1 [12].

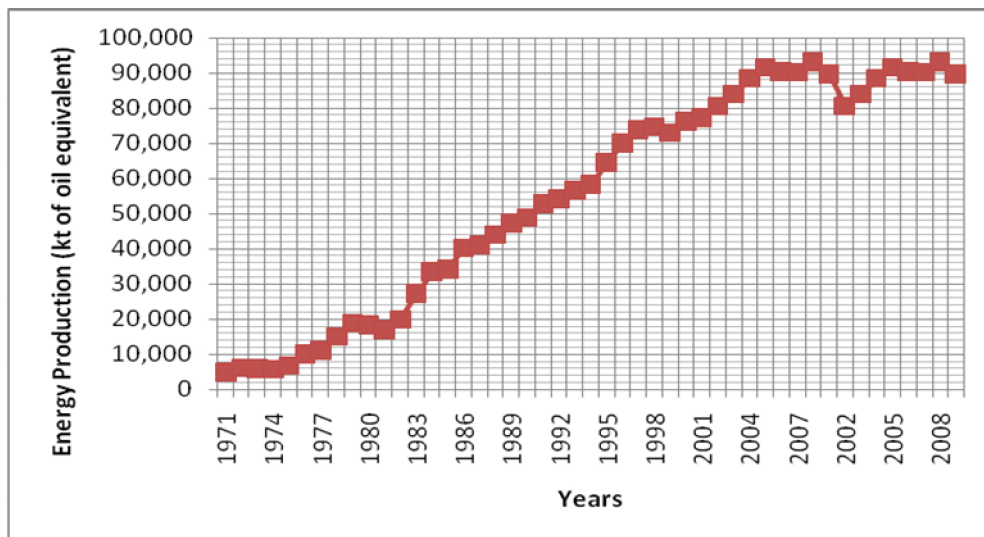


Figure 1: Energy Production in Malaysia from 1971-2008

Electricity production increased from 23,061 in 1990 to 87,306 GWh in 2005. This is equivalent to an average annual growth rate of 9.3% over this period. Over the period from 2005-2030, and the rate is expected to hit 314,984 GWh in the reference scenario with an annual growth rate of 5.3% and 389,734 GWh in the high scenario posting an annual growth rate of 6.2% [12].

**Table 2: Electricity Production to 2030, in GWh**

| By Type          | 1990         | 2005          | 2030<br>(Reference) | 2030<br>(High) |
|------------------|--------------|---------------|---------------------|----------------|
| Coal             | 2,825        | 23,134        | 154,684             | 194,913        |
| Thermal<br>(oil) | 11,138       | 2,489         | 3107                | 3,068          |
| Natural<br>Gas   | 5,064        | 55,899        | 139,025             | 173,587        |
| Hydro            | 3,989        | 5,784         | 18,166              | 18,166         |
| <b>Total</b>     | <b>2,016</b> | <b>87,306</b> | <b>314,984</b>      | <b>389,734</b> |

The Demand for commercial energy in Malaysia is projected to continue its upward trend from 1244 Petajoule (PJ) in 2000 to an estimated 2218 PJ in 2010 and is expected to keep on increasing in future years [13]. The trend of energy mix in Malaysia indicated a continuous decrease in the percentage of oil and petroleum product share and steady increase in coal demand; figure 2 shows the share of primary commercial energy supply sources [14].

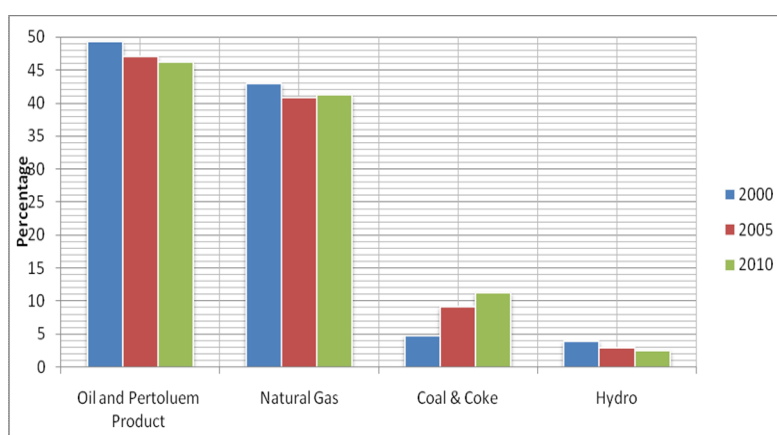


Figure 2: Share of Primary Energy Supply Source

Malaysia primary energy consumption is shown in Figure 3. The total consumption increased from 6,940 Ktoe in 2005 to 9,240 Ktoe in 2011 [15].

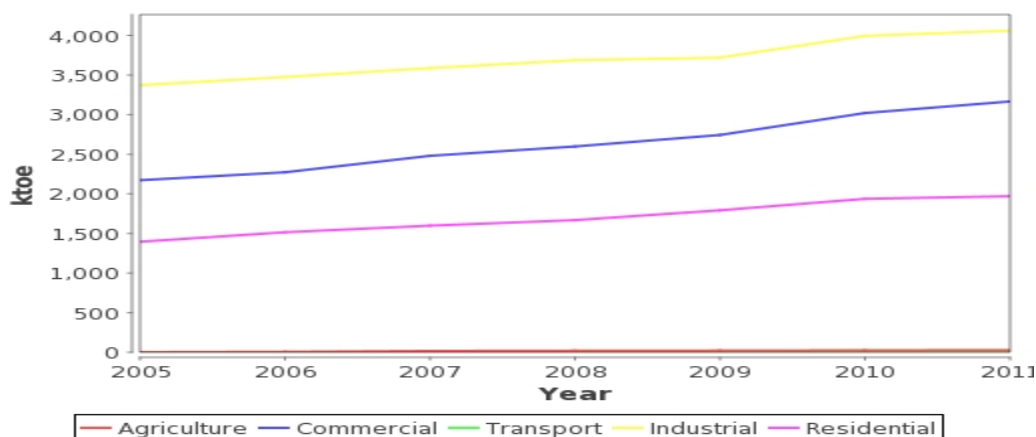


Figure 3: Primary Energy Consumption in Different Sectors of Malaysia

From the figure, it can be noted that the energy utilization had increase from 2005 to 2011. The industrial and transport sectors are the two major consumer of energy in the stipulated years. However, commercial and residential sectors were the third biggest consumers, while the agricultural sector was the smallest consumer of energy in the country.

