Highlighting Innovation Policies and Sustainable Growth in Malaysia

Hussain Ali Bekhet and Nurul Wahilah Abdul Latif

***Abstract*—Malaysia has grown tremendously over the past few decades because of its transformation from being predominantly agriculture-based in the 1970s to being manufacturing-based and modern services-based in the mid-1980s and 1990s, respectively. These achievements are attributable to the 10 Malaysia Plans covering 1966-1970 through 2011-2015. Presently, Malaysia is in the midst of a transformation phase to become an innovation-driven country in the fast-changing global environment. Therefore, understanding sources of growth patterns is indeed important to ensure that Malaysia's development is on the right path. Thus, this paper emphasises the importance of innovation and its framework, which comprises three components: technological innovation, financial innovation and electricity sector (TFE). Furthermore, this study aims to highlight the innovation policies and strategy choices in Malaysia. It is apparent that well-planned strategies and relevant policies must be supported by all institutions and parties. It is hoped that a clear picture of innovation issues, policies and strategies can shed light on the progress of innovation in Malaysia.**

***Index Terms*—Electricity consumption, financial innovation, innovation factors, technological innovation.**

I. Introduction

The need to understand sources of growth has become imperative to explain world economic growth patterns [1]. Growth can be attributable to fundamental forces like increases in the factors of production, improvements in efficiency of allocating the factors of production and the rate of innovation [2]. Innovation consists of any kind of creation or diffusion of new products and any significant contribution to the production process or method [3], [4]. It also provides new businesses, new productions, new opportunities and new jobs. In addition, it is more productive, more resistant, more flexible and more adaptable to change, which may put off diminishing returns [5], [6] and at the same time enable support for a higher living standard [7]. Thus, innovation can allow countries to grow consistently at a sustained rate.

Recently, there has been growing awareness among all countries and policy makers, including Malaysia, regarding innovation, as it is the key driver of long-term economic growth [8]-[10]. The rising concerns about innovation issues have focused on the question of instability of a country's growth trend and how this indicator of innovation can sustain the growth trend for the long term. Past studies [11]-[15] have revealed a significant nexus between innovation and economic growth which confirms that innovation is of key importance for sustainable growth. The growing interest in innovation is the result of economies experiencing the limits of traditional input factors (capital and labour) to uphold productivity and growth in the long run [16]. It is important to understand that innovation, productivity and efficiency are related to each other. Innovation raises productivity through new or improved processes, technologies and business models [17], whilst productivity refers to total factor productivity (TFP) (producing more output), which is determined by efficiency in producing the product (with less input) [18].

Innovation has broad meaning, perspective and measurement and the definition of innovation has changed impressively over time [3], [19], [20]. Innovation is the most difficult part of the growth model in terms of measurement and materialisation [10]. The idea of innovation encompasses not only technology innovation, but also services and infrastructure such as financial sectors and electricity. These support systems (financial sector and electricity) provide an efficient foundation and are included in an integrated platform [21]. According to [1], an adequate description of the economic system must cover resources, energy flows and money flows. Reference [22] stated that financial sector development plays an important role to promote and support technological innovation and economic development in the country. The key ideas of financial innovation are to establish efficient institutions, operate self-sufficiently, be more flexible and support customer needs [21]. Furthermore, [23] suggested that the government should focus on electricity infrastructure and encourage technology innovation to ensure a sufficient electricity supply for the country's development. Therefore, these indicators (i.e. technological innovation, financial innovation and electricity) are discussed in detail (see Section III).

In this fast-changing global environment, appropriate policies are important to ensure improvement of innovation and sustain long-term economic growth [24]. Thus, these issues have become an important agenda of policy makers in both developed countries [25], [26] and developing countries [27]-[30]. Therefore, a need exists to promote and strengthen development in developing countries through innovation. The extant literature has suggested that the rate of innovation has lagged behind in several developing countries [31]-[34]. Furthermore, [35] argued that developing countries should encourage innovation by developing technological, social

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and financial innovation.

A country that has either advanced technology or the capability to produce innovative products or high absorption capabilities [10], [36], [37] has an advantage. Based on Global Innovation Index (GII) rankings, Switzerland, Sweden, the United Kingdom (UK), the United States (US), Finland and Singapore are ranked as the most innovative countries in the world [38]. This achievement is attributable to continuous investment and effort towards innovation quality.

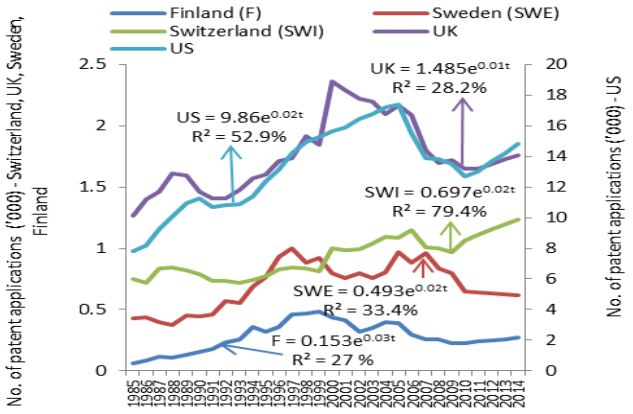

Fig. 1. No. of patent applications ('000) – GII the most innovative countries [39].

Fig. 1 shows that the number of patents of five leading GII countries grew at a moderate rate due to enhancement in innovation quality in these countries. The number of patents grew at a moderate pace of 3%, 2%, 2%, 2% and 1% for Finland, Sweden, Switzerland, the US and the UK, respectively, for the 1985-2014 period.

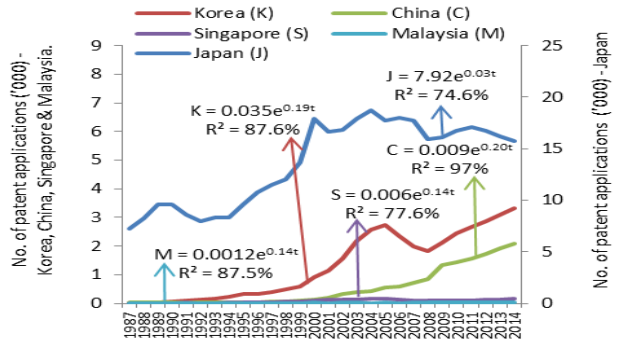

Fig. 2. No. of patent applications ('000) – Korea, Japan, China, Singapore and Malaysia [39].

