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Promoting the Use of Renewable Energies

An Evaluation of the Hungarian Feed-in Tariff System

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Table of Contents

List of Figures

List of Tables

„Progress in every age results only from the fact
that there are some men and women who refuse to believe
that what they knew to be right cannot be done."
(Russel W. Davenport)

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1. Introduction

The role renewable energy sources have in energy production is becoming more and more significant, as the gaining ground of green energy production enhances the security of supply, reduces the burden on the environment and, at the same time, fosters economic growth. For the time being, however, it is a more costly, high-investment alternative to traditional (nuclear and fossil) energy production methods, and thus it is at a competitive disadvantage under current market conditions.

Considering the future exhaustion of fossil fuels, the emission of greenhouse gases and their global warming effect, and mankind's desire for a livable environment, the demand for green energy sources is certain to keep on growing. „[…] renewable energy sources […] are the only types of energy currently available that respond to the compelling challenge of sustainable development." (Dinica, 2006)

In order to facilitate this recognition and to support related efforts, the European Union expects its member states to deliver higher and higher proportions of renewables in energy production. The Directive 2009/28/EC set the target of achieving a 20 percent share of green energy in overall Community energy consumption by 2020. The figure was 10.3% in 2010, thus the intention is to nearly double the proportion within ten years, which clearly necessitates large-scale investments from the green energy sector. To this end, member states need to have renewable energy promotion schemes in place that are capable of creating an environment that is sufficiently attractive to investors.

It is the duty and the interest of the regulator to take into account and to recognize the advantages that are not reflected in market prices (less external effects, reduced dependence on fossil energy sources, fostering innovation). Market preferences are adjusted via renewable energy promotion/subsidization systems. They are a mechanism through which the regulator provides green energy producers with an additional income above the market price, which might suffice for their investments to offer reasonable rates of return.

Considering electricity, there are basically two types of green energy promotion schemes (that prevail in today's renewable energy regulations). Price-based schemes are called **feed-in tariff** systems; green energy producers are guaranteed a predetermined feed-in rate that exceeds the market price. The other typical type of regulation, the **green certificate** scheme, intervenes in the marketplace based on quantity (rather than price), by prescribing a certain share of green energies. Of course, some complementary promotion schemes – like investment subsidies, tax allowances or R&D subsidies – do exist, as well, yet the two basic types mentioned above are the ones that constitute the foundations of promotion mechanisms.

Papers on the evaluation and analysis of regulatory systems (Menanteau et al., 2003), (Fouquet-Johansson, 2008), (Haas et al., 2011a); (International Energy Agency, 2011) usually conclude that feed-in tariff systems are better-suited and more effective. Also, this is the type that prevails in the EU (where nearly 3 out of every 4 states opted for a feed-in tariff scheme) and in the majority of the countries that have pioneered the use of green energies (Germany, Denmark, Spain).

The primary difference between the two schemes is that green energy has a guaranteed price in feed-in tariff systems, that is, the regulation is predictable. In green certificate schemes, on the contrary, regulators only prescribe the required share of green energies in total energy production, while pricing is left to the market. Green producers sell the energy they produce in the marketplace, while the green certificates received in exchange for their green energy production are traded in a market specifically created for this purpose. The price of green certificates is a function of market processes and hence hard to predict. This higher level of unpredictability means higher uncertainty for investors, which makes green certificate schemes appear less attractive.

Based on a thorough review of the qualities of the different promotion schemes and an evaluation of experiences from Europe, my thesis aims at formulating recommendations that facilitate the improvement of the Hungarian feed-in tariff system. Accordingly, it is divided into the following chapters.

Following this introductory section, Chapter 2 gives a more detailed account of the objectives that can be achieved by capitalizing on green energies: the reduction of both our dependence on fossil energy imports and of the burden on the environment, and the fostering of economic growth. Based on their conditions and preferences, different countries may prioritize these objectives in different ways.

Chapter 3 comprises a description of the characteristics and mechanisms of feed-in tariff and green certificate systems. I provide a one-by-one review of the aspects under which the performance of these schemes may be assessed. After summing up the potential advantages and shortcomings of the two systems, I give some rules of thumb for making a reasonable choice between them based on one's preferences.

In Chapter 4, I will provide an overview of the objectives and the fundamental documents of the European Union's renewable energy policy, which have to be taken into account by the member states in establishing their own regulations. I will analyze member states' promotion schemes, their qualities and effectiveness, as well as their deficiencies. Several countries have replaced the system they had started out with or opted for employing a combination of price and quantity-based regulation. As of today, the majority of member states are using a feed-in tariff scheme, primarily because experience so far has shown that this is the system that is capable of delivering a more significant improvement in the share of green energies.

In Chapter 5, I shift the focus to the Hungarian regulatory framework. Just like in the majority of EU member states, it is a feed-in tariff system that Hungary has had in place ever since 2003. Having achieved an approximately 6-7% share of renewables during its first ten years of operation, the Hungarian system has got several special properties in comparison to typical feed-in tariff systems, which have had an influence on its development path so far. In line with the EU's requirement, Hungary also prepared its National Renewable Action Plan („Nemzeti Megújuló Cselekvési Terv" – hereinafter also NMCST) outlining the steps planned and the path to be covered in order to meet the 2020 renewable goals, pledging to achieve a renewable share of 14.65% by 2020. Meeting this goal requires the country's renewable energy production capacity to be more than doubled, necessitating investments in the several thousand billion HUF range, which clearly is a tough challenge for the industry. The chapter also features a description of the intended principles of the new regulatory framework that was announced some two years ago yet has not been actually completed ever since, along with the harmful effect of this regulatory uncertainty, which led to a temporary halt in renewable energy production investment.

The sixth section consists of the empirical research, which served to formulate recommendations for the improvement of the Hungarian regulation by exploring the deficiencies of the existing situation and their potential remedies. Implementing these recommendations could facilitate the meeting of our pledges for 2020, that is: the re-vitalization of the Hungarian renewable energy sector's development. My research and my hypotheses were centered around three topics.

First, I explored the theoretical background of the „PV bubbles" observed in several European countries. During the period from 2008 to 2011, some of the countries with a feed-in tariff scheme experienced an unexpected surge in the construction of solar power stations, which led to the renewable sector's divergence from its intended path, power grid management problems and an increase in the price of electricity. The phenomenon was caused by policymakers' inability to determine, with sufficient accuracy, the optimal feed-in tariff for this rapidly developing technology, and the prices they introduced turned out to be too high, and thus led to investment booms. My first hypothesis revealed that in a situation of imperfect information, the slope of the marginal cost curve of the technology in question affects whether it is the price or the quantity-based regulation that might cause the more severe regulatory failure, damage and problem.

This hypothesis is of particular significance to the Hungarian regulation because no significant PV capacity has been installed yet in the country due to the low feed-in tariffs; yet we have set ambitious targets for 2020, thus the administration needs to be prepared to deal with the potential flaws of the feed-in tariff scheme.