Malaysia estimated total oil production is 630,000 barrels per day (bbl/d) in 2011. More than half of the total oil production comes from Tappis field in the offshore. The country consumes majority of its oil production. Gross natural gas production has been rising steadily reaching 2.7Tcf in 2010. While the domestic natural consumption has also reach 1.1Tcf in 2010, this shows 42% of the total production [16].

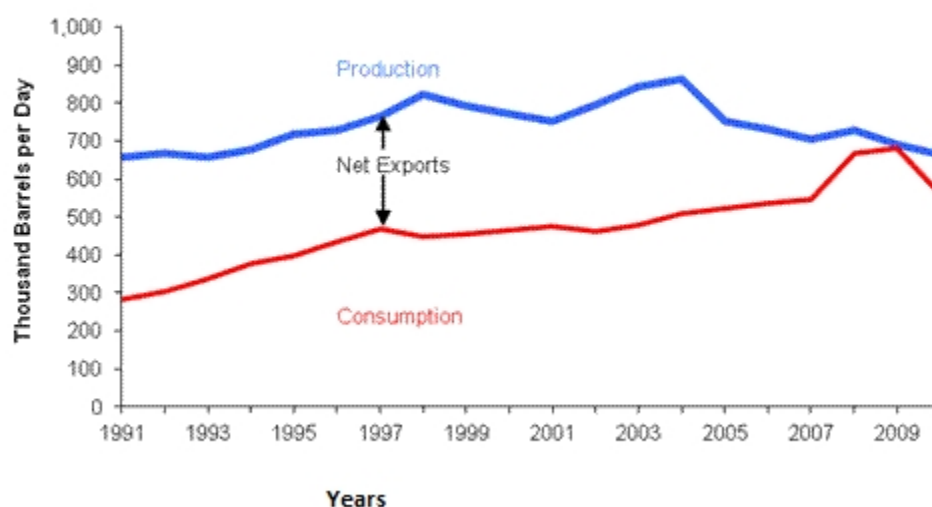


Figure 4: Malaysia's Oil Production and Consumption

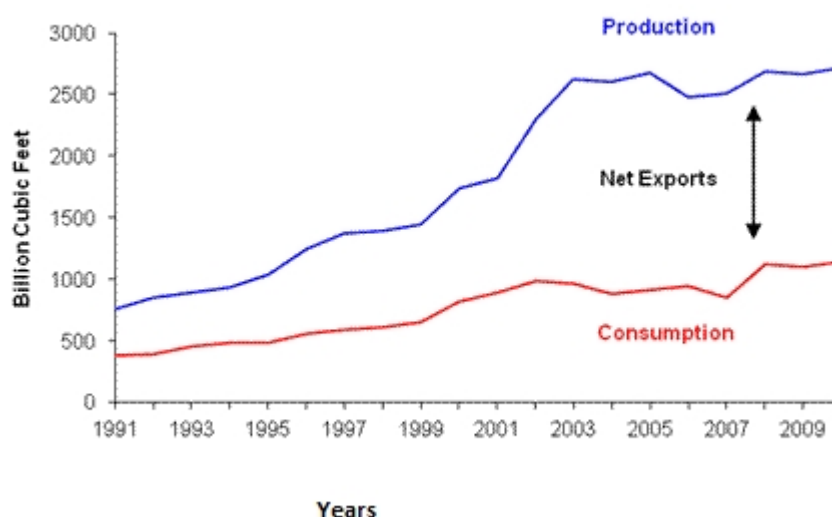


Figure 5: Malaysia Natural Gas Production and Consumption

As seen from figure 4 Malaysia is a large oil producer. On the other hand, there is significant variation in the rate of oil production/consumption from 1991 to 2006. However from 2007 onward involves a mark reduction and increase in the consumption. Therefore to balance up the high demand in the near future there is need for alternative energy sources.

Burning of coal is associated with many challenges like emission of greenhouse gasses; coal is still projected to play an important role in Malaysia energy supply. Coal has been identified as part of fuel mix strategy and form part of the long term plan development of a sustainable energy supply in Malaysia. The country is blessed with large reserves of coal deposit. Most of the coal reserves are found in less developed areas where there is an inadequate infrastructure. As of 2004, the production of coal in Malaysia stand at about 383,000 tons, an significant increase from 65,000 tons 1n 1991[17]. Similarly the reserves and production of coal as at December, 2005 are 1,483.06 and 782,107 metric tons respectively [14].According to the 2010 BP Statistical Energy Survey, Malaysia had 2009 coal consumption of 4 million tones oil equivalent, 0.12% of the world total. Coal production has been decreasingly slowly, due to mine closure as well as lower demand. Malaysia's coal reserves are located primarily in Sarawak and Sabah, with smaller deposits in Selangor, Perlis and Perak. Total estimated coal resources stand at just more than 1000 Mt. These coal resources are considered as strategic in terms of Malaysia's power requirements. Malaysia actively promotes coal as a fuel of choice for power generation in order to free up more of its natural gas for export [18].Malaysia coal importation, production and consumption is shown in figure 5 [19].

