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Renewable energy technology acceptance in Peninsular Malaysia

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HIGHLIGHTS

- Public acceptance is an essential element in the diffusion of renewable energy.
- Perceived ease of use and perceived usefulness affect intention to use renewables.
- It is important to reduce the cost of renewable energy, particularly for end users.
- Renewable energy policies should address issues of public perception and awareness.

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ABSTRACT

Despite various policies, renewable energy resources have not been developed in Malaysia. This study investigates the factors that influence renewable energy technology acceptance in Peninsular Malaysia and attempts to show the impact of cost and knowledge on the perceived ease of use and perceived usefulness of renewable energy technology. The results show that cost of renewable energy has an indirect effect on attitudes towards using renewable energy through the associated impact on the perceived ease of use and perceived usefulness. The results also indicate that public knowledge in Peninsular Malaysia does not affect perceived ease of use, although the positive impact of knowledge on perceived usefulness is supported. Furthermore, our results show that the current business environment in Peninsular Malaysia does not support the adoption of renewable energy technology, and thus, renewable energy technology is not commercially viable in Peninsular Malaysia. Additionally, the population of Peninsular Malaysia associates the use of renewable energy with a high level of effort and therefore has a negative attitude towards the use of renewable energy technology. There is, therefore, a definite need to pay more attention to the role of public perception and awareness in the successes and failures of renewable energy policy.

1. Introduction

Research has indicated that the threat from global warming and climate change has increased and requires more attention (Saboori et al., 2012). The Intergovernmental Panel on Climate Change (IPCC) stated that total anthropogenic greenhouse gas (GHG) emissions continued to increase between 1970 and 2010, with larger absolute decadal increases towards the end of this period. Despite a growing number of climate change mitigation policies, annual GHG emissions grew, on average, by 1.0 Gt carbon dioxide equivalents (GtCO2eq) (2.2%) per year from 2000 to 2010, compared with 0.4 GtCO2eq (1.3%) per year from 1970 to 2000 (IPCC, 2014). The IPCC also reported a possible increase in global temperatures from 1.1 °C to 6.4 °C and a rise in sea levels from 16.5 cm to 53.8 cm by 2100 (IPCC, 2007).

As a country in Southeast Asia, the climate in Malaysia shows the same trends as those encountered globally (Bindoff et al., 2007; Trenberth, 2009). According to MOSTE (2000), the country's temperature has increased by 0.18 °C per decade for over 40 years. The UTM (2007) also reported a sea level rise of approximately 1.25 mm at a southern coastal site in Peninsular Malaysia since 1986. The rate of increase in carbon emissions in Malaysia is also one of the highest in the world: Malaysia ranks as the third highest worldwide, with an average annual growth of 4.7% from 1970 to 2008 (Klugman, 2011). The "business as usual" scenario (i.e., the continuation of the current trend) projects that, without additional mitigation measures, 285.73 million tonnes of CO_2 will be released in Malaysia in 2020, which is a 68.86% increase compared with the amount of CO_2 emitted in the year 2000 (Safaai

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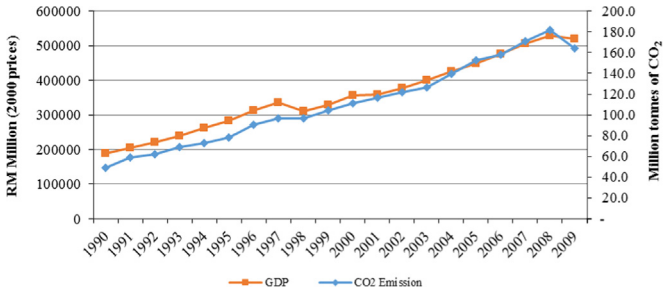

Fig. 1. CO_2 emissions and GDP trends in Malaysia. Source: NEB (2010).

et al., 2011). The trends in total CO_2 emissions and gross domestic product (GDP) in Malaysia are presented in Fig. 1. This figure shows that the increase in total domestic output is correlated with an increase in carbon emissions.

In addition, Malaysia, like other countries around the world, strongly depends on non-renewable energy sources, which has increased economic policy makers concern over the reserves of these resources and their global price fluctuations.

It is important to note that the total energy demand in Malaysia grew at an average annual growth rate of 6.6%, from about 5114 ktoe (kilotonnes of oil equivalents) in 1980 to 41,476 ktoe in 2010. Fig. 2 illustrates the annual growth rate of the total energy demand in Malaysia for 1980–2010.