Through my second hypothesis, I point out that the amount of subsidy Hungary currently provides to fossil production methods via the electricity bill exceeds the amount going to renewables. The significance of the statement lies in the fact that the subsidies built into the feed-in tariffs of renewable energy producers have to be paid for through the price of electricity, and hence by the end consumers. Consequently, a potential increase in end consumer prices might be an argument against increasing renewable energy production. The gradual phasing out (and redirection) of the subsidies going to the fossil energy sector via the electricity bill would allow for raising the support going to green energies without increasing the burden on end consumers.

The third research avenue I have pursued in my dissertation is the evaluation of the Hungarian KÁT scheme's operation, the description of the industry's current situation and the exploration of the stakeholders' expectations of the new regulatory framework. As part of this stage, I conducted structured in-depth interviews with 25 subjects, the vast majority of whom had been working in the field ever since the implementation of the KÁT system.

The evaluation of the in-depth interviews revealed the main strengths and weaknesses of the KÁT scheme, and the goals the Hungarian renewable policy is expected to serve. I concluded that the primary advantage of the KÁT system was that it provided for a predictable environment. Its achievements (the increase in the share of renewables) might have been far more impressive if the feed-in tariff structure had been more differentiated, and if the government had not announced the taking effect of the new regulatory framework called METÁR two years ago, for that step rendered the KÁT scheme practically dysfunctional, and incapable of promoting investments in the field.

My evaluation of the KÁT scheme also served the purpose of formulating possible improvements to the system, which might provide useful guidance in developing the new regulation. Policymakers' attention is called to a further challenge by the hypothesis asserting that the primary obstacle to the promotion of renewable energies currently is the unpredictability of the regulatory environment. During the in-depth interviews, I clearly sensed an atmosphere of distrust towards the regulation, which may, for the most part, be explained by the repeated postponements of the new scheme's implementation and by retroactive legislation in certain other areas. Thus the need to restore predictability and trust towards the regulation was identified as the main expectation from the METÁR system.

Finally, I asked the interviewees to discuss whether the next eight years still give us a chance of achieving our 14.65% target at all – given the drawbacks of the current situation and the two year delay of the new regulation, which have, in addition to raising distrust in the regulation, prevented us from making any significant progress towards our 2020 goals from 2010 onwards. The majority of respondents believe the answer is still 'yes'. Yet it necessitates the prompt restoration of the reliability, credibility and predictability of the regulatory environment.

2. The Ever More Significant Role of Renewable Energies

The role of green energy production is becoming more and more significant in the European Union, both on a community level and in the individual member states. The requirement to increase the share of renewables in energy production is now part of our energy policy objectives. As of now, renewable technologies are not yet competitive with fossil and nuclear energy production in terms of price, which is why governments support the green energy industry through economic regulations.

The vast majority of relevant studies are in accord on the **three primary objectives that call for the increase and promotion of renewable energies**, as also underlined by Lipp**:**

- **reduce dependence on imported fossil energy sources** (increase security of supply);
- **moderate the harmful environmental effects of the energy industry** (the primary measure of which today is the emission of CO_2, the greenhouse gas largely responsible for global warming);
- **stimulate industrial development** (Lipp, 2007, p.5481).[1]

With respect to the early years of renewable energies, a number of sources only mention the first two objectives (Meyer, 2003), (Neuhoff, 2004), and environmental effects are further narrowed down to the reduction of carbon dioxide emissions only. Innovation and economic development only became a clearly formulated objective as newer and newer technologies kept appearing and emerging as a result of innovation, along with entire new industries trying to exploit the opportunities (the manufacturing of wind turbines, for example, became a key industry of both the German and the Danish economy).

Considering EU member states, these are complemented by the objective of meeting the community's directives, which, though clearly formulated in order to meet the three objectives listed above, still represent a significant additional stimulus to some countries.

[1] Lipp divides this last objective into two subparts: innovation promotion/improving competitiveness; and capitalizing on local and regional opportunities.

2.1. Security of Supply, Dependence on Fossil Energy Imports

Increasing countries' security of supply has had a central role ever since the appearance of renewable energies, yet as Lipp points out, the motivations have changed during these last three or four decades (Lipp, 2007, p. 5485).

The promotion of renewable energy production dates back to the end of 1970s. At the time, the energy sector's research activities were centered around the finite availability and the exhaustion of fossil fuels. The primary reason why renewable energies appeared as a reasonable alternative was the fact of the exhaustion itself, and the expected (and actual) soaring of market prices (especially those of oil). As evinced by Figure 1, this trend was particularly strong between 1970 and 1980, during which period political events in the oil-exporting countries (embargo on Arab oil, Iranian revolution, Iran-Iraq war) caused the price of crude oil to skyrocket to nearly eight times its previous level. By 1985 the oil price returned to normal levels, yet that very decade made the world aware of the risks of an excessive dependence on fossil energy imports, though worries were centered more around the uncertainty of price fluctuations and less around the exhaustion of resources.

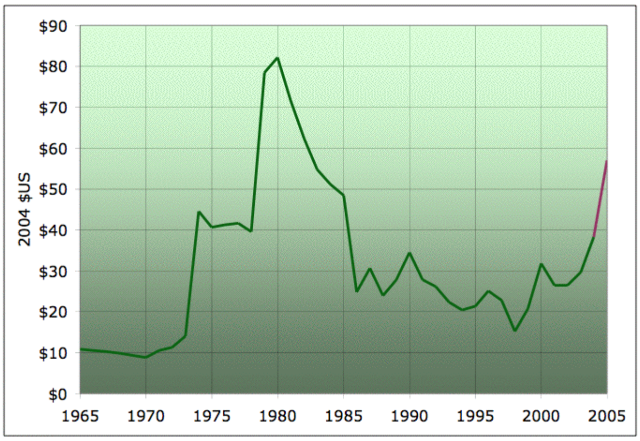

Figure 1: Crude oil price 1965-2004

Source: BP Statistical Review of world energy;
http://www.theoildrum.com/story/2006/1/20/162942/196

The issue lost in importance during the period 1985-2004, when the price remained within a relatively narrow band. As we can see from Figure 2, showing data for the last ten years, the period after 2005 has once again witnessed an enduring rise in the price of oil. In comparison to early 2007, the price doubled by the middle of 2008, reaching an all-time maximum of USD 130.