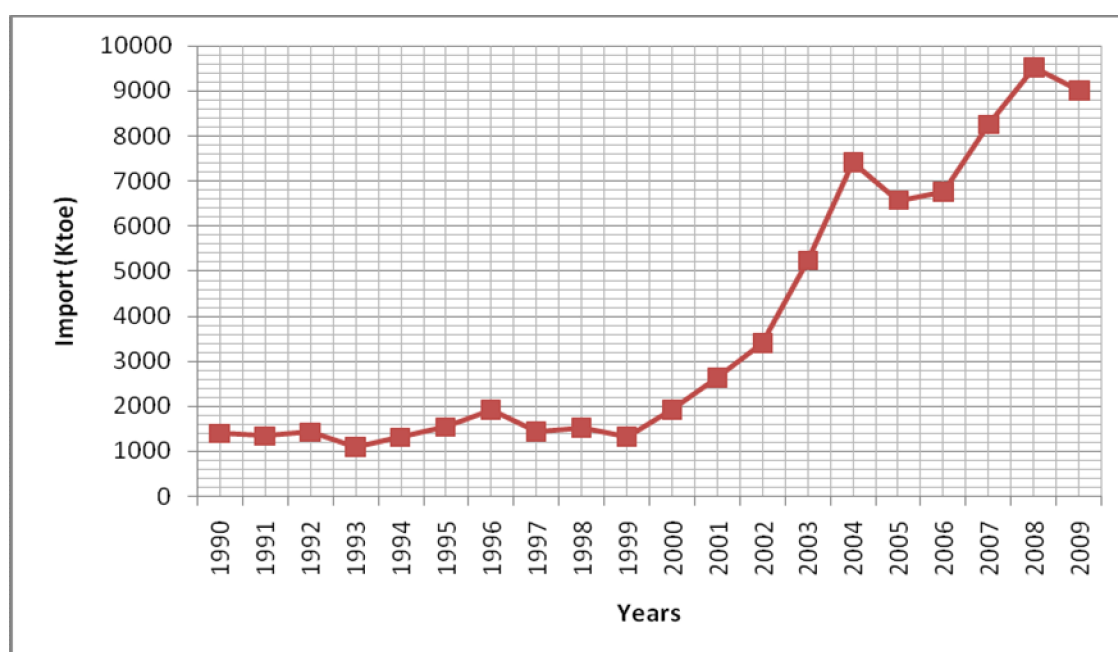


Figure 6: Malaysia Coal Import

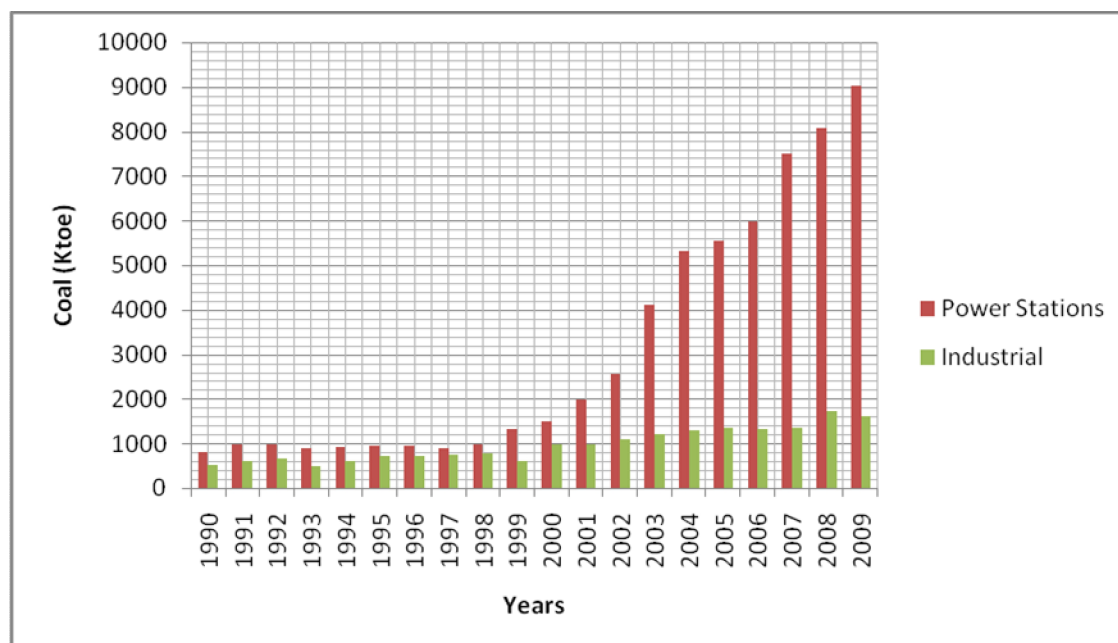


Figure 7: Coal Consumption by Sectors

Hydropower is cost effective and environmentally friendly use of water resources toward energy development [20]. Hydropower energy is widely used throughout the world, varying in size from Pico to large scales serving several countries. Hydropower provides significant percentage in many developed and developing nations. Malaysia uses hydro power for 11% of its electricity. Due to high rainfall receives in the country; the average rainfall is slightly above 2,600mm per year. The total gross estimated hydropower potential is 414,000 GWh/year of which about 85,000Wh/year is available in Peninsular [21].

At the moment, Malaysia had utilized this potential mainly in the range of large and mini hydropower but very few in the micro hydro range, the country have a total of 149 sites with estimated micro hydro potential of 28.9MW were identified. Currently, there are twelve large scale hydropower stations and eight mini scale hydropower stations in Malaysia, wholly owned by Tenaga Nasional Berhad (TNB) and has been trusted to operate and maintain 30 numbers of mini hydro stations throughout the Peninsular of Malaysia with total installed capacity of approximately 16 MW [22].

Malaysia is a tropical country that has significant solar radiation but a very limited radiation network. The mean annual average of total solar radiation varies (table 7).The country receives solar radiation at the level of about 15MJ/day; average sunshine hours are estimated more than 4000 hours per annum [23-24].