Meanwhile, Asia Pacific countries have improved their competitiveness in recent years and emerged as the fastest growing region [38]. Singapore leads the GII ranking in the region at 6th, followed by the Republic of Korea (11th), Hong Kong (China) (14th) and Japan (16th). Accordingly, the ranking among upper middle-income economies is led by China (25th), followed by Malaysia (35th) and Thailand (52nd). Fig. 2 shows that China's number of patents grew at the fast rate of 20% per year from 1987 to 2014, followed by Korea (19%), Singapore (14%), Malaysia (14%) and Japan (3%) during the same period. Furthermore, China leads the middle-income countries in terms of innovation quality (17th place). China's progress reflects the effort the country has made in innovation performance enhancement, especially in quality of universities, number of scientific publications and international patent filings [38].

In Malaysia, innovation has been encouraged by the government since the 5th Malaysia Plan (MP; 1986-1990). The recent 11th MP (2016-2020) discusses the interest in innovation from the Malaysian government, policy makers, institutions, researchers and academicians [17]. In 2000, Malaysia's gross expenditure on research and development (GERD) was 0.5% and increased to 1.26% by 2014 [40]. In 2016, Malaysia was ranked 35th out of 128 countries by GII. Korea and China had allocated a greater amount of gross domestic product (GDP) to research and development than Malaysia.

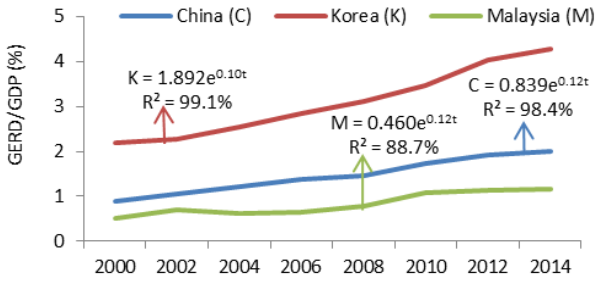

Fig. 3. The R&D intensity for Korea, China and Malaysia [39], [40].

Korea's GERD increased from 2.18% in 2000 to 4.29% in 2014, whilst China's GERD improved from 0.9% in 2000 to 2% in 2014 (Fig. 3). GERD grew at the fast rate of 12% per year for Malaysia, as compared to Korea (10%). This means that Malaysia as a developing country has ample opportunities to shift paradigm in terms of innovation to accelerate sustainable growth. In Malaysia, progressive transformation is aiming to focus on innovation growth and moving towards vision 2020.

References [20], [41], [42] highlighted the rising innovation concerns in Malaysia, such as the innovation rate lagging behind and even innovations being slow to materialise and heavily dependent on technology transfer from other countries. Reference [43] suggested that the best alternative approach for the country to keep growing is to continuously expand innovation. This is because innovation in the form of ideas creates value, which provides opportunities of new jobs, production and techniques, among other benefits [44]. Therefore, even though innovation has a broad perspective and is difficult to measure, it is by far the best solution for the country to achieve sustainable growth [10]. Fig. 4 shows that the Malaysian economy is still reliant on capital and labour instead of multifactor inputs, which contributed about 70% of GDP growth. It also shows that the growth rate of capital was 2.4% and 2.6% in the 7th MP (1996-2000) and 10th MP (2011-2015), respectively. The growth rate of labour was 1.2% in the 7th MP and dropped about 0.1% to 1.1% in the 10th MP; it is targeted to reduce further to 0.9% in the 11th MP. These inputs (capital and labour) are necessary for production, but multifactor productivity (MFP) such as technological innovation is rather important to ensure that the country will achieve sustainable growth. This is because the use of capital and labour, even though increasing, did at one point reach diminishing returns in production [45].

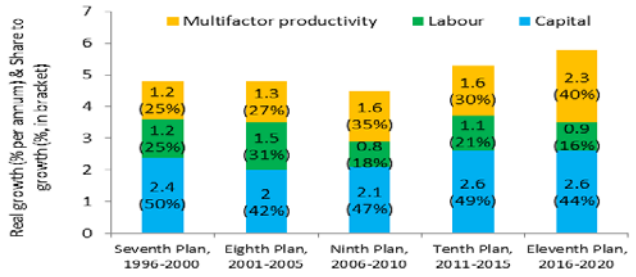

Fig. 4. Malaysia's sources of growth, (2010=100) [17].

The 11th MP is targeted to increase MFP, whilst reducing capital and labour as compared to previous Malaysia Plans (Fig. 4). MFP to GDP growth is targeted to increase to 40%, whereas capital and labour are likely to drop to 44% and 16%, respectively. The Malaysian government has emphasised multifactor productivity input up to 2.3% in the 11th MP, with clear outcomes at all levels (national, industry and enterprise) [17]. Therefore, it is a great challenge for the government to formulate suitable strategies to uplift the innovation rate and further to ensure the effectiveness of innovation implementation.

Based on the above discussion, this study aims to provide insights into innovation progress and the importance of the innovation rate to attain sustainable growth in Malaysia. Furthermore, it reviews Malaysia's development, technological progress, financial development and electricity consumption. This study also aims to highlight the technological innovation, financial innovation and electricity consumption policies and strategies adopted in Malaysia.

The rest of the paper is organised as follows. Section II reviews Malaysia's development, technological progress, financial development and electricity consumption. Section III discusses the policies of technology innovation, financial innovation and electricity consumption in Malaysia and, finally, policy implications and conclusions are presented in Section IV.

