



Research Article

Renewable energy policy in Germany and Malaysia: success factors

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Abstract

Energy-sectors in both developed and developing countries face three major challenges, namely emission of greenhouse gases (GHGs), depletion of fossil fuel reserves, and increasing demands. Despite renewable energy retains many advantages over fossil-based energy, its wider dissemination is still restricted in many countries owing to techno-economic, societal and policy barriers. Renewable energy policy is meant to promote renewable energy by overcoming these barriers. Globally more than 140 countries had laid policy measures to promote the development of renewable energy, however, very few countries are successful. Germany is one of the successful countries in the world in developing renewable energy in terms of per capita installation and cumulative capacity expansion. Malaysia, on the other hand, undertook several initiatives in order to increase renewable energy uses to reduce dependency on fossil fuels and to contribute global effort to minimize GHG emissions but is not yet as successful as it desires. This paper examines renewable energy policy of both these countries and identifies the key success factors in German case. We found that the main success factors of Germany were appropriate and dynamic FiT (Feed-in Tariff) mechanism. German FiT mechanism ensures marginal profits with the negotiated FiT rates.

Keywords

Renewable energy, policy, feed in tariff

1. Introduction

Reduction of emissions, security of supply, and meeting increasing demands are the major challenges in energy sector activities both in developed and developing countries. Energy related emissions accounts for around 65% of the total anthropogenic GHG (greenhouse gas) emissions in the world, and are the main contributor to the climate change [1]. The three major fossil fuel resources such as coal, oil and natural gas, which account for about 85% of the global total primary energy supply, are depleting very rapidly. In the current consumption pattern, the major fossil fuel reserves will nearly be exhausted by the end of this 21-century. In this context, renewable energy sources appear as the potential candidates to combat with these fossil-fuel depletion and GHG emissions challenges.

Several countries in the world-initiated measures to decrease GHG emissions through application of renewable energy sources. However, renewable energy is still facing huge socioeconomic and policy challenges to compete with the traditional fossil based energy. To accomplish the wider applications of renewable sources, various levels of legislations and policies are being enacted. Still to date, globally more than 140 countries had set their renewable energy targets and employed policies to support the development of renewable energy. Due to these efforts, renewable energy supply aggregated to around 19.1% of the total final energy consumption in the world in 2013. In this endeavor, only few countries are successful, whereas, many are still struggling.

Germany stands out as one of the very successful countries in the world in the development of renewable energy with highest per capita installation (1 070 W/inhabitants as of 2014). This country is also the world leader in installing photovoltaic (PV) power in terms of installed capacity (38.2 GW by December 2014). This country stands third in wind capacity amounting to 39.2 GW in 2014 (nearly 11% of global capacity) after China and USA. Germany is also European leader in supplying biofuel (biodiesel) to transportation sector (3.4 billion liter per year in 2014) and solar heating system (12.3 GW_{th} per year in 2013) [2], [3].

Malaysia, a South Asian Country, on the other hand, has long been emphasizing to increase renewable energy use to mitigate the issues of security, energy efficiency and environmental impact and to meet the rising energy demand [4], [5]. This country laid initiatives to increase renewable energy in order to reduce dependency on fossil fuels and to contribute to global effort to minimize GHG emissions. Despite initiative, still renewable energy dissemination in Malaysia has been quite low [6]. This paper examines renewable energy policies of both these countries and identifies the key success factors in German renewable energy policy. This study also examines background conditions and policy features that contribute to German renewable energy success.