**Table 3: Average Yearly Solar Irradiance in Various Town of Malaysia KWh/m<sup>2</sup> per day [25]**

| Town       | Annual Average Solar Irradiance<br>(KWh/m <sup>2</sup> ) |
|------------|----------------------------------------------------------|
| Alor Setar | 4.96                                                     |
| Georgetown | 5.15                                                     |
| Kota Bharu | 5.28                                                     |

|               |      |
|---------------|------|
| Kuala Lumpur  | 4.90 |
| Johor Bharu   | 4.55 |
| Kota Kinabalu | 5.41 |
| Kuching       | 4.61 |

Malaysia is the fourth largest PV modules producers in the world, but the utilization of solar technologies is still limited due to high cost of installing PV systems. Currently solar energy is used for thermal applications and PV technologies are used for electricity generation [26].

Geothermal power generation is another potential in Malaysia. There are 79 confirmed geothermal manifestation areas, 61 of which are in Peninsular Malaysia, 8 are in Sarawak and 10 in Sabah. The total number excludes other geothermal areas reported to exist in the remote vicinities of Sabah and Sarawak, the veracity of which is yet to be determined due to the areas' inaccessibility[27]. Malaysia's first geothermal plant, to be build at Apas Kiri in Sabah's Tawau district is expected to have capability of generating more than 100MW of electricity [28].

Malaysia possesses the potential of generating electricity from indigenous biomass source, however the estimated capacity based on current biomass yields is about 400MW. Palm oil is the single source which could contribute to generate about 375MW (figure 8). On the other hand paddy residue is another emerging source that could contribute substantial amount of electricity; other sources such as pineapple fruit and vegetable plant are currently under investigations for consideration as future energy potentials [29]. Figure 9 and 10 shows potential of biomass energy and resources from palm oil mills in Malaysia [30].

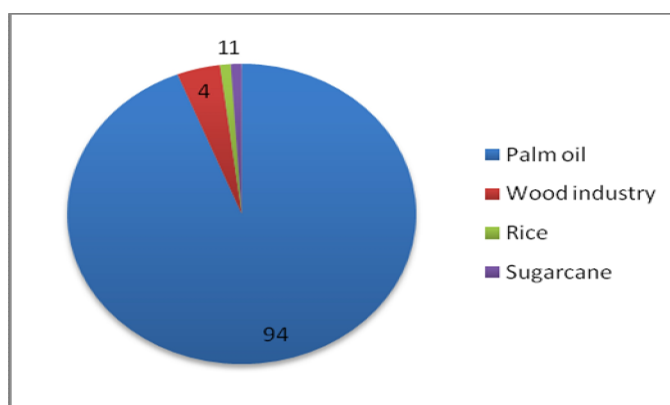


Figure 8: Biomass Resource from Agricultural Residue

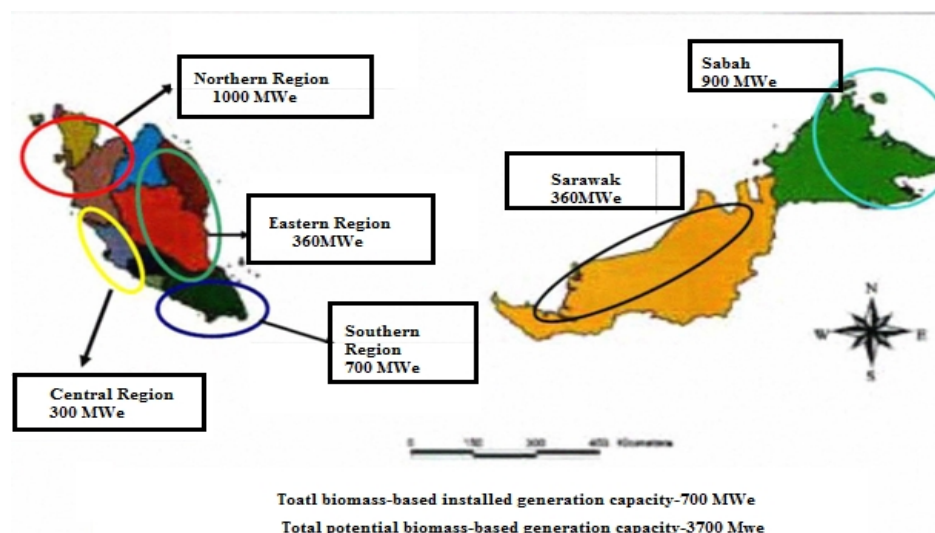


Figure 9: Biomass Energy Potential in Malaysia

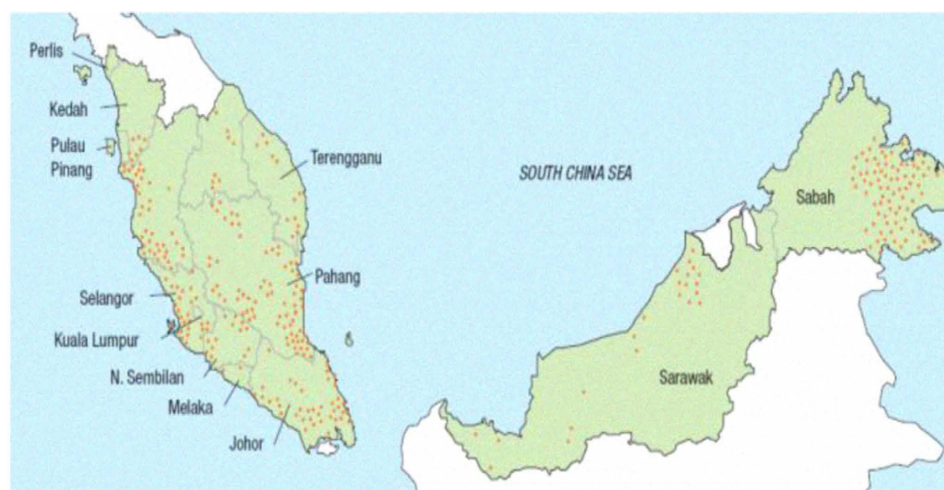


Figure 10: Biomass Energy Resources from Palm Oil Mills in Malaysia

### 3. WIND ENERGY POTENTIAL

Wind energy is considered as a clean source of renewable energy and is almost the fastest growing energy source in the world. At the end of the year 2012, the total annual installed wind capacity attains 44,711MW. However, the cumulative installed wind capacity from 1996 to 2012 is 282, 430MW and is expected to reach 265 GW by 2020 [31]. The change in global wind power from 1996 to 2012 is shown in figures 11 and 12 respectively. The installed capacity in Asia has increased by 16% between 2011 and 2012 as shown in table 4. Wind energy stills provide a fraction of the global electricity demand and currently very little electricity is produced from wind in Asian region to reach more than five million people.

