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Energy efficiency policy in Germany and Malaysia: key driving factors

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Abstract

Energy efficiency is one of the twin pillars of transition towards sustainable energy. Energy efficiency refers to the methods, technologies, and practices, which requires less energy to perform the same function. Energy efficiency not only saves energy but also reduces greenhouse gas emissions and dependence on fossil fuels. Energy-using activities across the world is substantially increasing due to economic development. Economic developments also trigger increase of energy consumption if extra measures are not taken. Energy efficiency can prevent the increase of energy consumption by uncoupling it from economic development. Germany is one of the leading countries in the world with the high-level of energy efficiency. Germany successfully limits the energy consumption growth by implementing a wide range of mechanisms. On the other hand, Malaysia, an emerging economy, sets to improve its energy efficiency by 20% by 2030 comparing to 2005. Despite Malaysia has initiated several policy measures, its current rates of progress in energy efficiency is not enough. This research work examines the energy efficiency policies of both Germany and Malaysia and figure out the major factors which brings about success for Germany. This work found that several policy support tools stimulate the increase of energy efficiency in Germany.

Keywords

Energy efficiency, Policy, Intensity, Incentive, Economic.

1. Introduction

Energy efficiency is one of the twin pillars of the sustainable energy development. Energy efficiency means using of less energy to produce the same services and products or to perform the same task. In other words, energy efficiency refers to the method or technology which requires less energy to perform the same function. Energy efficiency not only saves costs but also reduces greenhouse gas emissions and dependents on imported fuels. Energy efficiency also enables economic growth and improve energy security. Energy efficiency alone can deliver substantial economic, environmental, and social benefits. It is the cleanest, quickest, and most cost-effective way to extend the current energy supply into the future. Energy efficiency also helps to improve the environmental performance of industry and buildings (Saeed Mokhatab and William A.Poe, 2012).

Energy-using activities across the world is significantly increasing driven by economic development and rapid urbanization. Economic developments usually trigger increase of energy consumption if extra measures are not

taken. Energy intensity is an option which can offset or even can reduce this increasing energy consumptions due to economic development (de la Rue du Can et al., 2014). Energy Intensity is the amount of energy required per unit of output or activity. It is calculated as unit of energy consumption per unit of GDP (GJ/USD). Lower energy intensity means higher energy efficiency. Decreasing energy intensity behaves as a proxy for the improvements of energy efficiency provided that energy intensity is represented at an appropriate level (DOE, 2020). Energy efficiency is found to be a major driver for uncoupling energy consumption from economic development.

The energy efficiency also supports to achieve the Sustainable Development Goals (SDGs) set by UN and bring in multiple benefits for economies, households, and the environment. Only right energy efficiency strategy can effectively transform the energy sector to meet economic, environmental, and societal goals. The policies have the significant impact for improving the energy efficiency over the last decades (IEA, 2017). Energy efficiency globally prevented about 12% increase of energy use between 2000 and 2017. The major economies of the world have been successful to offset a one-third of the rise in energy-intensive activities through judicious energy efficiency policy. The appropriate efficiency policies alone can achieve more than 40% of the emissions cuts needed to reach global climate goals without new technology. Projection also shows, global gross domestic product (GDP) will double by 2040, the energy efficiency alone can limit the resulting increase in energy demand (IEA, 2017). Global building spaces in 2040 could be 60% larger than today (in floor area) and energy efficiency would be the main driver to address the increasing demand. Similarly, industrial, and commercial sectors are projected to increase energy-using activities and this need to offset 40% increase through energy efficiency.

Germany is one of the leading countries in the world with the high-level of energy efficiency (Anke Brüggemann, 2018; Weber and Wolff, 2018). Germany has also made a remarkable growth in economic developments in the last decades. This country successfully limits the energy consumption growth by increasing energy efficiency with successfully delinked the energy consumption from economic growth. The improvement of energy efficiency is measured by using the reduction of energy intensity as the main indicator. Germany succeeded in reducing its primary energy intensity by 25% between 2000 and 2017. Industry, building and commercial sectors account for most of the final energy consumption amounting to 40%, 47%, and 10% respectively in Germany. This country has implemented a wide range of mechanisms for raising energy efficiency in its industrial, commercial, and building sectors.