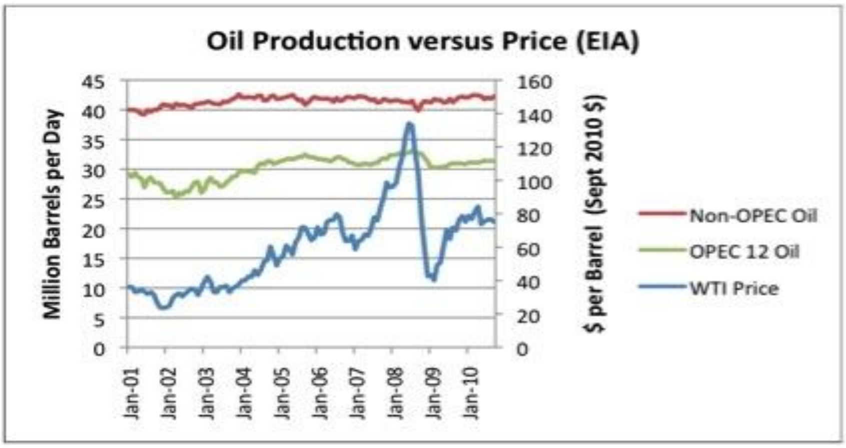

Figure 2: Crude oil production and price 2001-2010

Source:http://ourfiniteworld.com/2010/12/20/will-2011-be-a-rerun-of-2008-longer-version/

In addition, there was the Ukrainian-Russian gas dispute in 2009 affecting large parts of Europe, and resulting in gas shortages in a number of countries. As a consequence of the economic crisis, the uncertainties concerning the political stability of the key fossil fuel exporting countries – as a potential source of problems – once again became an area of primary focus by early 2011 (Jäger-Waldau et al. 2011). The pillars of the economic models built upon fossil fuels from foreign countries were, once again, shaken, and recent years have seen security of supply receiving more emphasis as one of the key advantages of renewable energies.

In terms of import dependence, the EU is rather vulnerable. The average energy import dependence of EU states was 45% in 1999 and has been on the rise ever since, reaching 54% and 53% in 2009 and 2010, respectively. Hungary's figures of 59% and 58% thus infer an exposure somewhat worse than the average. Member states' gas and oil dependence figures are, however, even more striking (64% and 83% in 2009, 62% and 85% in 2010, respectively). In terms of gas dependence, Hungary is far more exposed than the EU average – even though import dependence fell to 79% in 2010 from 86% in 2009 – due to the conditions of its gas contract with Russia[2]. Concerning oil, its exposure in 2009 (78%) was more favorable than the EU

[2] The extent itself of Hungary's gas exposure is problem enough, yet a further unfavourable circumstance is that the vast majority (approx. three fourths) of imports come from one single source: Russia. A key task Hungary's energy policy will face in coming years is the diversification of gas supplies, in which respect the running out of our current contract with Russia in 2014 will clearly bring about new possibilities. There are several studies and presentations available on the topic, for example see (Regionális Energiagazdasági Kutatóközpont, 2011, pp. 59-81.) and (Kaderják, 2011).

average, yet the situation changed and Hungary caught up with the EU average at 84% by 2010. (Eurostat, 2011, p. 25; 28, 30.), (Eurostat, 2012, p. 28, 32, 34).

Thus security of supply is, both for the community and for Hungary, an important argument for promoting renewable energy production based on local energy sources, which partially serves to improve these figures. Of course, renewables will not be able to completely replace fossil fuels in the foreseeable future, yet they may substantially reduce our exposure. Moreover, countries have also begun to appreciate two more advantages of renewables: first, they are non-exhaustible and second, the countries themselves can decide on their utilization instead of being at the mercy of foreign oligopolists'/monopolists' current eco-political interests.

Renewable energy production is, naturally enough, not only about advantages, but it can also pose challenges to fossil fuel based economies. Due to their very nature, renewable forms of energy have a lower power density, they are typically available in smaller amounts, which allows for decentralized modes of power generation. In some cases, supply is heavily dependent on the weather and thus its distribution falls entirely outside our scope of control, which creates new challenges for electricity transmission, distribution and control systems.[3]

The interpretation the International Energy Agency suggests for energy security is broader: ensuring, at all times, that the demand for energy is satisfied from appropriate and reliable sources at affordable prices and that environmental impacts are avoided, as well (International Energy Agency, 2011, p.66). The study underlines that the reason for the current energy production structure being unsustainable is twofold. First because this very path leads to an intolerable increase in global mean temperature, and second because of the exhaustion of fossil energy reserves. They suggest that renewable energies need to take a central role in our future energy system to ensure its security and sustainability, both in the short as well as in the long run.

[3] For details on potential problems and how to deal with them see (Pál, 2007).

2.2. Mitigating the Harmful Environmental Effects of the Energy Industry

According to Lipp, the need to make energy production more environmentally friendly dates back as far as the mid-1950s, when the drastic increase in London's air pollution led to smog alerts becoming more and more common. During the 1980s, it was water pollution and forest damage caused by acid rain that called our attention to the ever increasing level of pollution. Energy production, due to its then power generation capacity having been primarily coal-based, was one of the root causes (Lipp, 2007). With environmentalist efforts constantly gaining ground, countries tried to limit pollution levels, mainly by promoting cleaner technologies, introducing emission limits and tightening regulations.

At the same time, the need for reducing the air pollution caused by traditional coal-fired power stations, for a cleaner environment and for improving people's quality of life found its way to the list of arguments in favor of renewable energy production. Moreover, the Chernobyl and Fukushima disasters (in 1986 and 2011, respectively) called attention to the risks of nuclear power, giving a further push to the shift towards renewables.

The concept of external costs and benefits was introduced by Marshall's *Principles of Economics* at the turn of the twentieth century. An external effect is whenever a financially independent unit has an influence on another independent unit's situation without the two of them having a connection via the marketplace (Kerekes-Szlávik, 1996, p.81). A well-known example of an externality is environmental pollution (Kerekes, 2007), that is, when the pollution caused by the polluter has a negative effect on others' well-being. By publishing his theory on the internalization of externalities in 1920, Pigou laid the foundation for the literature of environmental taxation. In 1960, Coase added his theorem on the socially optimal level of externalities. [4] These theories only hold true under ideal conditions (perfect information, competitive market), yet it was the approach they represented that

[4] As long as property rights are clearly defined, market negotiations automatically lead to a socially optimal level of externalities, and hence government intervention is superfluous (Coase, 1960). In practice, the validity of the Coase theorem is challenged by the number of those affected by environmental pollution being rather large, by bargaining costs being non-negligible and by the lack of perfect competition and information – but it is excellent as a theoretical starting point.

helped the necessity of managing and regulating environmental pollution and the economics thereof become part of general economic thought. The first regulatory instruments started to appear (environmental taxes, quotas, emission limits).

Instead of the local externalities that might be kept under control based on the above theories, environmentalists' attention is today primarily [5] focused on global environmental externalities – and particularly on global warming and how to cope with it. Several pieces of literature narrow down the role of green energies in environmental protection to climate protection, and define the utilization of renewable energies as an important means thereof (Hirschl, 2009, Fouquet-Johansson, 2008).

In energy production, as well, it is the CO_2 emission level of or the reduction[6] in CO_2 emission achieved by the various technologies that constitute the basis for comparison; and renewable technologies tend to score far better than their fossil counterparts. This is in accordance with the idea of Menanteau-Finon-Lamy that from a theoretical point of view, the subsidization of renewable energies can be interpreted as a compensation for the negative environmental externalities caused by our use of fossil fuels (Menanteau et al., 2003, p. 800).