II. Overview of Malaysia Economy

A. Malaysia Development

Malaysia has experienced tremendous achievements for the last few decades despite several challenges. The country's economy has transformed from an agriculture- and mining-based economy in the 1970s to being manufacturing-based and later to modern services in the mid-1980s and 1990s, respectively [46]-[49]. This remarkable achievement is due to consecutively planned government policies and strategies [1st MP (1966-1970) to 11th MP (2016-2020), and much further, to the New Economic Policy (NEP) [1971-1990], National Development Policy (NDP) [1991-2000], National Vision Policy (NVP) [2001-2010] and National Transformation Policy (NTP) [2011-2020] [50] supported by the New Economic Policy (NEM), Economic Transformation Programme (ETP) and Government Transformation Programme (GTP), as well as the Malaysian National Development Strategy (MyNDS).

The Malaysian economy experienced a stable GDP growth rate of 5.8% per year from 1980 to 2015 (Fig. 5). This was due to higher domestic demand and private sector expenditures during the period and GDP is targeted to grow to 5%-6% during the 11th MP (2016-2020). In addition, the Malaysian economy experienced a tremendous transition development process from a low-income country in the 1970s to a high middle-income country in 1992, but this has remained deliberate since 1997 due to Asian financial crisis (AFC) [1997-1998] [51].

Meanwhile, the growth rate of Malaysia's population has been 2.3% per annum since 1980. Its population rose from 14 million people in 1980 to 30.5 million people in 2015 (Fig. 5). This likely shows that population growth in the country is associated with the GDP growth trend, which is targeted to reach 32.4 million in next five years [52]. In general, rapid economic growth must be accompanied by growing populations, which, in turn, increase the supply of workers and consumers [53].

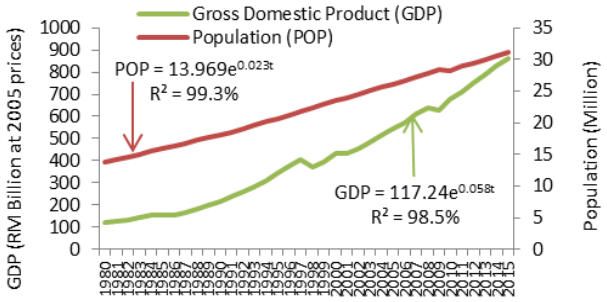

Fig. 5. Time trend of GDP and population for the (1980-2015) period [54].

It is essential to have well-structured and efficient infrastructure to drive economic development [55]. In Malaysia, domestic investment has increased tremendously at an average annual growth rate of 7% per year for 1990-2014 (Fig. 6). Large investments have been made in transport, digital and energy infrastructure due to rising demand from the society and all sectors [17]. Necessary infrastructure, like roads, railways, water and electricity, was expanded to reach all communities. Currently, the government is in the midst of planning a strategic development framework (SDF) for the high-speed rail (HSR) project linking Kuala Lumpur and Singapore [56]; this project outlines the direction of socio-economic development.

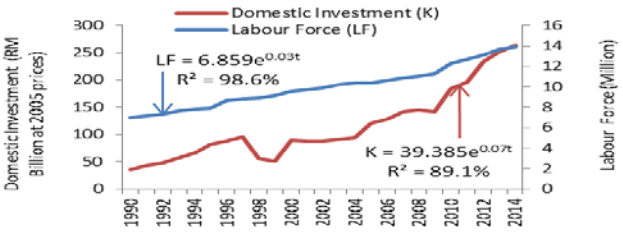

Fig. 6. Domestic investment and Malaysia labour force for the (1990-2014) period [52].

Meanwhile, labour (human capital) plays a significant role in absorbing knowledge and technology know-how to boost economic growth [57], [58]. Malaysia's labour force has steadily increased from 7 million in 1990 to approximately 14 million in 2015 [52] with an average annual growth rate of 3% between 1990 and 2014 (Fig. 6). Capital and labour share the same growth trend, but the labour growth trend is more

stable than the capital trend during economic shocks. Furthermore, [17] recognised that skilled workers, who include managers, professionals, technicians and associate professionals, accounted for 28% of total employment in Malaysia; this group is targeted to account for up to 35% for the next five years to become high-value-added industries towards vision 2020.

According to [59], [60], trade openness and foreign direct investment (FDI) provide strong impetus for economic development. Both facilitate technology transfer, provide access to foreign markets and stimulate innovations. Malaysia has a good performance in trade openness (i.e. export and import). Malaysia's exports and imports have grown strongly, both at the rate of 12% for the 1970 to 2015 period (Fig. 7). In 2014, export and import are approximately RM771 billion and RM676 billion, respectively, and are estimated to increase up to RM875 billion and RM784 billion, respectively, in 2020 [17].

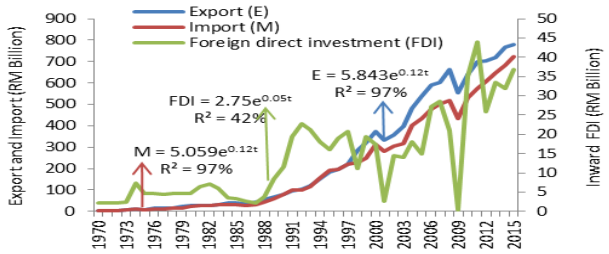

Fig. 7. Time trend of export, import and inward FDI for the (1970-2015) period [52], [61].

Furthermore, the Malaysian government has developed an important and strategic strategy to accelerate economic growth by attracting FDI throughout the period. Trade and liberalisation of FDI were important strategies behind Malaysia's successful achievement throughout these years. These strategies improved the manufacturing sector, specifically the electronic and electrical sectors [62]. The inflow of FDI from other countries benefited Malaysia as it brought better technology know-how [63]. Also, Fig. 7 shows that FDI grew at a moderate rate of 5% per year during 1970 to 2015. FDI remained an important source of investment as [17] recorded that the total amount of FDI inflow in Malaysia was RM35 billion in 2015. In addition, the government launched the ETP with the aim of attracting investment into Malaysia.