Malaysia is a south east Asian emerging economy, which sets to improve its energy efficiency 20% by 2030 comparing to 2005 (Fernando and Hor, 2017). Building and industry sector's electricity consumption comprises more than 80% of the total national electricity consumption. Despite, Malaysia has initiated several policy measures, its current rates of progress in improving energy efficiency is not sufficient to realise the target. Several studies investigate the energy efficiency policy in Germany and Malaysia, however, there were no clear findings why one country is successful than the other. In this work, we will examine the energy efficiency policies of both Germany and Malaysia and figure out the major factors which cause much success for the former than the latter.

2. Energy Efficiency Policy in Germany

2.1 Overall Trends in Energy Efficiency in Germany

Two major indicators are usually used to describe the overall energy efficiency of a country. The indicators are the primary energy intensity and the final energy intensity (e.g. GJ/USD). The energy intensity represents the correlation between energy consumptions and gross domestic product (GDP). The Figure 1 shows the energy intensity in Germany between the year 1990 and 2011 (Schlomann and Wolfgang Eichhammer, 2012). The primary and final energy intensity has been continuously decreasing from 0.13 (ktoe/million €) in 1990 to 0.09 (ktoe/million €) in 2011. Despite energy-using activities have been increased, energy per capita has decreased by 0.4 toe/cap over the period 2000-2015. This shows the significant energy efficiency achievement in Germany. Although, this reduction of energy intensity is caused by several factors such as structural changes and technological improvements, the energy efficiency policy is appeared as the most significant factor.

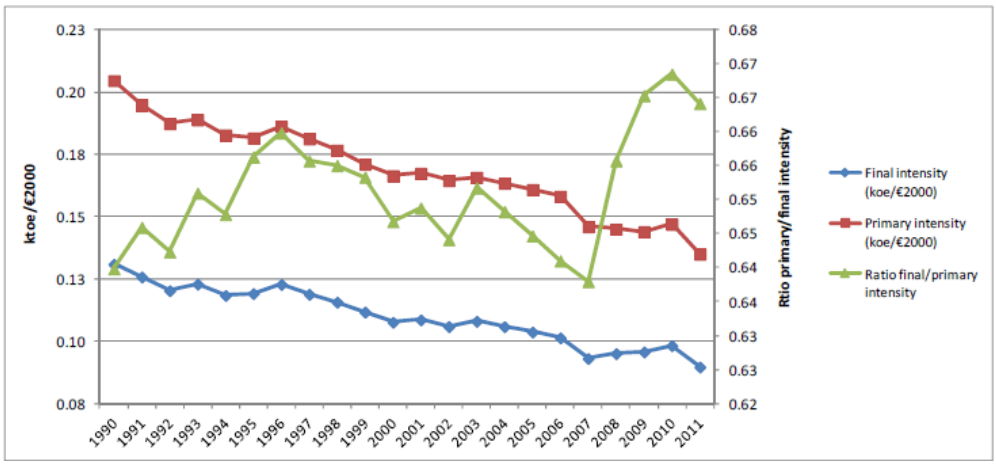

Figure 1. Development of primary and final energy intensity in Germany between 1990 and 2011

Germany has implemented a wide range of mechanisms (policies) for raising energy efficiency in its industrial, commercial and housing sectors. Germany has been appeared as a successful country in increasing energy efficiency among industrialized countries that have made remarkable progress in delinking energy consumption from economic growth. Increasing energy efficiency in industry and households boost economic growth and create new opportunity for employment. The German Institute for Economic Research (DIW) has estimated that 39 billion euros has been invested in existing residential buildings and 15 billion euros in existing non-residential building under energy efficient building renovation program.

Energy efficiency mechanisms and support policy have significantly contributed to improve energy efficiency in Germany. The energy efficiency policy has drawn a large amount of private investments, about 5 billion euros in households, industry, and commercial sectors by stimulated by the government regulatory supports (Schlomann and Wolfgang Eichhammer, 2012). The German government's goals were to promote energy efficiency to facilitate not only the development but also to disseminate the innovative technologies from Germany to other countries. This enables the energy service companies to penetrate to international markets for energy efficient products and stimulate energy efficiency. In the consequence, Germany exports a huge amount of energy efficient products such as electrical appliances, insulation materials, industrial equipment etc. In return, this brings in more investments in energy efficiency.