A Power Consult study set out to quantify the external costs of the various modes of electric power generation, including renewable technologies. The analysis defined external costs to be equal to the lifecycle emissions of harmful substances (solid particles, sulfur dioxide, nitrogen dioxide, greenhouse gases), which were then calculated accordingly (Power Consult, 2010).

	hydro	wind	biomass	PV	coal	gas	nuclear
external cost for the entire technological chain (cEUR/kWh)	0.2-0.45	0.1-0.3	0.1-1	0.1-0.6	1.5-4.5	0.4-2.5	0.007-1
CO_2 emission (g/kWh)	10-20	10-40	550-1100	50-200	660-1200	370-580	5-15

Table 1: External costs of the various sources of energy

Source: author's compilation based on Power Consult, 2010 pp.130-131.

[5] Especially in EU member states. In developing and underdeveloped countries, environmental protection is in its early stages, and local problems are still rather significant.

[6] This is what (Lipp, 2007) and (Power Consult, 2010) employed, as well.

The results, summarized in Table 1, clearly show that renewables are „greener" than fossil fuels both in terms of external cost and CO_2 emission, per unit of power produced. From amongst all known renewable energy sources, the figures were the lowest for hydro power stations and wind turbines, while biomass generators and PV panels are somewhat less favorable, especially concerning greenhouse gases.

There is an order of magnitude (approx. tenfold) difference in favor of green energies considering external costs, while in terms of CO_2 emission, they are almost two orders of magnitude ahead of traditional technologies. Though criticized by a number of environmentalist organizations, nuclear power undoubtedly boasts a surprisingly low CO_2 emission level – even lower than renewables –, while its external costs are somewhere in between those of traditional and renewable power plants. The external cost ranges of fossil power plants are similar in proportion, but much larger in absolute terms. The place any one specific power station takes within that range depends on its own individual attributes (age, technology, raw material quality, utilization rate).

In recent years, environmental thought has been focusing primarily on sustainability. From the containment and handling of, and the technological solutions to severe environmental disasters, emphasis has shifted towards aligning the needs and requirements of the society/economy/environment with each other. Even if our environmental objective is limited to following the principles of **sustainable development** – the foundations of which were laid down in *Our Common Future*, the 1987 report of the Brundtland Commission –, it is still obvious that renewables better serve the purpose than fossil power stations do. Sustainable development can be interpreted as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Comission on Environment and Development, 1987).

Out of the three criteria of sustainable development[7], two are related to the use of renewable energies. One is about the reasonable use of exhaustible resources, which may be facilitated by, on the one hand, using renewable substitutes and, on the other hand, by technological development. The other requirement is that renewable energy sources shall only be used at a rate that does not exceed the rate of their natural or

[7](Kerekes, 2007, p. 32).

managed regeneration[8]. There is not too much to explain about the first criterion: fossil fuels are only available in finite quantities, thus we need to make sure that they are used as efficiently/economically as possible, and that appropriate substitutes become available in due time.

The second requirement is, however, less obvious – basically, one would be inclined to think that the more renewables we use, the more sustainable our energy production will be. Nonetheless Kerekes also calls our attention to the fact that the availability of renewables at any one specific point in time is not infinite, either, as they do need a certain time for regeneration, which needs to be taken into account in exploiting them. This is particularly true for biomass and biogas based electricity production, for even though these raw materials are indeed renewable and thus continuously regenerated, that process takes time. The condition is also relevant to hydroelectric plants, as well, as their installation might have some downstream effects on the river, and even on the potential energetic use of its later sections. Accordingly, more renewable energy does not necessarily make the economy more sustainable; we have to make sure that our use of renewable energies is actually sustainable.

Some authors take an even more solid stance on the relationship between renewable energies and sustainable development. As Dinica put it: ”renewable energy resources reduce environmental and human health impacts and are the only types of energy currently available that respond to the compelling challenge of sustainable development” (Dinica, 2006, p.461).

Accepting the broad interpretation of sustainability – that it is an effort to create a balance between economic, social and environmental interests –, we are only just one more step away from formulating the requirements towards an ideal promotion scheme. In this sense, renewable energy use is sustainable if both economic (cost efficiency, non-excessive subsidies, using BAT technologies, non-wasteful use of resources, security of supply, competitiveness, innovation, economic development) and social interests (habitat conservation, projects that are optimal from a social point of view, employment growth, protection of regional values, improving quality of life, funding of green energies to remain a tolerable burden) are taken into consideration.

[8] The third criterion is that the waste production rate should be lower than or, at most, equal to the waste absorption capacity of the environment.

2.3. New Industrial Development, Innovation, Economic Stimulus

As of today, electricity production from renewable sources is not yet market-ready under all aspects, but it is rather a technology in its active innovation phase, therefore it is more expensive than fossil technologies in terms of traditional costs, and thus the clear underdog under market conditions. These technologies need support, need a „shield" until they can take off on their own learning/development path, which may be substantially aided by their use becoming widespread (Menanteau et al., 2003, p. 801).

The situation would be different, of course, if all economic, social and environmental external costs were incorporated into market processes, but a competitive marketplace cannot be reasonably expected to deal with external costs as of yet; the promotion of technologies with lower external costs – that is: renewables – can only be realized through government intervention.

By now, almost an entire new industry has been established to back the use of renewable energies, as the continuously growing share of renewables in energy production necessitates large-scale investments, and a wide range of equipment manufacturing capacities and auxiliary services. The countries that pioneered the development and the spreading of one or more technologies usually also managed to become successful in establishing manufacturing capacities, and turning them into key drivers of the country's exports (e.g. German wind turbine manufacturers and operators). The installation, operation and maintenance of renewable power stations also require special expertise, under which aspect early adopters might very well enjoy a competitive advantage.

In industries characterized by intensive innovation, technological improvements may even completely knock out the currently prevailing solutions, which is why there clearly is no shortage of new ideas (vertical-axis wind turbines and solar towers instead of flat solar panels, for instance) in the industry – nevertheless, those doomed to succeed are hard to tell apart from the rest.

The spread of renewable technologies and the growing economies of scale in their manufacturing are acting to significantly reduce their unit costs – investment and operation costs likewise. Thanks to this process (and innovation), these figures are getting closer and closer to becoming actually competitive. As Arthur so aptly put it: technologies do not get employed when they are efficient, but they get efficient when they are starting to get employed (Arthur, 1989, p. 158).

Lately, it has been the market of PV panels where drastic drops in unit cost have happened, the reason being that the technology only began to rapidly spread about 4 or 5 years ago, and experience from practical applications provided useful feedback to the innovators. In recent years, each time installed capacities were doubled, it brought along a 20% reduction in unit costs on average, which largely contributes to the increasing competitiveness of solar power stations (Jäger-Waldau, 2009).

Increasing the share of renewables in energy production necessitates investments, and thus has a stimulative effect on the economy, as well. Furthermore, the manufacturing of new power stations and their spare parts, their operation and auxiliary services[9] may create new „green collar" jobs. In today's shaky economic environment, employment is becoming more and more of a key aspect. Telling examples are the cases of Germany and Denmark. Both countries began making serious efforts in the field of wind turbine development as early as the late 1990s, both in terms of installation and manufacturing. Within 10-15 years, it was not only installed capacity where they had achieved a leading role, but they had also managed to build the world's largest wind turbine manufacturing corporations, which has had a significant positive impact not only on the economy and the exports of these countries, but on their employment figures, as well (Lipp, 2007).