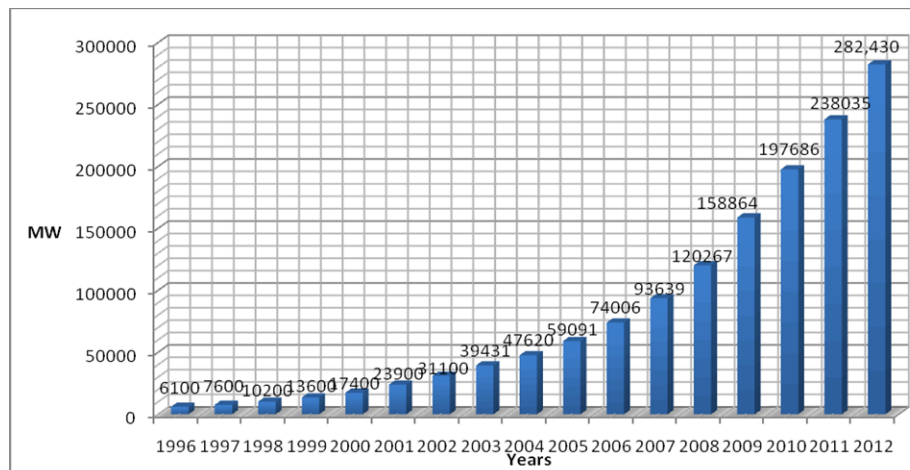


Figure 11: Cumulative Installed Global Wind Capacity

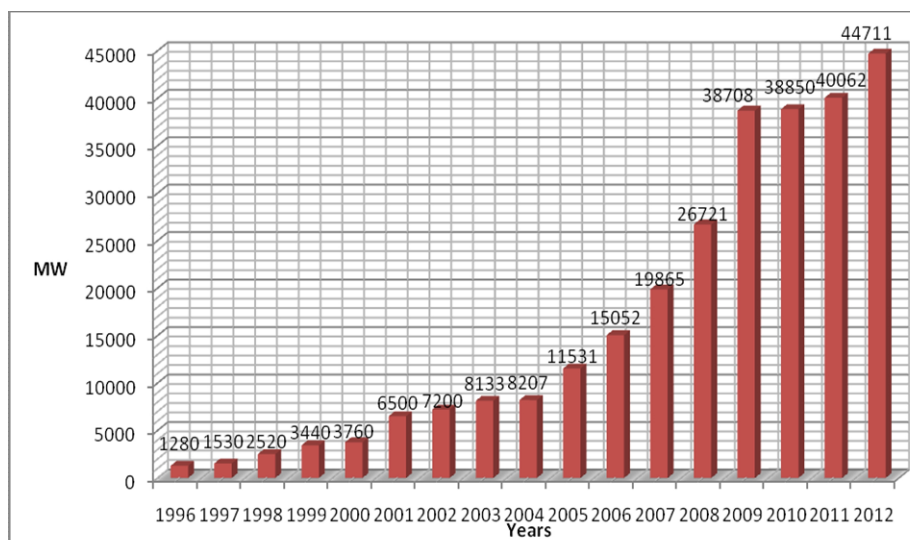


Figure 12: Annual Installed Global Wind Capacity

**Table 4: Change of Wind Power in Asia [31]**

| Installed Wind Capacity (MW) |             |          |             |
|------------------------------|-------------|----------|-------------|
| Country                      | End of 2011 | New 2011 | End of 2012 |
| PR China                     | 62,364      | 13,200   | 75,564      |
| India                        | 16,084      | 2,366    | 18,421      |

|             |               |               |               |
|-------------|---------------|---------------|---------------|
| Japan       | 2,536         | 88            | 2,614         |
| Taiwan      | 564           | -             | 564           |
| South Korea | 407           | 76            | 483           |
| Pakistan    | 6             | 50            | 56            |
| Others      | 106           | -             | 108           |
|             | <b>82,070</b> | <b>15,750</b> | <b>97,810</b> |

Wind energy potential varies depending on the location. Various studies have shown that Malaysia does not possess large scale wind generation potential. However wind turbine, speed limit 3-4m/s, is found to be economically feasible in many region in the country.

As mentioned earlier Malaysia has a land surface area of 329,847 km<sup>2</sup>. The country is vastly surrounded by ocean where wind power potential has been recognized by many researchers as a better site to harness clean wind energy source. The total electricity consumption of Malaysia as 2012 is 93.8 billion KWh (93.8TWh). The theoretical wind power of Malaysia is estimated about 25 TWh/year (figure 13) which is about 26.7% of the electricity consumption of Malaysia [32].