2.2. Energy Efficiency Policy Mechanism

Various successful energy efficiency policy measures have promoted continued progress in energy efficiency. Major policy mechanisms under National Action Plan on Energy Efficiency (NAPE) to promote Energy Efficiency measures are described below.

2.2.1 Information and Consulting

Information and consulting make up the major elements for German energy efficiency policy. Reliable and consistent information and data are the central aspect for business entities, households and public organizations (such as central government, local municipalities etc.) to make judicious investment decision. The reliable and independent data and information are also essential element for assessing and understanding the impacts of energy efficiency measures. That is why the German government promotes information and consulting services to various focused groups to persuade energy efficiency investments (Cajias et al., 2019).

2.2.2 Incentives through Funding Program

Financial incentives play a crucial role to enable industry, business and households to implement energy efficiency measures. The financial incentives help changes behavioral cultures in the organizations to set up example by establishing best practices. Incentives are policy tools that influence purchase and production decisions toward energy-efficient products. Incentives encourage implementing standards and labelling initiatives by accelerating market penetration of energy efficient products. Incentives also serve to advance the design of product and prepare to face the future challenges of more stringent requirements. Incentives can be directed at different levels of energy efficient products and services, one level may be more effective than another depending on the socioeconomic conditions (Ringel et al., 2016).

2.2.3 Carbon dioxide Building Renovation Program

Building accounts for 40 percent of total final energy consumption in Germany with heating accounting for the largest individual portion. Several programs have contributed to achieve the targeted goals for energy efficiency in buildings, these are: CO2 Building Renovation Programme (KfW funding), KfW Efficiency House Plus in residential construction (2016). The CO2 Building and Renovation program is one of the major funding instruments in Germany for energy efficiency. This mechanism supports energy efficiency measures in buildings by providing with subsidies, low interest loans and grants.

The key wining features of this program are:

- Funding amounting to more than a billion euros per year,
- Tax benefits over a period of 10 years,
- Targeting of both owner and tenants
- Cost-benefit analysis of potential assistance in rented housing, provided that tax concessions benefit the tenants,
- Assistance independent of tax progression through deduction of tax owing,
- Assistance for individual and comprehensive measures.

The amount of benefits depends on the improvement of energy efficiency and installing renewable supply in residential buildings. These features enhance the energy performances of the building (Franke and Nadler, 2019). The finding workflow is present in the Figure 2.

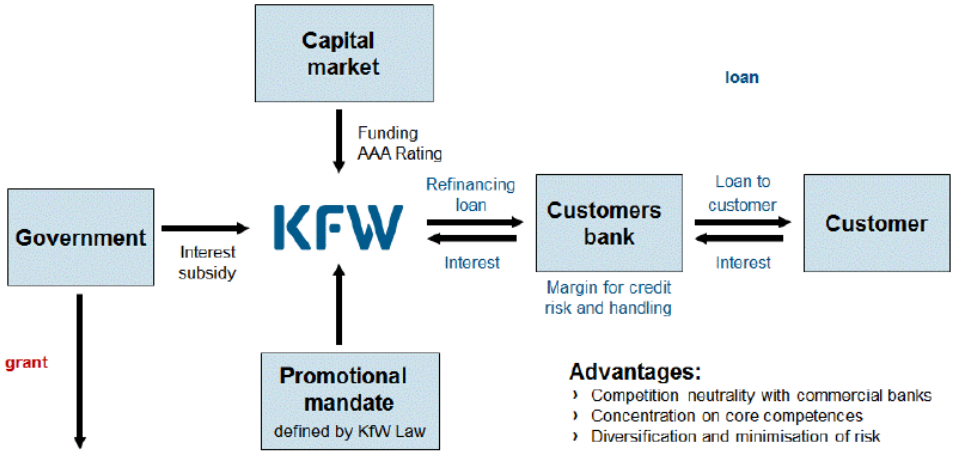

Figure 2. The KfW funding workflow diagram (Andreas Schüring, 2014)

2.2.4 Energy Efficiency Program

The Credit Institute for Reconstruction (KfW) has also initiated Energy Efficiency Program. Under this program, small and medium-sized enterprises (SMEs) can access to low-interest loans to finance energy efficiency measures in building services, building envelopes, equipment, heating and cooling systems, waste heat recovery system, metrology, control engineering, information and communications technology etc.

