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THE ROLE OF "GREEN" ELECTRICITY GENERATION INCENTIVES

ULOGA MJERA ZA POTICANJE PROIZVODNJE "ZELENE" ELEKTRIČNE ENERGIJE

ABSTRACT

Despite significant investments and incentives, renewable energy resources are still not economically competitive to traditional fossil energy resources, except for isolated sustainable power systems detached from the national electricity grid. As far as the cost of "green" power production, or the power generated from renewable resources, is not approximately equalized to the cost of fossil energy resources, or until the renewable energy technologies become competitive, it is necessary to make a considerable effort in the form of financial incentives and support towards the renewable energy sector. This implies further improvement and application of renewable energy technologies, which should stimulate the development of domestic production of energy equipment and services, the creation of new jobs and development of entrepreneurship in the energy sector and other related industries, the creation of new, innovative technologies and ultimately development of economy in general.

The purpose of this study is to determine the significance and the role of measures, or public authorities' incentives to stimulate production and greater use of "green" electricity. Thereby the paper analyzes various systems of stimulation, such as preferential purchase prices, or feed-in tariffs for generated energy, models of market premiums, systems of mandatory quotas, certificates, models of direct subsidies for renewable resources installation, support for research and development, and other. The paper confirms the hypothesis about the impact of incentives on the increased use of renewable energy resources in EU Member States. Moreover, even though there is a potential for renewable resources, further action is necessary in the form of technical and administrative/legislative mechanisms in order to grow and develop the renewable energy market.

***Key words**: incentives, renewable energy resources, "green" electricity, guaranteed purchase price, development of economy.*

SAŽETAK

Obnovljivi izvori energije, usprkos znatnim ulaganjima i poticajima, još uvijek nisu ekonomski konkurentni tradicionalnim, fosilnim energetskim resursima, osim za izdvojene održive elektroenergetske sustave koji su odvojeni od nacionalne elektroenergetske mreže. Sve dok se, barem približno, ne izjednače troškovi proizvodnje "zelene" električne energije, tj. električne energije proizvedene iz postrojenja obnovljivih izvora energije, u odnosu na fosilne energetske resurse, a tehnologija obnovljivog izvora ne postane konkurentna, potrebno je ulagati značajne napore u vidu financijskih poticaja i potpora u sektor obnovljivih izvora energije. Spomenuto znači daljnje unapređenje i primjenu tehnologija obnovljivih izvora energije te bi trebalo predstavljati poticaj razvoju domaće proizvodnje energetske opreme i usluga, odnosno otvaranju novih radnih mjesta i razvoju poduzetništva u energetici i drugim vezanim djelatnostima, kreiranju novih i inovativnih tehnologija, te u konačnici, razvoju ukupnog gospodarstva.
Svrha istraživanja ovog rada je utvrditi značaj i ulogu mjera, odnosno aktivnosti tijela javne vlasti kojima se potiče proizvodnja te veća primjena "zelene" električne energije. Pri tome se u radu analiziraju različiti sustavi poticanja, poput povlaštenih otkupnih cijena, odnosno zajamčenih tarifa (engl. feed-in tariffs) proizvedene električne energije, modela tržišnih premija, sustava obvezujućih kvota, certifikata, modela izravnog subvencioniranja instalacije obnovljivog izvora, podrške za istraživanje i razvoj, te ostalo. U radu se potvrđuje hipoteza o utjecaju sustava poticanja na porast korištenja obnovljivih izvora energije u državama članicama Europske unije. Isto tako, iako potencijal za obnovljivim izvorima postoji, potrebno je dodatno djelovati u vidu tehničkih i administrativnih/zakonodavnih mehanizama kako bi se tržište obnovljivih izvora energije nastavilo širiti i razvijati.

***Ključne riječi**: poticajne mjere, obnovljivi izvori energije, „zelena" električna energija, zajamčena otkupna cijena, razvoj gospodarstva.*

1. Introduction

Renewable energy resources are mostly considered within the context of sustainability, i.e. sustainable development. Even though, due to the limited availability and continuity of application, renewable energy resources alone cannot fulfill the conditions for achieving sustainable development, primarily the economic element of development, they appear as significant, additional forms of conventional energy. With time, renewable energy resources are expected to assume even a greater role in electricity generation and thus contribute to sustainability.