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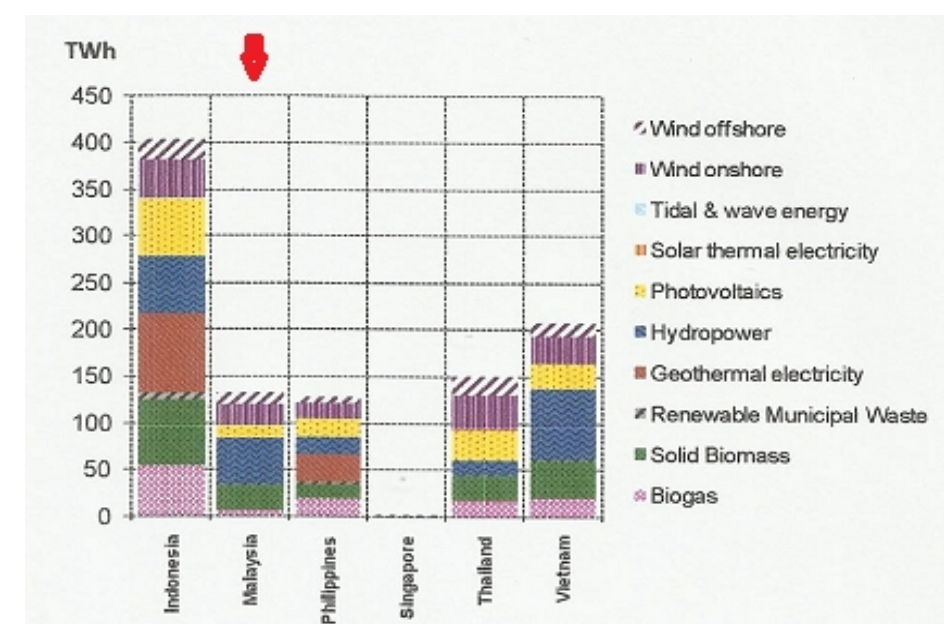
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Figure 13: Total Realizable Potential for Renewable Energy in ASEAN Countries

Considering Malaysia has great potential to harness the energy content in a wind, in recent time several research works has been carried out in order to investigate the potential of having wind energy in the country. Records from Malaysia Metrological Department (MMD) shows that the highest maximum wind speed of 41.7m/s was recorded at Kuching, Sarawak on 15<sup>th</sup> September, 1992, while maximum mean daily wind speed of 3.8m/s recorded at Mersing, in Johor. Due to availability of wind data, on daily, monthly, seasonal and annual wind potential have been investigated and reported by many researchers.

Based on wind data collected from 2004 -2007. Nik et al. [33] analyzed the potential of having wind energy in Kuala Terengganu. Monthly average wind speed of the potential site is shown in table 5. The maximum annual monthly wind speed is 5.20m/s, it could be concluded that a small wind turbine could be used to provide power at this area.

**Table 5: Monthly Average Wind Speed for Kuala Terengganu from 2004-2007**

| Study Area       | Latitude (°N) | Longitude (°E) | Monthly Average Wind (m/s) |      |      |      |      |      |      |      |
|------------------|---------------|----------------|----------------------------|------|------|------|------|------|------|------|
|                  |               |                | 2004                       |      | 2005 |      | 2006 |      | 2007 |      |
|                  |               |                | Min                        | Max  | Min  | Max  | Min  | Max  | Min  | Max  |
| Kuala Terengganu | 4°13.6'       | 130°26.1'      | 2.10                       | 4.82 | 2.01 | 3.78 | 2.12 | 4.72 | 2.15 | 5.20 |

Young et al. [34] have analyzed the wind speed for nine locations in Malaysia by using statistical approach, the average annual wind speed for the year 2009 at 10m and 100m heights are summarized in table 6. The results of this study show that the large wind turbine generator is not economically feasible; however, a small wind system can run throughout the year at Mersing.

**Table 6: Wind Energy Potential of Some Locations in Malaysia**

| Study Area       | Latitude (°N) | Longitude (°E) | Annual Wind Speed (m/s) |      |         |      |
|------------------|---------------|----------------|-------------------------|------|---------|------|
|                  |               |                | At 10m                  |      | At 100m |      |
|                  |               |                | Min-                    | Max  | Min-    | Max  |
| Mersing          | 2.4           | 103.8          | 2.40                    | 4.76 | 3.47    | 6.89 |
| Bintulu          | 3.2           | 113.03         | 1.66                    | 1.99 | 2.25    | 2.69 |
| Kuala Terengganu | 5.3           | 103.15         | 1.57                    | 2.65 | 2.83    | 4.79 |
| Pulau Langkawi   | 6.35          | 99.80          | 1.44                    | 3.10 | 1.95    | 4.19 |
| Sandakan         | 5.97          | 118.17         | 2.02                    | 2.97 | 2.73    | 4.01 |
| Kudat            | 6.88          | 116.83         | 2.05                    | 3.19 | 3.16    | 4.92 |
| Kota Kinabalu    | 5.97          | 116.12         | 1.81                    | 2.60 | 2.26    | 3.25 |
| Kuching          | 1.55          | 110.33         | 1.61                    | 2.14 | 2.91    | 3.87 |
| Tawau            | 4.28          | 117.91         | 1.51                    | 1.92 | 2.46    | 3.14 |

The monthly and seasonal variation of wind characteristics were investigated in [35], in terms of wind energy potential using available wind speed data from 1991-2008 at 10m altitude at Pemanggil Island. The result of the study strongly indicates that a small scale wind power can be generated at the area. The values are summarized in Table 7.

**Table 7 Wind Energy Potential in Pemanggil Island**

| Study Area       | Latitude <sup>0</sup> N | Longitude <sup>0</sup> E | Average Annual wind Speed (m/s) |      |
|------------------|-------------------------|--------------------------|---------------------------------|------|
|                  |                         |                          | Min –Max                        |      |
| Pemanggil Island | 2.58                    | 104.33                   | 1.71                            | 6.70 |

The work on wind resource assessment at five locations in west Malaysia conducted in [36]. Based on average hourly wind speed data available from (2005-2009), using maximum likelihood method, the study revealed that Mersing possessed high wind energy potential to implement low wind speed driving systems. Table 8 summarized the results.

**Table 8: Wind Energy at Various Locations in Malaysia**

| Study Location   | Latitude ( <sup>0</sup> N) | Longitude ( <sup>0</sup> E) | Annual wind Speed |
|------------------|----------------------------|-----------------------------|-------------------|
|                  |                            |                             | (m/s)             |
| Langkawi         | 06 <sup>0</sup> 25'        | 99 <sup>0</sup> 45'         | 1.76              |
| Penang           | 05 <sup>0</sup> 24'        | 100 <sup>0</sup> 23'        | 1.15              |
| Kuala Terengganu | 05 <sup>0</sup> 20'        | 103 <sup>0</sup> 08'        | 1.69              |
| Kota Bharu       | 06 <sup>0</sup> 70'        | 102 <sup>0</sup> 14'        | 1.58              |
| Mersing          | 02 <sup>0</sup> 25'        | 103 <sup>0</sup> 50'        | 2.65              |

The assessment of wind energy potential has been evaluated based on experimental set up using DavisPro weather station in Perlis by [37]. The recorded wind speed data from January to December 2008 is shown in Table 9. The results showed that, Perlis is the best area with maximum annual wind speed of 2.60m/s.