B. Technological Progress

Innovation has a variety of proxy measurements. Among the commonly used parameters are patents and research and development, which represent output and input indicators, respectively [11], [64], [65]. Patents are considered an informative indicator to show technological efforts of the country [20]. In view of the significant role of patents in promoting innovation, the Intellectual Property Cooperation of Malaysia (MyIPO) was established in 2003 [66]. Fig. 8 shows that total number of patent applications grew steadily at 14% per year during 1988-2014. Overall, it shows that the patent indicator has been in an upward trend since 1988 in Malaysia. In addition, scientific and technical journal articles (STJAs) and trademark applications can represent technological innovation as well. STJA shows how human capital can engage the knowledge gained to create value and innovation, make a profit and thus make the economy more competitive. Fig. 8 shows that scientific and technical journal articles and trademark applications grew moderately at an average rate of 19% and 6%, respectively, during 1986 to 2014. The scientific and technical journal articles and trademark applications show an upward trend throughout the above period.

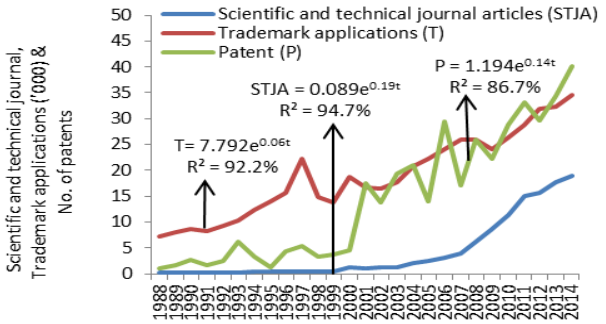

Fig. 8. Number of patents, trademark applications and scientific and technical journal articles for the (1986-2014) period [7], [61].

According to [67], the GERD anticipated by the government has a significant impact on long-term economic growth. The higher the GERD anticipated from the government, the greater the investment in new ideas, innovation and invention, which indeed will benefit the country. However, innovation involves the expenditure of time and money and the imposition of risk to achieve the awaited breakthrough which has a significant positive impact on TFP [68]. The research and development (R&D) intensity is the percentage of gross expenditures for research and development to gross domestic product (GERD/GDP). Fig. 9 shows the gross GERD/GDP, which grew at 13.5% per year for 1992-2014. In 2014, it was increased to 1.26%, as compared to 2000, when it was at only 0.5% [41]. Thus, one can see an upward trend of the GERD/GDP proxy moving slowly during the aforesaid period.

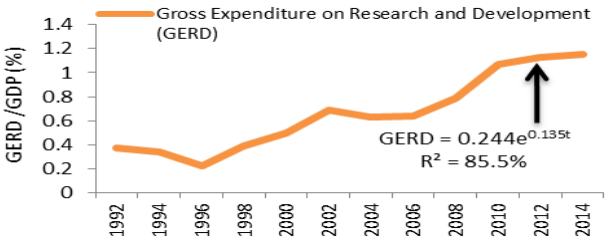

Fig. 9. The R&D intensity [40].

C. Financial Development

The financial sector acts as an intermediary for the flow of funds in the economy. The efficiency of the financial sector is essential to ease capital accumulation, offers saving and investment mobility [69], [70] and helps to finance tangible and intangible investments, thus enabling innovation [22]. Lack of credit availability may affect the resource allocation and further reduce investment [71]-[74]. As innovation needs a significant amount of investment, financial innovation is indeed important to enable the fast transaction needed. This study considers M2 [narrow money (M1), savings deposits, small denomination time deposits], M3 (M2 plus large time

deposits) and domestic credit to private data to represent the banking sector, whilst market capitalisation (MC) and stock traded (ST) represent the stock market to measure financial development [75]. The money supply in the economy is proxied by money and quasi-money (M2) and the volume of the financial sector is indicated by M3. Fig. 10 shows that the broad money of M2 and M3 grew steadily at 10.6% and 8.6%, respectively, for the 1997-2015 period.

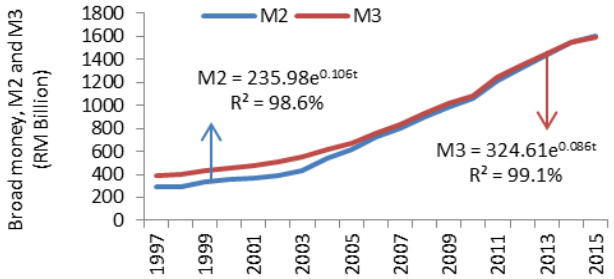

Fig. 10. Broad money, M2 & M3 for the (1980-2015) period [76].

Domestic credit to private sector (DCPS) is loans and non-equity securities provided to the private sector by financial institutions. The private sectors have the opportunity to develop and grow by using facilities provided by financial institutions, which indeed has an impact on the economy of the country as a whole. In Malaysia, the DCPS has grown steadily at 8% per year (Fig. 11) and shows significant movement for the (1981-2015) period.

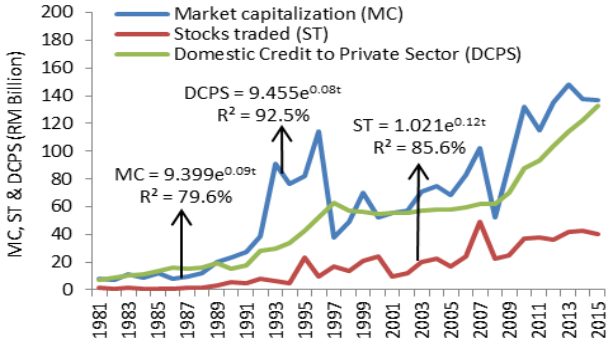

Fig. 11. Domestic credit to private sector, Market capitalization & Stock traded for the (1981-2015) period [61], [39].

Meanwhile, MC is the total market value of a company's outstanding shares, which shows the size of the company. An understanding of company size is important to investors to derive a basic determinant of various characteristics of the company, including risk. Fig. 11 shows that MC has an upward trend throughout the years, growing gradually at 9%, whilst ST grew at 12% for the 1981-2015 (period). Also, ST illustrates profitability in the stock markets in Malaysia [75]. Developing countries such as Malaysia need a strong and deepening financial sector to increase productivity and sustain economic growth [76]. Reference [77] highlighted that the advancement of the financial sector is essential in Malaysia to attract investment. Thus, analysing the financial innovation contribution over the long run is crucial to sustain long-term economic growth.