2.2.5 The Promotion of High-efficiency Cross-cutting Technologies

High-efficiency Cross-cutting Technologies program promotes the replacement of inefficient devices and components such as motors, pumps, air compressors with high-efficient installations and systems. This program promotes enterprises to select the most energy-efficient and environment-friendly investments. This program also helps to implement energy management systems in their premises.

2.2.6 Energy Labelling of Products

The energy labelling of products facilitate consumer to be aware about the energy performance of a product prior to purchase. This approach brings competitiveness among the manufacturers to design and produce more energy-efficient products that comply with the label. The energy label is developed in a way that they matched with the efficiency classes from A to G of the EU Energy Labelling Directives that help easy familiarity for the supplier and dealers. The labeling regulation also ensures market surveillance and inspections and enforce stern actions for breaching the rule. The labeling regulation is implemented under the directives of the Compulsory Watt Labelling Act (EnVKG), Compulsory Watt Labelling Ordinance (EnVKV) and Passenger Car Fuel Efficiency Labelling Ordinance (Pkw-EnVKV)

2.2.7 Specifying Minimum Standards

By specifying minimum standards for individual product groups, the requirements for the design of energy-related products make a major contribution to improving energy efficiency. The EU Eco-design Directive and product-specific regulations provide the basis for setting minimum requirements for the environment-friendly design of energy-related products. The Energy Saving Ordinance (EnEV) also sets the minimum requirements of energy efficiency for envelopes and technical components of newly-build and existing building. Setting standards for new products and buildings not only makes benefit by energy saving but also gives competitive advantages for the business by reducing costs of their products. Specifying minimum standards for new products and buildings has been appeared as a powerful approach to succeed energy efficiency.

2.2.8 Price Signals and Incentives Mechanisms

Price signals play a role to adopt energy efficiency through behavioral changes. External costs from energy use can be translated into adopting energy efficient technologies. Efficient technologies are entitled to tax reliefs which eventually converted to incentive for energy efficiency. Tax relief is granted as part of tax capping under the Energy Tax Act and the Electricity Tax Act if energy intensity is kept within the statutory target.

2.2.9 Support for International Business

Energy efficiency also offers a role to enhance supply security and compliance with international climate pledges. It enhances international businesses for efficient products and services. German Government supports international partners for improvement of energy efficiency both at bilateral and multilateral level.

2.2.10 Introduction of a Competitive Tendering Scheme for Energy Efficiency

Competitive tendering is a process of buying goods and services, where a buyer launches an open call for bids and chooses the seller that submitted the best bid. The main aim of the Competitive tendering is to trigger energy efficiency by using lowest energy consumption. The Competitive tendering has been found as a very efficient market-oriented tool to increase energy efficiency.

2.2.11 Waste Heat Use Initiative

Large amounts of waste heat are produced in industrial processes and manufacturing. The greater part of this energy then escapes into the environment following direct use. Utilisation of this waste heat offers huge potential. Germany are among the global leaders in the field of waste heat utilisation. The country has succeeded with waste heat recovery with the policy support of low interest loans and attractive repayment bonus under Energy efficiency waste heat utilisation program.

2.2.12 Requirement of Implementing Energy Management System

To avail the tax benefits through tax caps, enterprises are required to implement energy management system (EnMS) in their premises. The ISO 50001 is also required for the reimbursement of Renewable energy levy under German Renewable Energy act. Electricity Tax Act (StromStG) also requires energy management system or an environmental management system to be eligible for benefits through tax caps (SGS, 2020). According to EDL-G (the German law governing energy service providers, large companies are obliged to carry out an energy audit or alternatively establish an energy or environmental management system (Adelphi, 2020). Energy audit is mandatory for large and small companies according to the Energy Services Act. Implementing energy management systems has contributed to improve energy efficiency through best practices (EDLG, 2019) (TÜV Rheinland, 2019).