The development of the green industry has a complex impact on employment, existing jobs may be lost while new ones are created – thus it is the net employment effect that one should examine. The most labor-intensive activity is the manufacturing and the assembly of the equipment used in green power plants; without that, employment effects may be rather limited (Grabner, 2010).

Renewable energy sources are locally available materials, thus in contrast to fossil power plants' model of large, centralized production units, they represent a decentralized power generation mode of small, distributed capacities; and hence they open up new directions and pose new challenges for countries' energy policies and,

[9] A good example is how the Hungarian wind forecasting profession (as part of the Meteorological Service) has developed hand in hand with the spread of wind turbines in the country.

undoubtedly, their distribution systems, as well. Due to their decentralized, local, distributed nature, they are capable of stimulating economic development regionally, they may create jobs for the inhabitants of micro-regions, and not only „power plant towns". They can be deployed in areas that are – possibly because of their otherwise unfavorable natural conditions – unsuited for the usual economic activities (e.g. land unsuitable for arable farming). Besides being particularly labor intensive, the utilization of biomass/biogas may also have some additional favorable effects on agriculture and rural development.

Concerning innovation, policymakers have to weigh a number of important questions. They have to find the technologies where their country may have a chance for a technological breakthrough, and they need to support the spreading of these technologies and related research efforts. By now, a stable status quo has been established between our countries in terms of manufacturing capabilities – for anyone entering the market now, the chances for substantial success would be miniscule. Another question is what phase of innovation a project should be in to be deemed worthy of support or promotion by the country in question, for it may be a waste of money to support an early (pre-innovation) technology, while waiting too long for innovation to happen may carry the risk of missing our renewable targets, and of foregoing valuable experience in the utilization of the energy source in question. For instance, a key factor to the evolution of the aforementioned German wind turbine manufacturing base was that Germany had deployed even the very first technologies, far less efficient than today's equipment, and the experience from the operation of these served as a basis for developing and refining the technology (Butler - Neuhoff, 2008).

A number of sources in the literature split up this objective into several elements, and talk about innovation promotion, improving competitiveness, and local and regional opportunities as (partly) separate matters (Infrapont, 2010) or analyze economic development and industrial development/innovation separately (International Energy Agency, 2011); and the Hungarian action plan, as well, lists agricultural-rural development and the development of the green economy as two individual goals (Nemzeti Fejlesztési Minisztérium, 2010).

3. Schemes for Promoting Green Electricity Production

In comparison to traditional ways of energy production, renewable energy production is not yet competitive under the current market conditions, primarily due to the higher investment costs of green technologies and to external environmental damages not being adequately reflected in market prices. Therefore, some form of support is required for renewable energy production to actually gain ground.

There are two basic types of economic incentives in the field that have become widespread: price-based incentives (feed-in tariff schemes) and quantity-based incentives (green certificate schemes). Naturally, there are some complementary supporting mechanisms, as well: capital support, investment subsidies, tax benefits, preferential credits. The dissertation will not discuss these instruments in detail; I will only analyze the two schemes that dominate the regulation of the green sector.

It has been only in recent years/decades that renewable energy production has become more widespread and received more emphasis among the EU’s objectives. Consequently, the literature has expanded with a number of articles trying to identify the properties an effective promotion system should have. As a whole, the lesson can be drawn that Ekins’ statement from 2004 is still valid, that is: the nature of the ideal instrument may differ country by country, with regard to the connections and deviations between the different histories and cultures of the individual countries. The author also draws attention to the great possibilities in analyzing and comparing the different schemes in order to identify opportunities for the development of existing schemes (Ekins, 2004, p. 1903), and to draw conclusions that our own country can capitalize on.

3.1. Principles of Operation of Feed-In Tariff and Green Certificate Schemes

The essence of **feed-in tariff (FiT) schemes** is that the policymaker guarantees priority dispatch for electricity from renewable sources, and that at a tariff above the market price. The purchase obligation lies with either the electricity retailers or the transmission operator or the network license holders.[10] The amount of subsidy contained in the price of green energy is then charged to end consumers via the electricity bill. This way, renewable energy production – or more specifically, the part of the feed-in tariff in excess of the market price – is financed by electricity consumers instead of the central government. The method of division seems to be just, as each consumer bears a burden that is in proportion with their own electricity consumption, thus large consumers assume a larger share of these costs than those using only smaller amounts of electricity.

Authorities usually choose the price-based method when their support is intended to promote some valuable activity; one that is beneficial from a social point of view, but consumer demand is insufficient for promoting it through the market (Verbruggen – Lauber, 2012). Renewable energies having to compete with fossil fuels that are cheap owing to their external costs not being internalized is a typical example.

Thus the variable through which the feed-in tariff influences the system of demand and supply curves of the traditional intervention free market is price – a price offer above the market equilibrium (see Figure 3). This way it enables the production of an amount of renewable electricity that is above the market optimum (P_p;Q_p), as it might yield positive returns on technologies/projects that would not be competitive otherwise.

[10] The purchase obligation has no influence on the competition between the obligors, as the total quantity purchased is divided among them in proportion to their respective electricity sales, that is, each participant is allocated the same proportion of extra cost, which then again gets distributed between all their consumers.

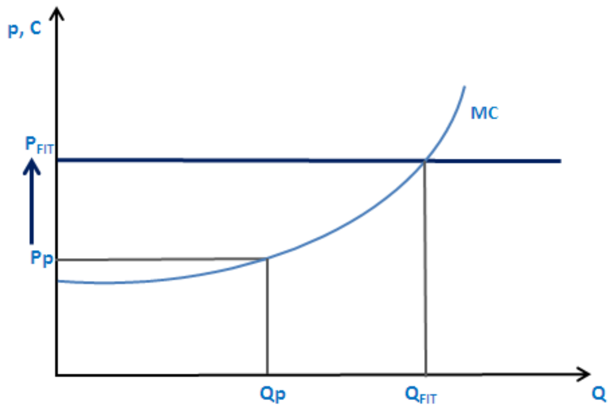

Figure 3: Principle of operation of feed-in tariffs

Thus the operation mechanism of the FiT scheme is that it sets a higher price level (P_{FiT}), which allows a production volume higher than the market equilibrium (for the energy source in question) to earn a revenue that exceeds its marginal costs. If we were to consider several technologies (solar power stations, wind turbines, hydropower plants) at the same time, we should draw several different marginal cost curves of differing shapes, for each one of which the FiT scheme would define the quantity to be produced by setting differing prices for the different technologies.

In a feed-in tariff scheme, renewables projects do not have to compete with each other, as each one of them enjoys the benefits of the purchase obligation and the guaranteed price, without any quantity limits. Nonetheless, as Butler-Neuhoff point out, feed-in tariff schemes also generate competition: project developers compete for the best locations, while equipment manufacturers all want their share of the orders (Butler-Neuhoff, 2008).