D. Electricity Sector

The electricity sector has developed considerably in the last few decades [78], [79]. This rapid growth is due to the nation's economic activities, especially the industrial and commercial sectors [80].

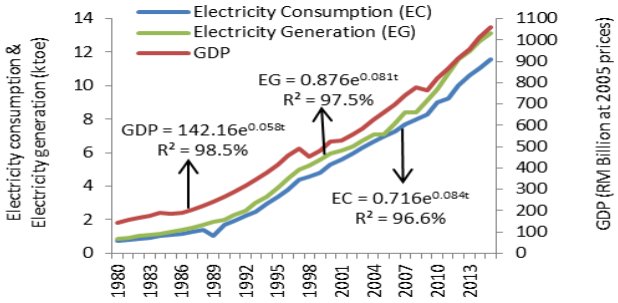

Fig. 12. Time trend of electricity consumption and electricity generation (ktoe, '000) & GDP (2005=100) for the (1980-2015) period [80].

Upward trends in economic growth, population and lifestyle in Malaysia have a significant impact on electricity consumption as well [81], [82]. Past research has frequently discussed the importance of electricity as compared to other forms of energy because electricity involves cleaner and safer energy sources [83]-[86].

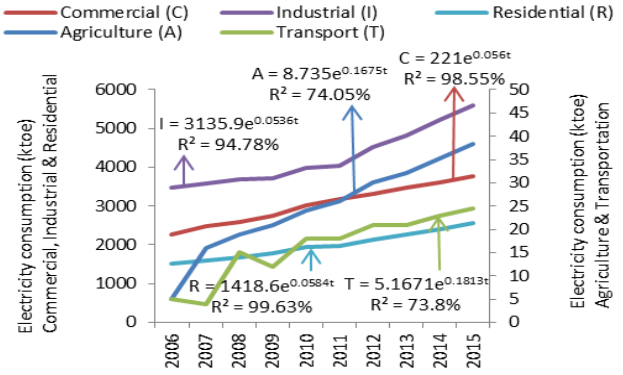

Fig. 13. Time trend of final electricity consumption (ktoe) by sectors for the (2006-2015) period [54].

In Malaysia, to date, 97.6% of all sectors and communities have access to electricity [17]. Electricity consumption (EC), electricity generation (EG) and GDP follow the same direction in path movement (Fig. 12), which is likely to continue in the future. The EC grew steadily at 8.4%, whilst EG and GDP grew gradually at 8.1% and 5.8%, respectively, for the 1980-2015 period.

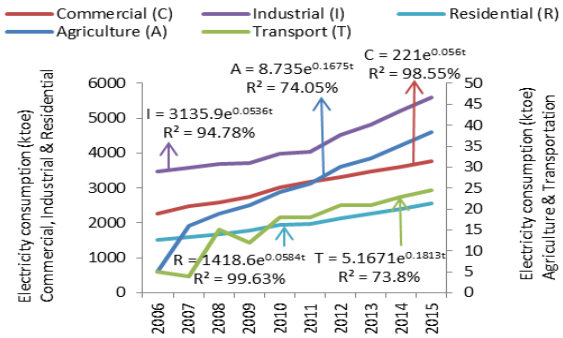

Fig. 13. Time trend of final electricity consumption (ktoe) by sectors for the (2006-2015) period [54].

To date, the industrial sector has been the biggest electricity user, consuming about 4,809 ktoe (refer to Fig. 13). The second biggest electricity user has been the commercial

sector, at around 3,466 ktoe, followed by the residential sector at 2,262 ktoe, the agriculture sector at 32 ktoe and the transportation sector at 21 ktoe [54]. The growth rate in electricity demand and supply must be manageable in terms of sustainability, affordability and alternative electricity resources like renewable energy (RE) technologies to ensure the competitiveness of the Malaysian economy in the future [87], [88]. In this regard, sound energy policies must be supported by clear implementation and proper strategies to achieve continuous sustainable development in Malaysia.

III. Malaysian Innovation Policies and Electricity Consumption

A. Technological Innovation Policies

In Malaysia, the issues of the innovation rate lagging behind, innovations being slow to materialise and sustainable growth have led to rising concerns about technological innovation [20], [41], [42]. In Malaysia, the policy makers have formulated and introduced various technological innovation strategies and policies to ensure the effectiveness of technological innovation. In the mid-1980s, the government's efforts to enhance the country's science and technology were started. In general, technological innovation policies are grouped into two major policies: National Science, Technology and Innovation Policy 1 (NSTIP1) and National Science, Technology and Innovation Policy 2 (NSTIP2).

In 1986, Malaysia formulated the first NSTIP1 with the purpose of outlining a framework for science and technology development. The aim was to ensure the continuous achievement of science and technology development. The policy was incorporated into the 5th Malaysia Plan (1986-1990) [89]. In 1987, implementation of the Intensification of Research in Priority Areas (IRPA) strategy and mechanisms were initiated with the aim to ensure the quality of R&D activities in the public sector. Furthermore, the National Council for Scientific Research and Development (NCSRD) was re-formed and a Cabinet Committee on Science and Technology (S&T) was established. In 1990, the National Action Plan for Industrial Technology Development (APITD) was intended to overcome the weaknesses Malaysia faced related to national industrial development capability to move forward [90]. The main objectives were to strengthen the role of science and technology, technology capabilities of local industries and Malaysian society as a whole. The APITD provides various strategies and programmes to enhance the adopting process of technologies and market-driven R&D. In the plan period, the government launched the Industrial Technical Assistant Fund (ITAF) to provide funds specifically to the technical industry with the aim of enhancing product development and encouraging private sector involvement in research and technology development. Nevertheless, during the NSTIP1 and APTID periods, the Malaysian government faced a significant challenge in terms of incapability to commercialise R&D and lack of techno-entrepreneurs.