3. Energy Efficiency Policy in Malaysia

Malaysia has initiated and enacted several policy mechanisms to implement its energy efficiency goals. The major policy mechanisms are present in the following paragraph.

3.1 Efficient Management of Electrical Energy Regulations

For enhancing energy efficiency in industrial and commercial facilities, Malaysia has passed Efficient Management of Electrical Energy Regulations in 2008. This regulation has ensured energy efficiency practices in power generation and consumption facilities.

3.1.1 Energy Management Obligations

According to this regulation, any power generation or supply entity who supplies electrical energy to any installation or consumer whose total electrical energy consumption is equal to or more than 3 million kWh over a period of six consecutive months needs to report to the Energy Commission Malaysia the names and particulars of consumers. Similarly, any power generation entity, who generates total net electrical energy that equals to or more than 3 million kWh over a period of six consecutive months needs to report to the Energy Commission Malaysia. Any installation or consumer whose total net electrical energy generation or total electrical energy consumption equals to or exceeds 3 million kWh needs to appoint or designate a registered electrical energy manager (REEM) to carry out the energy efficiency functions as prescribed by the energy commission. The installations or consumers also require clarifying the energy management measures it takes to achieve energy efficiency.

3.1.2 Engaging Electrical Energy Manager

Impacted entities are required to appoint an Electrical energy manager in their facilities. Functions and duties of an appointed electrical energy manager are also defined by the regulation so that the appointee can take the appropriate measures. The energy manager shall have the following functions and duties:

i) to audit and analyze the total electrical energy consumption or total net electrical energy generation at the installation, including the significant end use of electricity,
ii) to advise the private installation or consumer in developing and implementing measures to ensure efficient management of electrical energy,
iii) to monitor effective implementation of the above measures,

iv) to supervise the keeping of records on efficient management of electrical energy at the installation, and
v) to ensure the submission of the information and report to the regulatory body,

3.2 National Energy Efficiency Action Plan 2015

National energy efficiency action plan takes 5 key initiatives to implement energy efficiency goals in Malaysia. The major functions of the initiatives are presented below.

3.2.1 Promotion of 5-Star Rated Appliances

Energy rating and label has been appeared as a key driver in the transition towards energy-efficient products for the households and industries. It has been successfully applied worldwide in Europe, USA, Japan, Australia, and Canada for the last decades and has brought in significant improvements in energy efficiency of the appliances and devices. Energy labels allow the consumers to estimate the energy consumption of the appliances in anticipated whole life. The consumer can take the decision based on life cycle costs which include both initial cost and operation cost. As higher rated appliances enjoy higher energy saving, its operational cost is lower than that of the low rated appliances. In this way, purchase decision has been inclined towards more energy efficient products.

3.2.2 Minimum Energy Performance Standards (MEPS) for Lighting

Lighting is an important electrical energy consuming appliance in homes. In the commercial sector, lighting account for about 15% to 20% of the total electrical energy used. Thus, improving lighting energy efficiency can result in substantial savings. The campaign will include the promotion energy efficient lighting (e.g. CFL, T5 and LED) through awareness enhancement programs, the enforcement of Minimum Energy Performance Standards (MEPS) and labelling and the enhancement of awareness on the benefit of using smart meters.

3.2.3 Energy Audits and Energy Management in Buildings and Industries

Energy audits identify the mapping of buildings energy consumption pattern and figure out the areas where there are rooms for energy efficiency improvement. Energy audit often suggests measures which involve no additional cost to improve efficiency. Through performing the energy audit, facility managements can know the energy saving potential and related costs to implement the energy efficiency measures. It provides the cost benefit analysis and promotes to investment towards energy efficiency measures. The Energy efficiency measures are implemented through systematic procedures and practices under Energy management program.

3.2.4 Promotion of co-generation

Generating electricity and thermal energy using cogeneration can achieve overall efficiencies more than 80% as compared to less than 50% of updated combined cycle gas turbines. Under this initiative, cogeneration systems are promoted through addressing barriers such as high top up and standby rates and the inadequacies in the natural gas supply.