It is worthwhile to acknowledge the important role that energy has had in the attainment of Malaysia's development targets. An early benchmark was the establishment in 1974 of the Petroliam Nasional Berhad (PETRONAS) as the national oil company. The formation of PETRONAS was the first policy that really impacted the industry (Oh et al., 2010). In 1979, the National Energy Policy was launched, and this policy identified priorities and objectives for energy issues and aimed to minimize any negative environmental impacts in the energy supply chain (Othman et al., 2009). One year later in 1980, the National Depletion Policy (NDP) was introduced to guard against the over exploitation and depletion of oil and gas resources (EPU, 1981). During the Fourth Malaysian Plan (1981–1985), a four fuel diversification policy was designed to assist in fuel diversification and alleviate the country's dependence on oil; with this policy, increased emphasis was placed on oil, gas, coal, and hydro (NEDO, 2004). The 1990s began with the announcement of Vision 2020, which contemplates that Malaysia will be a developed and industrialized nation by 2020. The government emphasized that "every member of Malaysian society should have access to high-quality, secure electrical power and other convenient forms of energy supplied in a sustainable manner by the year 2020" (Poh and Kong, 2002). The new century and the second decade of Vision 2020 started with the introduction of the Third Outline Perspective Plan (OPP3), which focused on building a resilient and competitive nation. Within this framework and to provide adequate and sustainable energy and reduce the emissions of greenhouse gases, in 2001, the government of

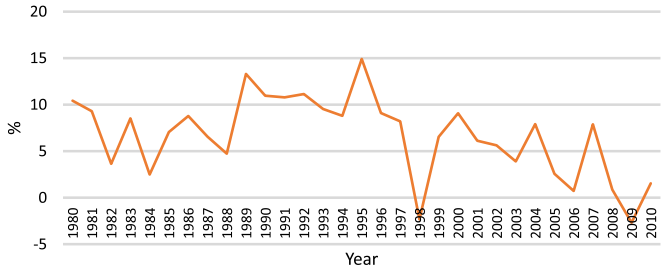

Fig. 2. Annual growth rate of the total energy demand in Malaysia (1980–2010). Source: Malaysia Energy information HUB (2015), http://meih.st.gov.my/statistics.

Table 1
Total realizable potential for renewable energy; share of ASEAN countries. Source: Ölz and Beerepoot (2010).

Country	Renewable energy potential per capita
Malaysia	4.73
Vietnam	2.18
Thailand	1.85
Indonesia	1.57
Singapore	0.73

Malaysia broadened the country's four fuel energy policy, which focused on oil, gas, coal, and hydro resources, by adding renewable energy as the fifth fuel.

Among the members of the Association of Southeast Asian Nations (ASEAN), Malaysia is a country that is gifted with abundant renewable energy potential (see Table 1), which is defined as energy "that comes from resources which are continually replenished by nature such as sunlight, wind, rain, geothermal heat, biomass, waves and tides" (Chang et al., 2003). Renewable energy technologies include technologies that use—or enable the use of—one or more renewable energy sources. It is important to note that there is significant realizable potential for renewable resources in Malaysia (Chua et al., 2011). The main indigenous renewable energy sources include (1) palm oil biomass wastes, (2) hydropower, (3) solar power, (4) solid waste and landfill gas, and (5) wind energy. Among these resources, hydropower is suitable for both small- (mini-hydro) and large-scale applications. Solar photovoltaic (PV) power is suitable for use in small-scale applications and at the household level. Biomass developments have been established and proven cost-effective, particularly at large scales and in industrial applications (Haris and Ding, 2009). Table 2 summarizes the estimated renewable energy potential in Malaysia.

It should also be noted that Malaysia has the highest renewable electricity potential compared to its share of the ASEAN population (Ölz and Beerepoot, 2010).

The Fifth Fuel Policy was launched during the 8th Malaysian Plan (2001–2005), and the government set itself a target of obtaining 5% of its energy from renewable sources by 2005. However, this policy ended up reaching only 0.3% of the target by the year 2005 (Muhammad-Sukki et al., 2011). The same target of 5% renewable energy was again set in the 9th Malaysia Plan (2006–2010).

Under the 8th and 9th Malaysian plans, the Malaysian government took several steps to explore and promote the use of renewable energy as an alternative fuel source (see Table 3). In this regard, more than 800 million USD were invested in new renewable energy production (Ölz and Beerepoot, 2010). Nonetheless, the renewable energy goals under the 8th and 9th Malaysian plans were not achieved, and so far, only 8.3% of the target has been reached (Maulud and Saidi, 2012).

Even though the target for Peninsular Malaysia is 300 MW, and that for Sabah and Sarawak is 50 MW, only 56.7 MW of energy in Malaysia is produced from renewable energy sources (Hashim and

Table 2
Renewable energy potential in Malaysia. Source: Oh et al. (2010).

Renewable energy	Potential (MW)
Hydropower	22,000
Mini-hydro	500
Biomass–biogas	1300
Municipal solid waste	400
Solar PV	6500