Furthermore, the important issues of scientific and technological capabilities were further addressed under the 5th Malaysia Plan to ensure continuous improvement and close monitoring by the government. Under the 6th MP (1991-1995), further development of S&T were made by providing basic infrastructure, including incentives and supporting services, among others. During this phase, automated manufacturing technology (AMT) was identified as one of the key technology areas. AMT is the application of advanced techniques of management, technical methods and methodologies to enhance the quality, speed and flexibility of the manufacturing environment. Among others are computer-aided design (CAD), computer-aided manufacturing (CAM) and computerised numerical control (CNC). In 1992, the Malaysian Technology Development Corporation (MTDC) was established as a joint public-private technology venture capital company to facilitate the commercialisation of public research findings [91]. Meanwhile, the Malaysian Industry-Government Group for High Technology (MIGHT) organises sector- and technology-specific interest groups to study technology developments and identify business opportunities.

Under the 7th MP (1996-2000), the NCSRD, under the chairmanship of the chief secretary to the government, was re-formed and restructured. In 1996, the Malaysian government announced the industrial technology policy incentive for the establishment of a multimedia super corridor (MSC), which was a special development zone, intended to attract investments in multimedia software development. The area included the new federal administrative centre at Putrajaya, the new Kuala Lumpur International Airport at Sepang and a new high-tech city, Cyberjaya. In the period plan, three new schemes were funded to enhance private sector R&D. These schemes included the Industrial Research and Development Grant Scheme (IGS), MSC Research and Development Grant Scheme (MGS) and Demonstrator Applications Grant Scheme (DAGS). Furthermore, all the budgetary allocation was centralised at the Ministry of Science, Technology and Environment (MOSTE) to ensure coordination in R&D activities and optimum utilisation of research resources. In 1999, the Malaysia-Massachusetts Institute of Technology (MIT) Biotechnology Partnership Programme (MMBPP) was launched to build a foundation for development of a sustainable biotechnology industry. The aim is to develop high-value-added palm oil products and herbal-based natural products. During this phase, the National Technology Mapping Programme 1 was initiated to identify long-term technology development targets. In 1997, the Commercialisation of Research and Development Fund (CRDF) was launched with an allocation of RM100 million.

Under the 8th MP (2001-2005), the S&T development focused on productivity-driven growth and competitiveness of the economy. The National Technology Mapping Programme Phase II was commenced to increase the domestic capabilities, international and domestic benchmarking by reviewing Malaysia's technology level and future directions. In 2003, the MyIPO was established, raising the need to strengthen the patent registration and management system. During this period, technology incubation was highlighted to create and nurture the new technology-based enterprises. In this regard, technology

incubator programmes were implemented by the Scientific and Industrial Research Institute of Malaysia (SIRIM) Berhad, Technology Park Malaysia (TPM), MTDC, Multimedia Development Corporation (MDC), Kulim Hi-Tech Park and several institutions of higher education, such as Universiti Sains Malaysia (USM) and Universiti Technology Malaysia (UTM), to commercialise their R&D output.

Under the 9th MP (2006-2010), the Biotechnology R&D Grant Scheme was introduced. The Scientific Advancement Grant Allocation (SAGA) was introduced as well to enable promising researchers at institutions of higher education to work on basic research for capacity building and knowledge advancement in fundamental sciences. Furthermore, the Technology Acquisition Fund (TAF) was introduced to provide assistance to companies to acquire strategic foreign technologies for further value creation. The Malaysia Intellectual Property Association's (MIPA's) role, which is under the Ministry of Domestic Trade and Consumer Affairs (MDTCA), was administered by the Patents Act 1983, Trade Marks Act 1976 and Copyright Act 1987 [20]. In 2006, Malaysia joined the Patent Cooperation Treaty (PCT) and become a party to the Nice Agreement and Vienna Agreement to improve the legal commitments for intellectual property (IP). Malaysia also amended the Trade Marks Act 1976 to meet the international standard. In 2007, the National Intellectual Property Policy (NIPP) was launched to harness IP as a new source of economic growth. In 2007, the government announced the National Innovation Model to promote an innovation culture and environment for the people.

Under the 10th MP (2011-2015), the Malaysian government announced the NSTIP2 agenda for 2013-2020 to overcome NSTIP1 problems and to redesign the structure. NSTIP2 provides strategic guidelines for science, technology and innovation (STI) policy and investment for Malaysia's transition to become an innovation economy by 2020. The objectives are (1) to increase R&D spending to at least 1.5% of GDP by year 2020 and (2) to achieve a competent work force of at least 60 researchers, scientists and engineers (RSEs) per 10,000 in the labour force. The government afterwards announced the Science for Action to implement the NSTIP2 under the 11th Plan (2016-2020) as one of the key strategic thrusts of Malaysia. The NSTIP2 accentuates the links between the public and private sectors, developing indigenous technology and product development capabilities among local firms.

Under the 11th Malaysia Plan (2016-2020), the government introduced the National Transformation Policy (NTP), which aims to translate innovation into wealth, where integrated research, development, commercialisation and innovation (R&D&C&I) initiatives generate high returns on investment throughout the years and stimulate productivity growth as well. Thus, the government intensified R&D&C&I initiatives to gain long-term advantage. A number of specialised agencies were established to drive innovation programmes, such as Agensi Inovasi Malaysia (AIM), National Science and Research Council (NSRC), Yayasan Inovasi Malaysia (YIM) and higher order thinking skills (HOTS) for schools and tertiary institutions to inculcate a thinking culture. A centralised repository of IP called Khazanah Harta Intelek Malaysia was created to catalyse commercialisation in Malaysia. Intermediaries such as PlaTCOM Ventures Sdn. Bhd. (PlaTCOM) and Steinbeis Malaysia Foundation (Steinbes) were set up to enhance collaboration and provide advisory services between researchers and companies [92].

In the plan period, the government has highlighted the importance of skilled workers by enabling industry-led technical and vocational education training (TVET), with a target that since 60% of the 1.5 million jobs will require TVET-related skills, the annual intake of TVET must increase from 164,000 in 2013 to 225,000 in 2020. An effective and efficient TVET sector is where supply meets demand in terms of quality, where industry and TVET providers must collaborate across the entire value chain, streamlining the system and providing a variety of programmes through it.