2. Renewable Energy (RE) policy in Germany

A range of policy measures has been put in place and implemented to promote the use of renewable energy (RE) in Germany. These include feed-in laws, quota obligations, incentives, tax rebates, emission trading [7]. Different countries enact policy measures by considering their effectiveness and strategic objectives for developing renewable energy [8]. Although the energy policy objectives are very similar for most of the countries-such as reducing GHG emissions, relieving dependence on imported fossil fuels, creating fuel diversity, reducing price risk, the policy measures are chosen based on national context which is shaped by topographical, sociocultural and economic conditions. The most prominent and successful policy package to promote renewable energy in Germany is Renewable Energy Sources Act (EEG) [9]. From the commencement, the EEG act has been updated during several phases until 2012 [10]. During EEG-first phase (2000-2009), Germany established Feed-in Tariff (FiT) tool to support electricity generation from renewable sources with very modest degression option. During EEG-second phase (2009-2011), Germany adjusted degression principles to manage the volume of renewable installations (especially PV installations) by linking FiT rates with previous installations volume. During EEG- third phase (2012-), it adjusted FiT policy again through decreasing FiT rates, and employing market premium and Cap option, and PV capacity threshold. The policy tools which had been placed in Germany are summarized in Table 1. Among these options, Feed-in Tariff, renewable energy target, renewable energy quota obligation, and monetary incentives were proved very effective [8]. The following sections describe the main features of these policy tools.

TABLE 1. OVERVIEW OF RE POLICY TOOLS IN GERMANY

Policy tools	Major features
Feed-in Tariffs	[1] Priority grid access [2] Guaranteed Feed-in Tariff for 20 years [3] Yearly degression in FiT to encourage innovation and cost reduction [4] Negotiable FiT rates to ensure marginal profit [5] Market premium
Renewable energy targets	[1] At least 12.5% power supply is to be provided by renewable energy sources by 2010. [2] New targets: 35% power supply by 2020, 50% by 2030, 65% by 2040, and 80% by 2050
Biofuels obligation	[1] A minimum level of biofuels must be used in road transport [2] Oblige sustainability law to be qualified for quota consideration
Heat obligation	[1] Requires the integration of heat production from renewable sources in new construction or cogeneration [2] Requires energy efficiency measures [3] Transparency in sharing of data among
Capital subsidy, grants	[1] Grants towards investment costs [2] Low interest loans with repayment subsidies [3] Low interest loans [4] Public guarantees [5] Labour-related incentives [6] R&D incentives

2.1 Feed-in Tariff (FiT)

The FiT has been recognized as the most efficient policy tool to promote and maintain the renewable energy progress in Germany [11]. FiT is a mechanism/tool that allows electricity produced from RE sources to be sold to electricity utility or transmission system operator (TSO) at a fixed price. The legislation package which facilitates this mechanism is the

Renewable Energy Sources Act (EEG) [7]. The money and power flows in German FiT mechanism is presented in Figure 1[12].

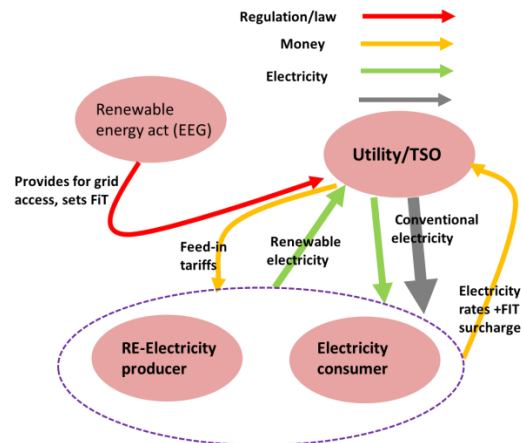


Figure 1. Money and power flows in German RE policy

2.2 Features of FiT in Germany

The FiT policy in Germany is not just serving as a tariff but it serves more [2]. The FiT for the generator operator is guaranteed for longer time frame i.e. 20 years, which provides sufficient security for the long-term investment in renewables and attracts institutional or big investors. The generator operators are guaranteed to sell power even during the hours of demand contraction [7]. The FiT rates vary over plants based on resource quality, plant size, feedstock type, which ensures fair treatment to all types of generator operators (Table 2). FiT law imposes technology specific deployment caps, which is to encourage towards competitive bidding. FiT rates also vary over technology types to ensure removing technology disparity. FiT rates get lower over the year under the term of degression to stimulate innovation and to encourage advances in technology. The investment costs are determined by using learning curve concept, which incorporates the effect of economies of scale. The most important is that the FiT values are negotiated to be such that at current investment prices, marginal profits are maintained.