In the recent decades, several reasons for the public support of the production of electricity from the renewable sources have been put forward. Besides various social-economic advantages such as job creation, energy diversification, security and stability, and the improvement of opportunities of regional and local development, the environmental motives in the form of pollution externalities from conventional energy sources have been the main argument for promoting electricity generation from renewable energy sources.

Despite significant investments and incentives, renewable energy resources are still not economically competitive to traditional fossil energy resources, except for isolated sustainable

power systems detached from the national electricity grid. As far as the cost of "green" power production, or the power generated from renewable resources, is not approximately equalized to the cost of fossil energy resources, or until the renewable energy technologies become competitive, it is necessary to make a considerable effort in the form of financial incentives and support towards the renewable energy sector. In this context, the participation of governments is necessary in the initial phase of the introduction of the new renewable energy technologies. It will allow to secure their development and to protect them from the direct competition of conventional technologies. This governmental support can be justified from two points of view: the correction of the negative environmental externalities resulting from the use of fossil fuels and the stimulation of the technical/technological change (Menanteau, Finon, Lamy, 2003).

Given the mentioned above, the purpose of this study is to determine the significance and the role of measures, or public authorities' incentives to stimulate production and greater use of electricity generated from renewable resources. The paper confirms the hypothesis about the impact of incentives on the increased use of renewable energy resources in EU Member States. Moreover, even though there is a potential for renewable resources, further action is necessary in the form of technical and administrative/legislative mechanisms in order to grow and develop the renewable energy market.

2. Literature review

Numerous studies point out the impact of support schemes / incentives on the increasing use of renewable energy sources, i.e. analyze the development of renewables in the "green" electricity generation as a result of different support schemes and incentives.

It is cited that the past two decades of growth in renewable energy sources of electricity have been largely driven by out-of-market support policies, i.e. fixed-price feed-in tariff. While these policies have proven to be effective, today it led to costly market distortions as well as to limit investor risk (Huntington et al., 2017). García-Alvarez and Mariz-Pérez (2012) analyze the main characteristics and the results of the promotion mechanisms of renewable energy used in the two European countries leaders in terms of installed capacity and production of renewable energy (Germany and Spain). They research can serve as the basis for the design of regulation in other countries given that it highlights the main advantages of a feed-in tariff system. In a similar way, Winkler et al. (2016) cite that the kind of support instrument can influence the degree to which renewables influence the market. In a case study for Germany they analyze the market impacts of different support schemes. In a stylized Cournot model of interacting spot and forward electricity markets, Dressler (2016) analyze how different price-based support schemes affect producer strategies and competition in the wholesale market. She compare the strategic behavior of renewable and conventional producers in terms of electricity production and forward market sales in the presence of two different price-based support schemes: feed-in tariffs and feed-in premiums. Results show that the feed-in premium, which is the European Commission's current scheme of choice, may enhance market power and favor conventional electricity production.

3. Characteristics and specificities of "green" electricity generation incentives

Depending on the life cycle of power plant that exploits a renewable energy source, it appears various mechanisms and forms of support, i.e. incentives, such as, for example, fiscal incentives (tax reduction/exemption, or tax credit for investment/production), incentives of public authorities (direct payment for the renewable energy production, or guarantees or loans for the renewables), or regulation/incentives which can be price-driven (fixed payment feed-in

tariff/premium payment feed-in tariff), quantity-driven (tendering/bidding), or quality-driven (voluntary "green" electricity purchasing) (Irena, 2012). Supports that are the subject of this research analyzes the regulatory measures to encourage "green" electricity generation, i.e. price-driven and quantity-driven / quality-driven regulation incentives. These support schemes represent the main mechanism in supporting and increasing the share of renewable energy sources.