Producers are granted the feed-in tariff for a certain period of time, stipulated in laws or individual decrees. For any given feed-in tariff, the criterion for a technology to be viable is that the feed-in tariff exceeds its marginal cost of production. As both the historical and the maintenance costs of the various technologies tend to differ, feed-in tariff schemes usually differentiate their prices according to technology, capacity, startup date and other parameters (Verbruggen - Lauber, 2012).

Feed-in tariffs being determined by the policymaker, it is of utmost importance that they be properly informed about the tariffs currently available technologies require for a project to pay off. Is the tariff too low, its incentive power will be lost and the technology to be promoted will fail to appear until technological progress enables production costs to fall below the specified tariff. Setting an excessively high tariff is not advantageous, either, as the extra profit producers can expect to earn will result in the relevant capacities being deployed at a price (and hence at a total cost) above the desirable level. Beyond its negative impact on the efficiency of the regulation, this may also lead to the technology becoming excessively widespread, and thus to an increase in the burden on end consumers (that is: in the price of electricity), to investors becoming „lazy" in terms of innovation (Pylon, 2010 c).

If, however, policymakers are sufficiently informed about the renewable energy market, set the right tariffs [11] and ensure they are adequately maintained (differentiated, and periodically reviewed in order to adjust to technological progress), the potential drawbacks of the scheme can be minimized and its benefits maximized at the same time, thereby promoting renewable electricity production in a way that is both efficient and effective (Fouquet-Johansson, 2008).

FiT schemes may take different forms; basically, there are two sub-types (International Energy Agency, 2008):

- the feed-in tariff may be fixed and not depend on the market price of electricity ***(fixed feed-in tariff system);*** or
- it may provide a fixed premium above the market price of electricity, and hence make the feed-in-tariff (as perceived by the producer) depend upon the free market price of electricity ***(feed-in premium system).***

The fixed-price, market price independent variant is more widely used (Klein, 2008), as that is the one that ensures the highest degree of predictability for investors.

Couture-Gagnon distinguish some further types within both categories, based on how tariffs are adjusted during the guaranteed purchase period (Couture - Gagnon, 2010). Considering fixed-price schemes, prices may be absolutely fixed for the entire term or, and this is the more frequent variant, they may increase during the years to keep track with inflation, and thus balance the operating costs of the projects, which also rise at the rate of inflation. The third variant employs two tariffs: a higher one in the

[11] The policymaker can facilitate his work by studying and/or monitoring other countries' feed-in tariffs and adapting those tariffs to the natural conditions of their own country.

first years and then a lower one in the last couple of years, thereby reducing the burden on end consumers in the long run (Couture - Gagnon, 2010).

The authors mention three types of pricing mechanism for feed-in premium schemes. The standard variant applies a fixed premium above the market price, which is constant with time, and therefore the feed-in tariff of green energy perfectly follows the market price. Variable premium schemes, on the other hand, include both an upper and a lower price limit, that is, the price of green energy is not allowed to decrease below or increase above a certain level. This solution means predictability for the investors, and sets a cap on the subsidy incorporated into the price of electricity. The third variant employs a premium that corresponds to a certain percentage amount of the market price, and thus further increases the exposure of investors (Couture - Gagnon, 2010).

Even though FiT schemes might differ in the specific pricing method they employ, what they guarantee is always related to price in one form or another, and thus they are more predictable than quantity-based instruments.

Tradable green certificate (FZB) schemes, in contrast to FiT schemes, manipulate the price-quantity relations of the market from the quantity side. Green electricity producers receive certificates of origin („green" certificates) corresponding to amount of energy generated (and attested by the competent authority). The policymaker obliges one of the parties in the electricity market (usually it is the retailers, but sometimes the producers or the consumers) to hold a certain number of green certificates. For any given year, the total amount of green certificates/quotas, as prescribed by the policymaker, determines the amount of electricity the renewable energy sector is expected to produce (Ringel, 2006).

In this case, producers sell two products in two separate markets: on the one hand, they sell the electric energy they generate at the market price and, on the other hand, they can also sell the green certificates issued to them. The principle of operation of the TGC scheme is shown in Figure 4:

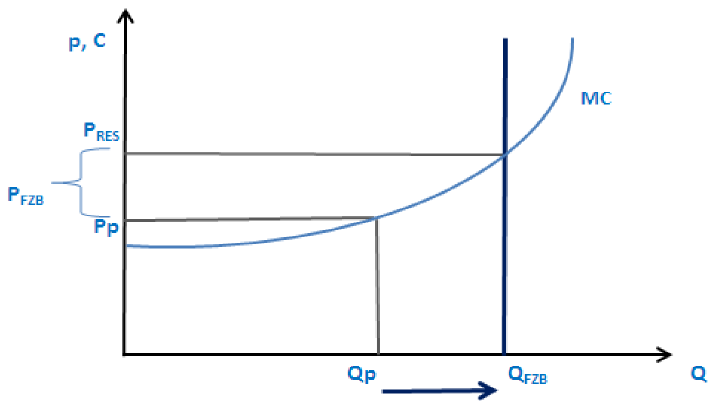

Figure 4: Principle of operation of tradable green certificates

Green energy producers sell the electricity they generate above the market price in this model, as well, however, this time it is not the price but the quantity that is set by the policymaker, which then again gives the price of green energy at the intersection of the marginal cost curve with the fixed-quantity demand curve. It is the price of green certificates that constitutes the price premium, the „bonus" above the market price – which represents the extra value of green energies in comparison to energy produced with traditional methods. As a matter of fact, this premium is also paid for by the consumers, for whoever is obliged to buy the green certificates, the extra costs they incur will surely be reflected in the consumer price of electricity.

Green certificate systems are built on market processes instead of government guarantees, as the price of certificates is not fixed but determined by their demand and supply. The policymaker usually increases the total amount of green certificates to be bought – that is: the expected volume of renewable energy production – year by year, which amount is then again distributed among the obligors proportionally in order not to distort competition. Green certificates can not only be bought from producers, but from other obligors, as well, thus these certificates indeed function as an individual, tradable good.

Owing to the pro-market nature of the scheme, green projects do compete with each other in this case, they all go for the very same green certificate quota. The entry of a new, cheaper producer may bring down the price of certificates, which necessarily results in a drop in other producers' profits and, in the long run, it may even crowd them out of the market completely. Accordingly, producers have a vested interest in operating and developing their technologies in the most efficient and innovative ways (Fucskó et al., 2003).

If there is excess demand in the green certificate market, that is, if the state requires more renewable electricity than what is available, the price of green certificates goes up, encouraging new actors and investments to enter the market. If there is excess supply, prices will drop, diminishing the expected returns on any potential new projects and the appeal of the renewable electricity sector at the same time. Given the multiple-year lead times of renewable energy projects, the time it takes for the market to clear (for capacities to enter or exit the market) after a shift in demand and/or supply is relatively long, as well, it does not take place immediately. Some schemes solve this by permitting actors – both producers and obligors – to restructure or transfer their certificates from one year to the next, if necessary.[12]

Consequently, the risk borne by investors is higher than in a feed-in tariff scheme, as the return of their projects, being dependent on market processes, is fairly uncertain. If technological progress allows a new actor to practically seize the market, it may even become impossible for existing certificate producers to sell their product. In order to moderate investor risk, some schemes lay down a minimum and a maximum value for the price of certificates, between which it is free to move. The price floor warrants a certain premium above the market price for green electricity, while the maximum value can ensure that the price, and hence the burden on end consumers, is kept under control even if there is excess demand on the market (Lipp, 2007).