The FiT law provides purchase obligation guarantee and priority feed-in. That means, the power utility or TSO are obliged to purchase renewable based electricity and feed into their grids on a priority basis. The FiT provides clear market signals to the operators by providing long term perspective for big investments and capacity expansions. It also ensures generic grid access without delay and bureaucratic hassles, which minimizes transaction costs and attracts small investors. FiT law provides rewards for every positive measure to encourage operational efficiency. It provides regular monitoring and evaluation process to ensure smooth operation.

TABLE 2. THE FIT RATES FOR DIFFERENT RE SOURCES AND TECHNOLOGIES, 2012

Sources/technologies	FiT (€cent/kWh)	Degression %	Varies on
Hydropower	3.4–12.67	1	Plant size, age
Methane from dumps, sewage, mine	3.98–8.6	1.5	Plant size, fuel
Biomass	6–25	1	Plant size, fuel, CHP, technology, feed-in site
Geothermal	25–30	1	Plant size, CHP, technology
Wind power: onshore, off shore	8.93 15	1.5 0	Location, technical compliance, repowering
Solar photovoltaic	31.94–48.01	8–29	Plant size, building integration

German FiT also brings two new innovations in 2012 namely the market premium and the flexibility premium. The plant operators can opt to sell their electricity directly into the market. In this case the operators are entitled to receive a market

premium instead of the fixed FiT rates in addition to the revenue obtained from selling of electricity. Another innovation in FiT is the flexibility premium. It promotes biogas-fired flexible power generation capacity.

2.3 Contribution of FiT in German RE success

The renewable energy success has been demonstrated by many factors such as installation capacity, energy generation, investment in renewable energy, creating jobs etc. The installed capacity was 4.7 GW in 1990 whereas it reached to 93 GW in 2014 (Figure 2)[13]. The contribution of FiT in this success has been proved by the fact that 88% of renewable energy investments in power generation installation in 2011 were come through Renewable Energy Sources Act (EEG).

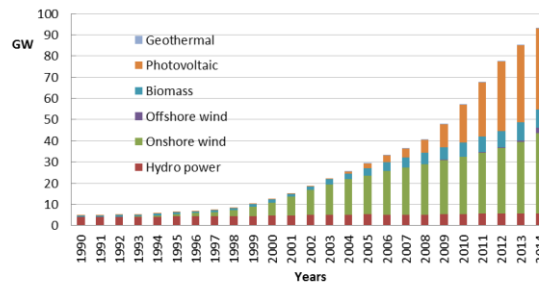


Figure 2. RE installation in Germany, 1991-2014

2.4 Renewable energy targets

The renewable energy target was designed to reduce emissions of GHGs through the increasing use of renewable energy sources (RES) through financial incentives and other promotion offers [14]. In 2000, the goal of German renewable energy was to doubling the share of RES in electricity generation in 2010 compared to the 1997 level. Accordingly, in 2000, Germany set target of generating 12.5% of electricity from renewables by 2010, including large-scale hydro. Due to the positive drive of setting target, it achieved 17% renewable energy by 2010. Later in 2012, amendment to the EEG, it put a new long term target for renewable sources. According to this new target, 35% of German power supply is to be provided by renewable energy sources by 2020, 50% by 2030, 65% by 2040, and 80% by 2050. The corresponding quantities of electricity are aimed to feed into the power supply system. Germany also set targets for GHG emission reductions. Climate-change commission in 1991 recommended deep cuts in CO₂ emissions in Germany. According to this recommendation, the target to cut emissions was 30% by 2005 and 80% by 2050 [8].

2.5 Renewable energy obligation

For increasing the share of renewable energy sources in its fuel mix, Germany also laid obligation mandates for biofuels and heating demands as described below.

a) Biofuels obligation mandate

The biofuels obligation mandate under biofuels quota act set a target for a minimum level of biofuels share in road transportation. The obligation quota from 2010 onwards has been set to the level of 6.25% based on energy content. However, in 2015, the basis for biofuels obligation quota has been shifted from energy content to GHG reduction limit. According to this quota, the biofuels contribution for GHG emission reduction must be 7% by 2020 [7]. Germany also enacted biofuels sustainability law, according to this law, biofuel is sustainable only if it saves minimum 35% emissions compared to fossil fuels. Under biofuels sustainability law, biofuels must meet these criteria to qualify to be considered for biofuels obligation quota.

b) Heating obligation mandate

Germany also enacted heating obligation mandate for renewable energy. According to this mandate, owner of the new buildings are required to meet a portion of their heating and cooling demands from renewable resources. The permitted renewable resources are solar thermal system, biomass based system, geothermal energy, environmental heat. According to this mandate, in addition to the residential building, the public owned building are also required to meet a fraction of heating and cooling demand from renewable sources [7].