Malaysia has made continuous effort in technological innovation since the 5th MP. Diverse policy and strategy were undertaken during the transformation period in the mid-1990s onwards to accelerate innovation progress and sustainable growth. Many ministries have been involved throughout this innovation build-up, and many institutions, parties and programmes have been appointed and arranged during this period through the present.

B. Financial Innovation Policies

The financial sector plays an important role in the mobilisation and allocation of funds to support the growth and development of the economy. In this current era, fast and easy transaction services are indeed important to ensure customer satisfaction and attract potential customers. The Bank Negara Malaysia governor [93] suggested that the current era is all about the 'new real economy', which is likely to be characterised by digital technology innovation with an unprecedented scale, scope and speed. However, financial innovation policy discussions are rather limited in the case of Malaysia.

Under the 5th MP (1986-1990), most of the banking and financial institutions were computerised to better serve their customers. An online book-entry system for government papers and Cagamas bonds and an online interbank funds transfer system were also introduced. Financial sector procedures to harness electronic technology to speed up and increase the efficiency of payments and information transfer were implemented as well. Furthermore, the Society of Worldwide Interbank Financial Telecommunication (SWIFT), an international financial telecommunication system, was also introduced and cheque clearing throughout the country was expedited with the launching of systems called SPAN 1 and SPAN II. The automated teller machine (ATM) network has been expanded rapidly, which permits cash withdrawals, fund transfers, payment of utility bills and electronic fund transfers at the point of sale (EFTPOS). In the plan period, to modernise and streamline the laws relating to the conduct of banking and financial activities, the Banking and Financial Institution Act (BAFIA) 1989 was enacted. The government made serious efforts to develop the Kuala Lumpur Stock Exchange (KLSE) into a sophisticated

international stock exchange. In 1986, the Corporatisation Policy was introduced to strengthen the capital base of the stockbroking companies and enhance the level of professionalism in the securities industries. In 1987, the Advanced Warning and Surveillance Unit (AWAS) were formed with the objective to alert KLSE of stockbroking houses and public listed companies which face problems. To keep up with its modernisation efforts, the Semi-automated Trading System (SCORE) was introduced to fully replace the traditional system. Furthermore, a fixed delivery and settlement system was also introduced to enhance the efficiency of clearing and settlement functions. In addition, another factor that can be described as an innovation product that links to the financial sector is venture capital (VC). VC is type of external financing other than loans, equity and bond financing. VC plays an important role by providing financing in the early stage of start-up companies, when they may have difficulty getting loans from banks. In the 1980s, the Malaysian VC industry started with a fund size of RM13.8 million. Several factors have influenced the development of the VC industry in Malaysia, including limited funding, risk aversion of the VCs, cyclical industry and difficulty of the VC to exit the industry. These factors, to some extent, have contributed to the slow growth of the industry.

Under the 6th MP (1991-1995), the BAFIA was refined to support the government's efforts to foster a modern, efficient and safe and sound banking system. In 1994, the National Payments System Council (NPSC) was established to coordinate the overall development of a comprehensive and efficient national payments system and to provide direction in developing an efficient payments system in Malaysia. During the plan period, a major task was the integration of the various ATM networks into a single shared national ATM network to facilitate implementation of the general interbank recurring order (GIRO) payments system. To further develop the KLSE, the Central Depository System (CDS) was introduced for scrip-less trading to create a more efficient and transparent clearing and settlement system. All the main board and second board counters were placed under CDS, which enabled the KLSE to handle a significantly larger volume of trading. During this period, the rating of all corporate bonds by Rating Agency Malaysia (RAM) was made compulsory for the private debt securities (PDS) market where corporations with good credit standing can obtain greater access to funds at more competitive rates than in the debt market, thus contributing to the overall efficiency of the financial sector.

In 1997, under the 7th MP (1996-2000), the Bond Information and Dissemination System (BIDS) was launched as part of the effort to develop the secondary market for bonds. This system facilitated the efficient pricing of new issues, improved liquidity and widened the market. Furthermore, the Malaysian Exchange of Securities Dealing and Automated Quotation (MESDAQ) was launched. MESDAQ provides an avenue for high-growth and technology companies' access to public funds and venture capitalisation [94]. In 1999, MSC Venture One was established to provide venture capital financing to innovative and emerging information and communication technology (ICT) and multimedia companies. Also, the Real Time Electronics Transfer of Funds and Securities (RENTAS) was launched to improve the overall efficiency of the large payment system with respect to reducing interbank settlement risk. During this period, effort has been made to increase the efficiency of the banking sector through the use of IT and the development of a reliable payment system. The implementation of network-based or Internet-based payment systems was begun in the late 1990s whilst the introduction of mobile-based payment systems began in the mid-2000s.

Under the 8th MP (2001-2005), in November 2003, the Payment System Act 2003 (PSA) was authorised to set out a comprehensive legal and regulatory oversight framework to govern the payment system. The aim of the PSA is to ensure the safety, soundness and efficiency of the payment systems infrastructure and to safeguard the public interest. During this period, several MESDAQ listing requirements for high-growth and technology companies were liberalised, including the requirement that 70% of the listing proceeds be used in Malaysia. In 2005, the first exchange-traded fund, the ASEAN Bond Fund Index, was listed on Bursa Malaysia as an initiative to improve issuance efficiency and product innovation. Furthermore, the Capital Market Development Fund was established to uphold growth and encourage innovation in the capital market.

Under the 9th MP (2006-2010), Bank Negara Malaysia (BNM) implemented the National Electronic Cheque Information Clearing System (eSPICK) to replace the previous cheque-clearing system to enhance the efficiency of the payment system by reducing the daily wait to receive funds from the cheque deposit process. Types of payment systems introduced include the large value payments system (SIPS) and retail payment system [95].