The policymaker only determines the targeted quantity of renewable energy each year, while all other conditions of the scheme – including pricing – are left to market mechanisms. Accordingly, the producers with the most competitive/cheapest technologies will be more certain to sell their green certificates than the more expensive, more obsolete or less market-ready projects (Ringel, 2006).

All the above suggest that the scheme should be efficient in practice. But it is still a question how much investors/financers will be discouraged by the lower level of predictability/higher level of risk or, in other words, whether the uncertainty of market price fluctuations will be motivation enough for new actors to enter the market.

[12] If prices were too low for a producer to sell its green certificates this year, they are allowed to sell them next year. And similarly, should an obligor happen to buy too many certificates, they can use them to offset a part of their obligation for the next year. The operation of the green certificate market shares many similarities with the carbon credit market.

3.2. Possible Aspects for the Assessment of Promotion Schemes

Renewable electricity production dates back no further than a couple of decades ago, thus its technologies are not yet completely ready for the market, they have not reached the maturity stage on their learning curve yet. In their study, Menanteau-Finon-Lamy listed three drawbacks of renewable power plants in comparison to traditional fossil power plants.

- First, their investment costs are higher than those of their fossil counterparts with the same capacity.
- Second, due to the very nature and availability of renewable energy sources, they can only be built in smaller units, in a decentralized manner, and thus they can only enjoy smaller economies of scale.
- Third, as another consequence of their „raw material", they are incapable of continuous production. This primarily pertains to weather-dependent green energies, where power generation is a function of certain weather conditions (changes in wind force, sunlight conditions, precipitation distribution) (Menanteau et al., 2003, p. 799).

Based on recent experience, a fourth disadvantage might be added to the above, one that has only become relevant with the increasing penetration of renewables: the challenges that countries' power transmission/distribution networks have to face in terms of scalability, loadability and controlling capacity due to wind, solar and hydropower stations being – in comparison to fossil/nuclear power plants – spatially distributed, their links to the grid being less centralized and their production rates being less steady and predictable. The problem originates in the design of our electric transmission and distribution networks, which was optimized for the then widespread technologies (large, centralized coal, gas and nuclear power plants), and hence, obviously, not ideally suited for the flexible and efficient management of renewable power stations. Another obstacle to the growth of renewables might be if baseload power plants have a high share in the country's energy production, as that could seriously limit the potential for green energies.

Renewable power plants, nonetheless, do have a number of advantages, as well, the most important of which is the reduction of the burden that energy production puts on the environment. However, the value of a cleaner environment does not get reflected in market prices yet, and consumers cannot be reasonably expected to pay substantially more for green energies, either – exactly because the environmental benefits from the utilization of renewables are not limited to the consumer paying for the subsidy, but enjoyed by the wider community, and thus constitute a typical „freerider" situation (Batley et al., 2001).

Avoiding negative environmental externalities should obviously be a priority objective – from a social, economic as well as an environmental point of view. However, owing to their current stage of market maturity and to the disadvantages mentioned above, renewable energies are not competitive with fossil and nuclear power plants under current free market conditions. As long as returns on green electricity investments are not positive under market conditions, even though their use clearly serves the public good, their promotion by government measures is justified and necessary.

It is not at all indifferent, however, exactly how a country tries to meet its renewable energy targets (share in total consumption or growth rate): how much the subsidization costs, how the expenses are divided among which market actors, and what sort of unintended effects the measures cause. In the early years of green electricity, the primary focus was the development and the spreading of the various technologies. Today, the ever growing share of renewables and countries' ambitious goals to raise it even higher put the efficiency and the social costs of regulation schemes at the forefront of researchers' and experts' attention.

The effectiveness of promotion schemes can be evaluated under a number of different aspects. Preferences might change country by country, year by year. What follows next is a one-by-one review of the considerations mentioned in the relevant literature with respect to the evaluation of price/quantity-based regulations. Based on a comparative summary of the advantages, disadvantages, strengths and weaknesses of the two schemes, I will formulate some theoretical conclusions on which scheme is more suitable for which situation.

3.2.1. Effectiveness in Increasing the Penetration of Renewables

The most basic one of the goals targeted by (and hence of the requirements towards) these incentives is to achieve a sufficient increase in the share of renewables, that is, they should be effective in serving the purpose they were meant to serve. Ringel's simple question makes the very same point: „is a certain share of renewable energy used at a given point in time?" (Ringel, 2006, p. 9). Accordingly, the scheme is considered successful if the renewable rate targeted by the policymaker for the year is met.

The impact on the share of renewables can be interpreted either at the per capita level or dynamically, considering the change in renewable capacities from one year to another. Effectiveness may also be defined as an increase in renewable electricity generation capacities, that is, the installation of new capacities. Possible measures include „installed renewable capacity per thousand people" and „annual increase in installed renewable capacity per thousand people (kW/thousand people)" (Magyar Energia Hivatal, 2011, p. 48).

Analyses in the literature (Fucskó et al., 2003), (Menanteau-Finon-Lamy, 2003); (Ringel, 2006); (Fouquet-Johansson, 2008), (International Energy Agency, 2011) concur that price-based regulations – that is: feed-in tariff schemes – deliver better results in terms of renewable capacity expansion. The main reason is that investor risk is lower with feed-in tariffs, as they are guaranteed, for a relatively long term, priority dispatch and a pre-defined tariff above the market price. In a green certificate system, at the same time, project owners can never be certain about their revenues, as the prices of both the electricity they sell and the green certificates they are issued are determined in the marketplace, and consequently far more difficult to predict. Accordingly, both investor appetite and, consequently, installed capacities tend to remain more moderate in this latter case.

Moreover, the fundamental attributes of the two schemes also imply certain differences in their „motivational attitude": while FiT schemes accept ("purchase") electricity from renewable energy sources without any limitation on quantity (that is: on capacity), TGC systems are a quota-based instrument, which only requires the obligors to purchase the mandatory (and thus a limited) amount of green energy.

Thus feed-in tariff systems are by definition more open to the highest possible amount of green energy, while there is an ab initio limit on the capacity to be accepted in green certificate schemes. As far as TGCs are concerned, continuously raising the quota at a predisclosed rate may increase investors' perceived probability of actually selling the green electricity they generate; this may, however, be influenced by other market actors, or even new entrants, by „filling the gap" created by the increased quota (Fouquet-Johansson, 2008).

In summary, we can conclude that price-based incentives can reasonably be expected to be more successful in speeding up the installation of renewable energy power plants.