The main difference between *feed-in tariff (FIT) policies* is whether the remuneration they offer to renewable energy generators is dependent or independent from the actual electricity market price (Klein et al., 2008). Market-independent FIT policies are generally known as fixed-price policies, since they offer a fixed or guaranteed minimum price for "green" electricity based on the specific development cost of the renewable energy technology for every kWh of electricity delivered to the grid. In this case, the remuneration is independent from the electricity market price. On the other hand, market-dependent FIT policies are generally known as premium-price policies, or feed-in premiums (FIP), since a premium payment is added above the market price. Premium-price FIT support schemes require that renewable energy producers provide their "green" electricity to the market, effectively competing with other energy suppliers to meet market demand (Couture, Gagnon, 2010). Hence, the premium tariff represents a modification of the commonly used fixed tariff towards a more market-based support instrument (Klein et al., 2008). Under market-dependent FIT policies, payment levels tend to rise in step with rising retail prices, and vice versa. In order to avoid extra profits when average market prices rise, some jurisdictions have begun to implement caps and floors on FIT premium amounts to ensure that overall remuneration remains within a reasonable range.

This premium can be designed either to represent the environmental and social attributes of renewable energy, or to help approximate the generation costs of different renewable energy technologies (Couture, Gagnon, 2010). Thereby, FIT support schemes have two main features. The first, redemption price that is given to producers of "green" electricity is above the electricity price given from the conventional sources. Secondly, it ensures the integration of "green" electricity in the electricity network, wherewith renewable generation power plants ensures the access to the transmission and distribution grid activities. Therefore, stated systems represent a key instrument that applies to both categories, economic and ecological aspect of regulation. In order to allow greater investor choice, some jurisdictions, as in the case of the Republic of Croatia, offer both the fixed price and the premium price option to renewable energy producers, leaving them the choice to decide which policy option is best suited to their individual risk and investment model (Couture, Gagnon, 2010).

Unlike price-driven policies which set a price for "green" electricity and let the market determine the quantity supplied, *quantity-driven policies* set the quantity to be achieved and allow the market to determine the price. Quantity-based policies include quota systems (also called quota obligations) and tendering/bidding support schemes. Under quota systems, governments typically mandate a minimum amount or share of capacity, generation or sales to come from renewable energy sources. Therefore, the mandate can be placed on producers, distributors or consumers. The share often increases over time, with a specific final target and end-date. Quotas can be linked to certificate trading, i.e. tradable "green" certificates. In general, certificates are awarded to renewable energy producers for the "green" electricity they generate, which can be traded or sold, and serve as proof of meeting their legal obligation. Also, electricity suppliers have to "prove" that they have met their obligations by showing the regulatory authority the number of certificates which must be equal to their obligation (Mitchell et al., 2011). Those with a surplus of certificates can trade or sell them; those with too few can build their own renewable

capacity, buy "green" electricity from other renewable plants (which generally involves a bidding process), or buy credits/certificates from others. It is important to know that most quotas have built-in penalties for actors who do not comply with quotas. On the one side, quota systems have produced increases in renewables, and, in general, the system is significantly less cost-effective than the FIT system, but on the other side, it can be inequitable and flawed (Mendonça, 2007).

Another quantity-based policy is the tendering system which is less commonly used support scheme. This is a mechanism in which renewable energy developers bid for power purchase agreements and/or access to a government-administered fund through a competitive bidding process. Regulators specify an amount of capacity or share of total "green" electricity to be achieved, and the maximum price per kWh. Project developers then submit price bids for contracts. Governments set the desired level of generation from each renewable energy resource, and the growth rates required over time. Also, there are sometimes separate tenders for different renewable energy technologies (Mendonça, 2007).

The instrument mobilising consumer's interest and support for a greater use of renewable energy sources is considered as *quality-driven incentive*, i.e. voluntary "green" electricity scheme. Its key feature relies on the voluntary purchase basis, ensuring a flexible and simple implementation. The advantages of such scheme are securing a pool of financial means from interested consumers, less state involvement and reduced spending from the already restricted public authority funds. The absence of "green" energy voluntary purchase implies the lack of guarantee measures ensuring quantity goals for the utilisation of renewable energy sources, thus failing to be cost-effective, and the effectiveness of which depends on electricity prices and consumers' access to information and awareness (Gan, Eskeland, Kolshus, 2007).