2.6 Incentive programs: Grant and capital subsidy

The market incentive programs in Germany were mainly meant for promoting renewable energy for heating. Capital subsidies up to 40% of investments costs are provided to individuals or small enterprises for installation of solar collectors for heating applications. Low interest loan with repayment subsidies are provided for large scale heating solutions for commercial customers or municipal bodies. Soft loans for biomass based combined heat and power, small hydropower, photovoltaic in schools are also provided. The interest rates were very low, 1% to 2% below market interest rate. Accelerated depreciations are also provided for owner or leaser of the buildings if they meet green building requirements.

2.7 Technical supports policy

Distribution system operators are obliged to optimize, reinforce and expand the networks in order to accommodate the electricity from renewable sources without delay. According to this policy, the networks are to be maintained to the updated standards so that it will not face problems to receive power from renewables. Policy is also aimed to provide suitable technical system solutions to fully integrate renewable power in the power grid.

2.8 Renewable energy policy in Malaysia

To promote renewable energy, Malaysia introduces several policy initiatives, such as Fifth Fuel policy 2000, National Biofuel policy 2006, National Green Technology policy 2009, and National Renewable Energy Act 2011. The major tools under these policy initiatives are presented below.

3. FiT in Malaysia

Malaysia enacted FiT instrument through National Renewable Energy Act 2011 to encourage renewable based power generations [15]. This mechanism enables the entity or individuals to sell renewable based electricity (up to 30 MW) to power distribution companies at a fixed premium prices for a certain period of time (Table 3). According to this policy, 1% of the electricity tariffs are imposed to the customers and manage a fund (RE fund) to support RE based generation (Figure 3). The RE based plant operator are guaranteed for the premium from distribution companies. The FiT rates differ for various renewable source types and technologies. The FiT rates in Malaysia for different options are presented in Table 3.

Table 3: FiT rates and duration in RE policy in Malaysia, 2011

RE technologies/resources	FiT duration (y)	FiT rates (MYR*/kWh)	Annual depression (%)
Biomass (palm oil, agro based)	16	0.24–0.035	0.5
Biogas (palm oil, agro based, farming)	16	0.28–0.35	0.5
Mini-hydro	21	0.23–0.24	0
Solar PV	21	1.25–1.75	8
Solid waste sewage	21	0.30–0.46	1.8
Wind	21	0.23–0.35	1.5
Ocean, geothermal	21	0.28–0.46	1

* MYR is Malaysian Ringgit

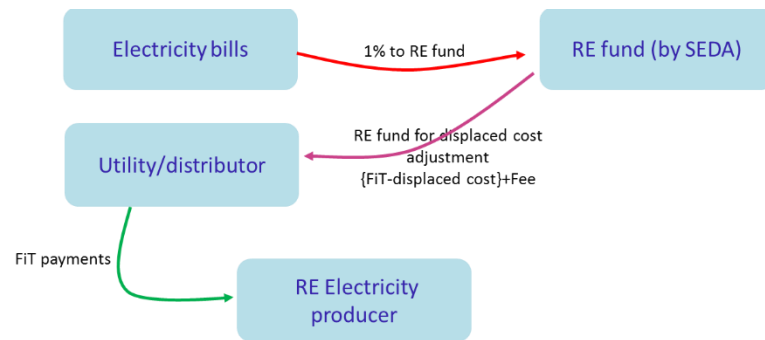


Figure 3. Flows of money in Malaysian FiT

3.1 The major features of FiT in Malaysia

Access for RE based electricity into grid is legally guaranteed provided that technical and legal criteria have been met by the power producers [16]. Power distribution companies are obliged to accept the electricity from the power generators within the specified limit. FiT rates are contractually fixed for the effective period. The FiT law provides adequate depression to promote cost reduction and grid parity. The RE law also facilities an online platform (e-FiT) to processing project application, quota balancing, monitoring and reporting modules, and payments.