Under the 10th MP (2011-2015), the Mudharabah Innovation Fund (MIF) was set up to provide risk capital to government venture companies. The government was allocated RM500 million to increase access to funding for innovative start-ups. The fund offers an enhanced risk-of-return profile to investors and attracts greater private risk capital [17]. Meanwhile, the Business Growth Fund (BGF) of RM150 million was established to bridge the financing gap between the early stage of commercialisation and venture capital financing for high-tech products. The aim is to help these companies until they generate sufficient commercial value to attract other forms of financing. BNM, together with the private sector, has launched a series of initiatives to move towards e-payment as it is cheaper than paper-based transactions.

C. Electricity Policies

The Malaysian government has introduced various energy policies and programmes to ensure sustainable energy development. In 1949, the Central Electricity Board was formed by the government for electricity generation, transmission and distribution and then renamed as the National Electricity Board in 1965. In 1975, the National Petroleum Policy was formulated to initiate the efficient use of the resource for industrial development and at the same time ensure that the nation exercises majority control in the management and operation of the industry. The major energy policy, formulated in 1979, was called the National Energy

Policy 1979. This policy highlights the three long-term energy objectives and strategies of supply, utilisation and environment [96].

In 1980 and 1981, the National Depletion Policy and the Four Fuel Diversification Policy (4FDP) were introduced to ensure the reliability and security of the energy supply. The aim was to reduce the country's over-dependence on oil as the main energy resource and to use an optimal mix of oil, gas hydropower and coal in the supply of electricity [79], [97]. The implementation of these policies resulted in a reduction in dependence on oil for the electricity sector whilst the shares of natural gas and coal increased in the electricity generation fuel mix. In 1990, the Electricity Supply Act was formulated to establish the state-owned utility Tenaga Nasional Berhad (TNB) to be peninsular Malaysia's national electricity provider [98].

In 2001, the Five-Fuels Strategy Policy (5FSP) was introduced under the 8th MP (2001-2005) to highlight potential renewable energy (RE) resources for electricity generation (i.e. biomass, biogas, municipal waste, solar and mini hydro). The Small Renewable Energy Power Programme (SREP) was introduced in 2001 to support implementation of the Five-Fuel Policy (5FP). Meanwhile, the Renewable Energy Act was introduced in 2010 to uphold RE projects. The act provides for the establishment and implementation of Feed-in-Tariff (FiT) systems [99].

Furthermore, a few additional policies were introduced to strengthen the initiatives of energy efficiency (EE) and renewable energy (RE), including the National Green Technology Policy (2009) and the National Policy on Climate Change (2010) [100]. The National Green Technology Policy has five objectives and only one is related to the energy sector, which is to reduce energy consumption while increasing economic growth. Meanwhile, the National Policy on Climate Change put forward the role of energy efficiency in both the demand and supply sectors. The EE initiatives have been undertaken in three sectors (i.e. industry, commercial and residential). In the industry sector, the Efficient Management of Electrical Energy Regulations 2008 were introduced under the Electricity Supply Act. Any installation which consumes more than 3 million units (kWh) of electricity over a period of six months will get the benefit of efficient utilisation of energy in the installation.

In the commercial sector, the government has taken a pre-emptive approach to promote EE through green building, such as the Low Energy Office (LEO), Ministry of Energy, Green Technology and Water in 2004 and the Green Energy Office (GEO) of Malaysia Green Technology Corporation (MGTC) in 2008. To encourage the construction of green buildings in Malaysia, the Green Building Index (GBI) has been introduced for all types of building. Meanwhile, star labelling was introduced for the residential sector in 2002 as a part of the EE initiatives [50], where household appliances are labelled from the most efficient (5 stars) to the least efficient (1 star).

IV. Policy Implications and Conclusions

Malaysia is in a transformation period of becoming a high-value, knowledge-based economy and innovation-driven country to achieve sustainable growth. Malaysia has continuously undertaken appropriate actions, formulating policies and programmes to highlight the importance of science and technology innovation in Malaysia. The initiative can be observed since the launching of NSTIP1 in 1986, more obviously in the mid-1990s and further during the transformation period towards vision 2020. The government has raised the issue of the innovation rate lagging behind and innovations being slow to materialise in regards to achieving sustainable growth [17], [20], [41], [42]. Malaysia faces several challenges that need to be highlighted and considered to increase innovation progress and capability.

Reference [17] recorded that Malaysia's productivity lagged behind due to the low contribution of MFP and showed that MFP real growth was 1.6% for both the 10th MP and 11th MP, whilst it was just 1.3% in the 9th MP. Reference [17] documented that Malaysia's GERD is considered quite small at about 1.26% in 2014 and targeted to increase up to 2.3% in the 11th MP. Furthermore, Malaysia had a labour force of about 14 million in 2015; however, skilled workers accounted for only 28% of total employment. This is targeted to reach up to 35% for the next five years so as to become high-value-added industries. Reference [46] revealed that due to the lack of indigenous firms exporting their own products, Malaysia's industrialisation is limited to final producer goods, with the majority of manufacturing industries being foreign owned.

Many initiatives have been undertaken by the Malaysian government, but little has been achieved. Hence, an urgent need exists for the Malaysian government to take further actions by collaborating with global players [20]. Malaysia should take advantage of external opportunities such as those offered by the Association of Southeast Asian Nations (ASEAN) Economic Community (AEC) and China's "one belt one road" (OBOR) plans that may benefit Malaysia as new impetus to achieve sustainable growth and development [101]. Accordingly, government efforts to create a strategic development framework (SDF) for the high-speed rail (HSR) project, linking Kuala Lumpur and Singapore is a first step towards this collaboration.

Furthermore, the implementation of these initiatives must be checked thoroughly, so that it reaches all the parties in the economy. The tremendous improvement in South Korean innovation is due to the appropriate role played by the South Korean government as an architect of the economy, which made a strategic decision to guide. Thus far, the implementations of any decisions are based on the needs of the industry [102]. It is clear that innovation processes must be supported by a complex set of social institutions with a mix of policies and strategies initiated [10], [92]. Thus, the government plays an important role to monitor the synchronisation and smoothness of all ministries, institutions, parties and the policy mix and strategies throughout this process. Thus, the innovation process may reflect significant progress, slowly yet surely.

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