4. Analysis of the promotion policies of renewable energy in the European Union with special emphasis on Croatia

Not only globally, but also in most EU Member States feed-in systems are applied as a support instrument for the electricity generated from renewable resources. These systems have proven to be effective and efficient in supporting renewable electricity generation in many European countries (Ragwitz et al., 2012). This refers to already mentioned incentives, namely feed-in tariffs and feed-in premiums.

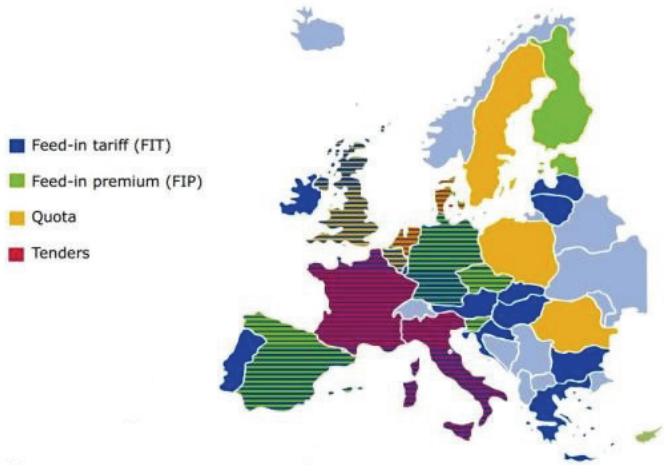
The first European country to introduce into legislation the incentives for the dispatch of electricity from renewable energy sources in the network grid was Germany. Since 1990 many supporting programs have been introduced in Germany to promote the development and use of renewable energy resources. The most important was the Law on Feeding Electricity into the Grid for Renewable Energy (*german: Stromeinspeisungsgesetz – StrEG),* that has been in force since 1991 (Alturki, Khelifa, El-Kady, 2013). Since German laws, i.e. incentive mechanisms for renewable energy have been very successful in creating the market of renewable energy resources and strengthening the electricity supply companies, they have often been used as a framework/benchmark for other national legislation.

Due to the restricting measures of application of feed-in tariff systems encouraging the generation of electricity from renewable resources and the lack of incentives for the improvement and development of renewable energy market, there was the need to evolve from a fixed-price feed-in tariff system into premium-price feed-in tariff payment policies. Moreover, over the last years, a trend towards feed-in premiums can be observed in different European

countries. Similarly, certain EU Member States apply other incentives and support schemes for renewable electricity as well, such as quota scheme[1] and tendering systems.

In order to clearly illustrate the types of incentives for renewable electricity generation in the EU Member States, Figure 1 is given. There is a wide variety of renewable electricity support schemes: while certain Member States apply only one type of support schemes for renewables on their electricity market, i.e. fixed-price feed-in tariff (FIT), premium-price feed-in tariff (FIP), quota or tenders scheme, it should be noted that a combination of these incentives and supports is applied on other markets. Until recently, most of national "green" electricity markets of EU Member States applied only one type of incentive, namely feed-in tariff or quota system. And while Figure 1 shows dominant renewable electricity support schemes only, secondary support instruments like tax incentives, investment grants, etc. are not indicated. A successful implementation of incentives for "green" electricity generation implies the inclusion of both primary and secondary support schemes with which a synergistic effect is achieved on the renewable energy market.

Figure 1 *Diversity of "green" electricity support schemes in the European Union in 2014*



Source: Klessmann, 2014

It is noted that the mentioned supports and incentives are a dynamic category that is constantly changing: depending on the activities on the electricity market, some EU Member States abolish or introduce new incentives and support schemes for "green" electricity generation. For example, a fixed-price feed-in tariff system was the only system applied in Croatia in 2014. After the introduction and implementation of the legal act of 1 January 2016 in Croatia, in addition to traditional feed-in tariff, feed-in premium is also applied (Official Gazette, 2015). According to this Act, a feed-in premium is a model of incentive for all renewable energy resources, while a feed-in tariff is a form of incentive for production plants and/or production units that use renewable energy resources, with a connected load of up to and including 30 kW. Considering technical advantages of the incentive model and the electricity production price, it can be

[1] At the time of writing of this article, quota scheme is applied in the following EU Member States: Belgium, Poland, Romania, Sweden, United Kingdom (European Commission, 2012).

assumed that the feed-in tariff system will primarily (or only) be used in solar power plants (Goić, Tojčić, 2016).