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**Table 9: Wind Energy Potential at Perlis at 21.7M**

| Study Area | Latitude<br>( <sup>0</sup> N) | Longitude<br>( <sup>0</sup> E) | Average<br>Annual wind<br>Speed (m/s) |      |
|------------|-------------------------------|--------------------------------|---------------------------------------|------|
|            |                               |                                | Min –Max                              |      |
| Perlis     | 2.58                          | 104.33                         | 1.60                                  | 2.60 |

233 An extensive study conducted in Kudat and Labuan presented in [38], by using 2-parameter Weibull function.

234 Findings from the study conclude that both sites are unsuitable for large wind energy production; however

235 small-scale wind energy of high efficiency can be generated at 100m. Table 10 show a summary of this

236 research works.

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**Table 10: Wind Potential at Kudat and Labuan**

| Location | Latitude<br>( <sup>0</sup> N) | Longitude<br>( <sup>0</sup> E ) | Annual Average<br>Wind Speed (m/s) |      |      |
|----------|-------------------------------|---------------------------------|------------------------------------|------|------|
|          |                               |                                 | 2006                               | 2007 | 2008 |
| Kudat    | 6.88                          | 116.83                          | 3.37                               | 3.36 | 3.00 |
| Labuan   | 5.00                          | 115.00                          | 3.50                               | 3.81 | 2.67 |

238 Recent studies conducted in [39] used Firstlook software to analyzed the annual mean and monthly wind speed

239 values from (2007-2009) and the view of wind speed distribution for 14 stations located at Alor Setar, Bayan

240 Lepas, Ipoh, Kota Bharu, Kota Kinabalu, Kuala Terengganu, Kuching, Labuan, Malacca, Mersing, Miri, Senai

241 and Subang. The software suggested that Kota Belud, Kudat and Langkawi are the most promising location to

242 install wind turbine. However, the monthly mean wind speed for the 14 selected stations is shown in figure 14.

243 As seen the highest monthly mean wind speed value determined is 4.25m/s in Mersing.

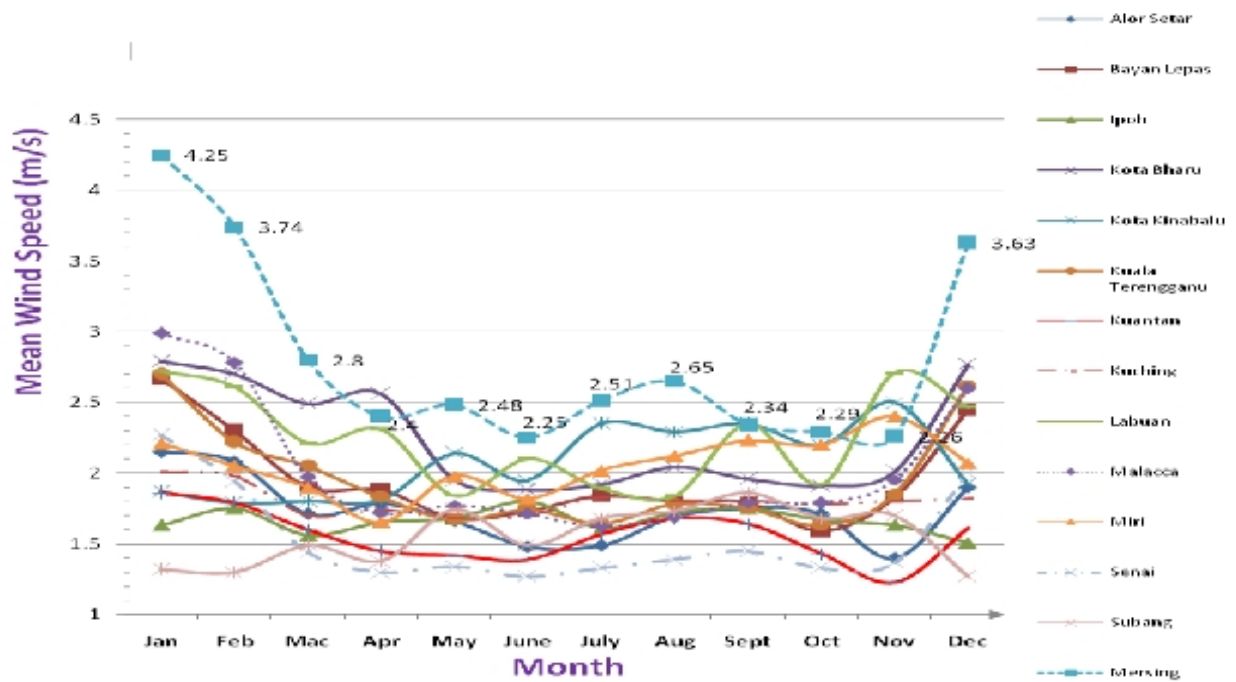


Figure 14: Monthly Mean Wind Speed at 14 Stations in Malaysia [39].

Most recent published study in [40] proposed the use of Wind Atlas Analysis and Application Software (WAsP) based on spatial analysis to investigate the potential of wind energy at Kudat. The result of the study proves strongly the potential for developing small scale wind farm in northern part of Kudat. The interpolated wind speed in the area varies from 4.3-5.4m/s.

Wind power density indicates the potential of wind energy per unit area. From various studies conducted in Malaysia, average wind power density is summarized in table 11. As seen from table 11, the wind energy potential varies depending on the location. However, the most attractive region to harness the wind energy potential is Mersing, Labuan and Perlis.