3.2.5 Energy Efficient Building Design

The commercial sector consumes about one-third of all electricity in the country and a large share of this is used in buildings for cooling, ventilation, lighting, appliances etc. The future increase in energy consumption in the commercial sector will come from new buildings. This initiative promotes new buildings to be designed and built with consideration of energy efficiency. Surveys have shown that new buildings are consuming energy around 200-250 kWh/m2/year, which could be reduced to about 135 kWh/m2/year by applying energy efficiency measures.

3.3 New Energy Policy 2010

New energy policy 2010 has also encouraged Energy Efficiency in industrial and commercial settings through fiscal incentives. The aims of fiscal incentives are to promote energy efficiency projects and equipment by providing tax incentives. The tax incentives are in the form of waiver of import duty and sales tax on energy efficient equipment and accelerated capital allowances or pioneer status for investment in energy efficient technologies and projects.

These incentives were enhanced over the years. New energy policy 2010 also taken the Green Technology Finance Scheme (GTFS) 2010 to support investments in green technology projects, which, among others, include energy efficiency. The fund provides a 2% subsidy to the interest rates offered by commercial banks and a credit guarantee support for the loan capital. Several projects have been implemented in the areas of energy efficiency and renewable energy. Some of the most significant are present below.

3.3.1 Malaysian Industrial Energy Efficiency Improvement Project

This project was a cooperative project between the Malaysian Government and UNDP with the aim of promoting energy efficiency within the industrial sector. The project focused on energy auditing of industries, demonstration projects, rating of higher efficient equipment and increasing the awareness among industrial consumers on energy efficiency.

3.3.2 Zero Energy Office (GEO) Building

Under this mechanism, GEO building was a demonstration building that had been designed with low energy features. The energy consumption of the building was designed to be 50kWh/m2/year - significantly lower than the average of 200 kWh/m2/year of typical office buildings. Furthermore, installation of photovoltaic systems brings the net electricity consumption down to about 35kWh/m2/year.

3.3.3 Centre for Education and Training in Energy Efficiency and Renewable Energy (CETREE)

This Centre located in the campus of University of Science, Penang. CETREE's focus is to increase awareness on energy efficiency and renewable energy among school children and students. The Centre has developed curricula for primary and secondary schools and assisted universities in incorporating energy efficiency in their teaching courses. Furthermore, the Centre organizes events for schools on energy efficiency and renewable energy and their exhibition busses visits schools all over Peninsular Malaysia.

4. Conclusions

Energy efficiency was found as the cleanest, quickest, and most cost-effective way to extend the current energy supply into sustainable future energy. The energy efficiency also supports to achieve the Sustainable Development Goals (SDGs) set by UN. Despite several measures are taken to increase the energy efficiency by the world countries, only a few are successful. Only right energy efficiency strategy can effectively succeed in achieving energy efficiency goals. Germany is one of the leading countries in the world with the highest-level achievement of energy efficiency. Although Germany has made a remarkable growth in economic developments, it successfully limits the energy consumptions. Malaysia is a south east Asian country, which also sets several policy measures to increase energy efficiency, but still the progress is not up to the mark. Several factors are found to be acted to make success for the Germany than Malaysia. Information and data sharing make up the major elements for German energy efficiency policy. Reliable and consistent information and data are the central aspect for success of energy efficiency. The financial incentives change behavioral cultures in the organizations to set up example by establishing best practices in energy efficiency. The CO2 Building and Renovation program is another major funding instruments in Germany, which targets both owners and tenants, contributed to increase energy efficiency. The energy labelling of products also enhances energy efficiency by making the consumers aware about the energy performance of a product prior to purchase. Cross-cutting Technologies program and competitive tendering also promotes the replacement of inefficient devices and components and enhances energy efficient installations. Requirement of implementing energy management system (EnMS) to avail tax benefits through tax caps has also contributed to increase energy efficiency in Germany. In Malaysia, among the policy elements that have contributed to increase energy efficiency are efficient management of electrical energy program, promotion of 5-star rated appliances, and implementation of energy management in buildings.

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