The system of incentives for "green" electricity generation is financed in the Republic of Croatia from two sources, namely from earmarked fees for the promotion of "green" electricity generation and from the funds collected from suppliers through the obligation of purchasing the electricity produced in renewable energy plants included in the incentive system proportional to the market share in the total supply. The fee for the promotion of "green" electricity generation is charged to final consumers of electricity as a fixed fee for every consumed kilowatt-hour (kWh) of electricity. This fee, as a support to "green" electricity producers, is charged in Croatia since 1 July 2007, then amounting to 0.0089 HRK/kWh (Official Gazette, 2007). It did not change until 2010, when it dropped to 0.0050 HRK/kWh (Official Gazette, 2009), whereas since 1 November 2013 the stimulation fee rose to 0.0350 HRK/kWh for all electricity consumers (Official Gazette, 2013). Such a drastic increase of the fee is attributed to the lack of funds necessary to pay renewable energy plants that are in the incentive system. Furthermore, the projections indicate that even the current fee of 0.0350 HRK/kWh is not high enough to settle the incentives for renewable energy technologies due to the legislative increase of quotas for wind power plants (with total installed capacity of 420 MW to 744 MW), which thus entered into the system of incentives without prior arrangement of the corresponding source of funding to balance the system (Bajs, Mikulić, Majstrović, 2016). One of the possible measures to ensure sufficient funding for "green" electricity generation incentives is an additional increase of the fee for renewable energy resources, which could even double in near or distant future, from current 0.0350 HRK/kWh to as high as 0.0750 HRK/kWh (Bičak, 2017). In this way, almost all contractual obligations of renewable energy plants or "green" electricity producers could be met.

This primarily refers to wind power companies that in Croatia lead the way in the production of electricity from "sustainable" renewable resources[2]. It was these supports and incentives for "green" electricity generation that ensured the penetration of wind power companies into Croatian electricity market. With relatively favorable wind potential and substantial funds in the form of incentives for renewable energy resources, wind power companies have become an obvious example of the increase in the share of renewable energy resources in certain EU Member States, including Croatia.

5. Conclusion

Renewable power deployment policies principally aim to increase the installed capacity of renewable energy technologies and the generation of renewable electricity. In achieving this, they may target a range of other outcomes (Irena, 2012), such as economic (enhancing economic competitiveness, job creation, technology cost reductions, a sustainable level of domestic production and market share in renewable energy technologies, etc.), environmental (environmental protection, reduction of greenhouse gas emissions (Kyoto protocol), (environmental) risks involved with nuclear power, etc.), and energy outcomes (a more sustainable, secure energy system, i.e. enhancing energy supply security, reducing import dependence of the energy system, etc.). In this sense, incentives and support schemes for renewable energy have a crucial role, on the one side, on the increased use of renewables and, on the other side, on the development of the national economy.

[2] In 2014, wind energy covered 78.55% of electricity out of the total electricity produced from renewable resources and cogeneration (HROTE, 2015).

Empirical analysis suggests that price-driven incentives, i.e. fixed-price / premium-price feed-in tariffs are (in this moment) the most effective policy to encourage the rapid and sustained deployment of renewable energy. There are several different ways to structure a price-driven policy, each with its own strengths and weaknesses (Couture, Gagnon, 2010), which can be analyzed more detailed in the further research.

Finally, towards to the successful functioning of support schemes and incentives for "green" electricity generation, and development of renewable electricity market, it is necessary to implement, not only the legislative framework and supporting administrative measures, but also the technical possibilities of the electricity sector in the acceptance these measures and activities in the market.

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