**Table 11: Wind Potential of Various Locations in Malaysia** [36, 38, 41].

| Location | Average Annual Wind Power Density ( $W/m^2$ ) |
|----------|-----------------------------------------------|
| Kudat    | 67.40                                         |
| Labuan   | 50.81                                         |
| Mersing  | 26.70                                         |
|          | 62.00                                         |
| Melaka   | 11.98                                         |

|               |       |
|---------------|-------|
| Kuantan       | 8.40  |
| Langkawi      | ≈10   |
| Penang        | ≈10   |
| Kota Bharu    | ≈10   |
| Kota Kinabalu | ≈10   |
| Perlis        | 64.27 |

The spatial prediction of wind speed at different heights investigated in [34]. Their research work indicates the low and high windy area of Malaysia. Figure 14 and 15 show the wind speed and energy potential distribution for 10m and 100m in Malaysia.

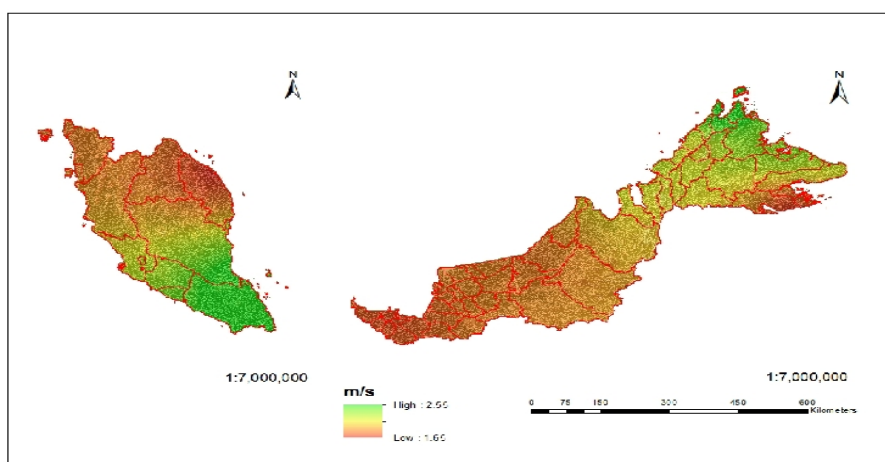


Figure 15: Wind Speed Distribution Map of Malaysia in 2009 at 10m Height [34]

As shown in figure 12 most of the high windy regions were found in southern part of peninsular and Sabah, while part of Sarawak and north peninsular are the low windy region at 10m height. Figure 15 shows wind energy potential at 100m,

The highest wind speed were in the south of Peninsular, the state of Johor showed the highest wind speed in the range of 2.36-6.88m/s. The highest wind speed found at the tip of Borneo is in the range of 2.33-4.92m/s.

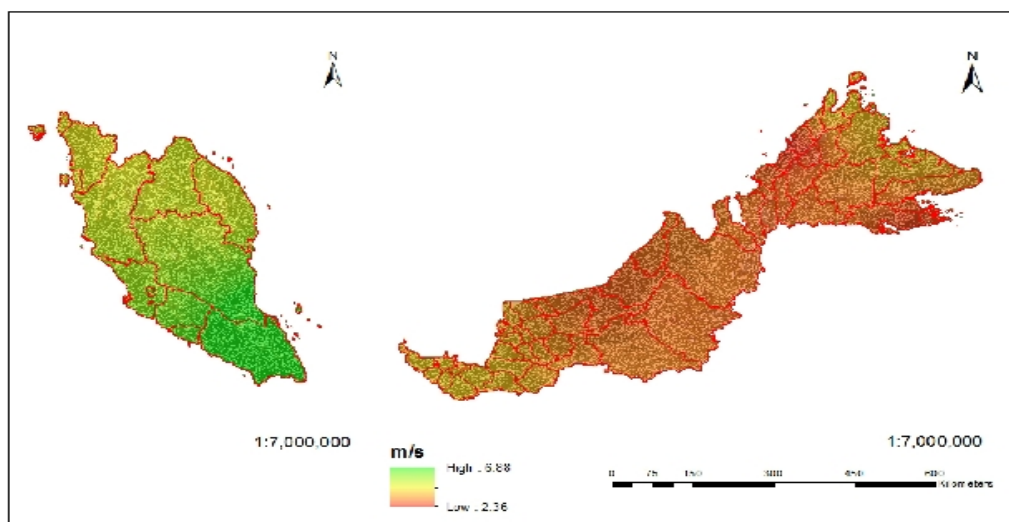


Figure 16: Wind Speed Distribution Map of Malaysia in 2009 at 100m Height [34]

#### 4. CONCLUSION

Malaysia is endowed with both renewable and non renewable energy sources. From the review hereof the country is heavily depends on fossil based fuel as source of energy, hence there is need for the country to enhance national competitiveness to face the challenges in domestic and global scenario in terms of prime environmental consideration of global warming.

More than 90% of the electricity generated in Malaysia is based on fossil fuels and the energy consumption is rapidly increasing. The share of renewable energy at present is negligible. Also, the country has substantial hydroelectric and geothermal potential at economic capacity. Currently there is no nuclear wind power plant in the country, hence nuclear power should be considered for future development of energy in the country.

Despite the above, the country is endowed with abundance of natural resources for renewable energy such as solar, wind and biomass. Considering the current utilization of wind and solar power systems in the world, the resources are still at limited utilization in Malaysia.

Wind energy is one of the most significant and rapidly developing renewable energy sources in the world and it provides clean emission free energy resource. Wind energy has great potential in Malaysia. Theoretically the estimated feasible wind power of Malaysia is 25TWh/year.

This figure stands as 26.7% of the total electricity consumption of the country per annum. Wind speed values are higher in northeast monsoon season in the country, most if not all research works conducted in the country shown the possibility of implement small scale wind power plant.

Currently wind energy in various parts of Malaysia is becoming economical due reduction in wind turbine costs. Because of this, it is necessary to make use of this abundant natural resource as additional source of energy especially for standalone applications in rural and remote areas.

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