3.2 Renewable energy targets

Malaysia set renewable energy targets to drive renewable energy dissemination through different policy frameworks [17]. In fifth fuel policy 2000, renewable energy was announced as a fifth fuel after coal, gas, oil, and hydro-electricity in the energy supply mix [18]. This country also announces bio-fuel policy to reduce the country's dependency on fossil fuels and promote the demand for palm oil. Lately it announced national RE policy 2010. The renewable energy targets for different years are presented in Table 4 [5].

TABLE 4. RE TARGETS IN MALAYSIA

Year	Target RE cumulative capacity (GW)	Target share of RE mix in total power generation (%)	Anticipated annual CO ₂ avoidance (Mt/y)
2011	0.22	1	0.848
2015	0.99	5	3.715
2020	2.08	9	7.759
2030	4.00	12	11.889
2050	21.37	24	30.503

3.3 Renewable energy promotion programs

Malaysia initiated Small Renewable Energy Power (SREP) program in 2001 to develop RE resources for power generation fuels [19]. According to this program, the power plant developer can sign contracts with the power distribution utilities to sell their RE generated power to the utilities. The SREP licenses enable power generation from renewable sources such as biomass and biogas from palm oil mill wastes, solar photovoltaic, biogas from municipal landfills, mini-hydro, wind and municipal wastes. Maximum 10 MW power can be sold to the power utilities for 21 year period [20].

4. Summary of major success factors in German RE policy

The main success factors of Germany are summarized as follows. The most important factor was appropriate and dynamic FiT mechanism. German renewable energy programme realized that renewable energy diffusion is a dynamic process which cannot succeed by sticking to a rigid model. Thus the FiT features of Germany were undergoing continuous adjustments depending on the ever changing needs and evolving challenges. German RE policy ensures minimizing transaction costs by simplifying legal, technical, and financial processes. Germany also made obligation for renewable energy use in transportation and heating sectors. This country also ensures improvement of transmission and distribution system to accept power from renewable energy sources with having very low or zero refusal. Most importantly, German FiT mechanism provided that the FiT rates are negotiated to a level that yields marginal profits at current investment prices.

5. Conclusions

Energy policy is meant to address issues of energy developments including energy production, transformation, exploration, distribution and consumption. Renewable energy policy facilitates to adopt RE by dealing various barriers and challenging issues such as technological barriers, market failures, societal challenges, negative perception, higher transaction costs, competitors etc.

Germany is a very successful country for using renewable energy sources in terms of cumulative generation, per capital installed capacity, and current dissemination rates. The effective energy policy was the main driver for these achievements in Germany because 88% of renewable energy investment in power generation installation in 2011 was channelled through Renewable Energy Sources Act (EEG).

Malaysia also has initiated several policies and programs to promote renewable energy applications. The main goals of Malaysia RE policies were to encourage communities and individuals to adopt RE as alternative sources of energy. Despite several policy efforts, Malaysia renewable energy is not as successful as it desires. In this context, this article examines the renewable policy of Germany and Malaysia to figure out the main factors in Renewable energy policy of Germany that are missing in case of Malaysia. The authors found that the main success factors of Germany are appropriate FiT mechanism and supportive environment. German FiT mechanism gives that the FiT rates are negotiated to be such that at current investment prices, marginal profits are maintained. German RE policy ensures minimizing transaction costs by simplifying and transparent process. Germany also made obligation for renewable energy applications for transportation and heating sectors, which also made a great push towards wider RE deployment. Germany also ensures improvement of transmission and distribution system to adopt power from renewable energy sources. Germany also provides long term perspective for big investment and capacity expansion. Despite Malaysia RE policy deploy many good features for expediting renewable energy penetration, it clearly lack some of the features that German's RE policy has. Countries which are not successful yet in renewable energy programme can upgrade RE policy based on German experience to facilitate further pace for renewables dissemination in their energy mix.

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