3.2.2. Investor Risk and Predictability

In regard to new, innovative industries still in the first stage of their learning curves, which may therefore offer great opportunities, it is always a key question how one can attract investors to participate in the sector. In addition, the renewable energy sector is rather capital intensive (its investment cost per unit of installed capacity exceeds that of fossil power plants), therefore projects can only be expected to pay off in the long run (8-15 years). The incentive has to be attractive enough to offset these disadvantages in the eyes of potential investors, which can be achieved in two ways: through a high profit margin and/or a moderate level of risk.

Looking deeper into the issue, one might say that guaranteed feed-in tariffs erect a shield around those not-yet-market-ready renewable technologies, as they are exempted from competition with not only their fossil/nuclear counterparts, but, as a matter of fact, with each other, as well – after all, every last unit of electricity they produce is guaranteed to be purchased at the predetermined price. In contrast, operators of renewable power stations in a TGC system must fight a two-front war for their revenues: first, in the traditional electricity market (selling the power they generate) and second, in the green certificate market, where prices are determined in the exact same way: as a function of demand and supply.

Mitchell-Bauknecht-Connor identify three categories of risk for green energy investors[13] (Mitchell et al. 2006):

– **Price risk** stands for the predictability and the possible volatility of the price of electricity, which policymakers completely eliminate in the FiT scheme by granting priority dispatch at a guaranteed price for a sufficiently long term (10-20 years). In a TGC system, however, the full extent of the double price risk (electricity plus the certificate itself, as explicated above) is borne by the project owner.

– **Volume risk** is also a possibility, whenever it is not (only) the price factor of the revenue that is uncertain, but the quantity, as well; that is, if the investor cannot forecast the volume of green electricity he will be able to sell each year. Again, it is the FiT scheme that is safer: every last kilowatt-hour generated is dispatched and purchased at a guaranteed price, without any restriction on quantity. Concerning the TGC system, investors cannot be certain in the long run that all the certificates they are issued will actually be sold. When a power station enters the market, the total installed capacity probably still matches the mandatory quota, but if new capacities keep entering the market at a rate that is higher than the rate at which the quota is raised, new entrants might conquer the market and thus render earlier entrants' certificates superfluous, resulting in the premium over the market price of traditional energies being lost. This kind of uncertainty, once again, drives potential investors towards FiT schemes.

– **Balancing risk** is, according to the authors and in contrast to FiT systems, a characteristic of TGC schemes, where producers face this risk when trying to sell the power they generate. For example, the production levels of weather-dependent renewables are more uncertain and more difficult to predict than those of traditional power plants, thus grid operators (buyers) might have to resort to power balancing measures to a larger extent than would be the case with energy sources that are easier to schedule. Consequently, green power will only achieve a lower price in the market. Producers may try to avoid that

[13] Other sources typically emphasize price risk alone – the real contribution of this article is the identification of and the emphasis put on volume risk and, most of all, balancing risk.

by stabilizing their production as much as possible, or possibly by adjusting their production schedule to on-peak (daytime) hours to achieve a higher price – but the risk cannot be eliminated, only diminished. In FiT schemes, however, prices are the same irrespective of the (un)predictability or the variability of production[14], thus producers do not really need to optimize their production profiles, the balancing risk lies almost entirely with the buyer.

It may be worth to **add one more thought** to the above analysis of investor risk. This factor I termed **„forecasting risk"** is present in TGC schemes because risks typically arise at a different point in time than the implementation of the investment. Under a FiT scheme, investors can assess the cash-flow and the returns the guaranteed tariffs are going to generate already in the preparation phase, and thus decide on the investment accordingly. They can use these data to optimize the characteristics of their projects; that is, they can have a clear picture of the payback period and the revenues before even starting the actual investment. If the investor, having weighed the information so learned, deems the industry unworthy of investment, they can still back off and not risk their capital at all.

In a TGC scheme, on the contrary, projects are based on expectations and forecasts – with respect to the market price of both electricity and green certificates –, that is, the investment is commenced (and finished) with all the prices in its background calculations being assumptions only. If prices lag behind expectations after the production has started that threatens the returns of the project – by that time, however, the investment has already been completed, and a decent amount of capital is locked up in a project that fails to perform up to the expectations. Had the investor known the prices of electricity and certificates in advance, they would probably have planned and optimized their project in a different way; but if their price estimates prove out to be wrong, their returns may easily fall behind expectations.[15]

[14] In fact, this is only true in general terms. Some FiT schemes (e.g. the Hungarian one) assign different feed-in tariffs to the different periods of the day, usually pertaining to controllable renewable energy power plants only.

[15] In a situation like this, the project owner will most probably continue production as long as the price remains above the shutdown point of their power plant, for their capital has already been spent, but its profitability and returns will lag behind expectations.

To make things even more complicated, the process is affected by a number of less forecastable, hard-to-influence factors (competition from new entrants bringing down the prices, the quota's future rate of growth). Projects with a history like this may affect future willingness to invest – and hardly for the better.

It is apparent that FiT schemes eliminate a far greater portion of investor risk than TGC systems do, which is probably one of the main reasons why they outperform the latter ones in terms of effectiveness.

3.2.3. Reducing Environmental Pollution

The more renewable energy power plants are in place, the more the fossil production they can substitute and the less the damage to the environment. Renewables' near-zero harmful environmental emissions (greenhouse gases, air pollution) are a favorable and preferable characteristic to begin with. The more we extend the definition of environmental externalities (life-cycle assessment, visual and noise pollution), the more difficult it becomes to quantify the indices. Today, the overwhelming majority of studies[16] measure/define environmental impact as the extent of contribution to global warming, i.e. the volume of greenhouse gas emissions, and this is the approach that prevails in the European Union's environmental objectives, as well. It is simple to measure and easy to understand, and hence suitable for the comparison of technologies.

It was renewable technologies' external costs and CO_2 emissions, as well, that was estimated by the Power Consult analysis referenced earlier, which concluded that hydropower stations and wind turbines had the most favorable figures, followed by solar and biomass power plants (Power Consult, 2010). Therefore if by environmental impact, we not only mean the existence and the increasing share of renewable energy production, but also consider externalities, then our order of preference should be based on these values.

[16] Fouquet-Johansson went as far as to not define the third primary objective of renewable energy production (besides improving energy security and competitiveness) as the reduction of environmental effects but as the reduction of greenhouse gas emissions instead (Fouquet-Johansson, 2008).

In a TGC scheme (under market conditions), only those technologies are deployed and survive the competition that are marketable, efficient and cheap (in comparison). Consequently there is a chance that renewable investments will only target the areas with the most favorable conditions and thus be highly concentrated, which is not desirable from an environmental point of view.

In FiT systems, however, it is not only mature technologies that can prevail, but, owing to the „shield" that the subsidies create, also those still in their development stage. There will probably be a larger variety of technologies, deployed not only in the most favorable locations but with a more even spatial distribution, in all locations where the tariff ensures they can be economically operated (Meyer, 2003).

Experts with Infrapont concluded that feed-in tariff schemes, due to the possibility to price differentiate between technologies, may better facilitate the realization of the technology mix that the policymaker prefers due to its optimum environmental effects than the free market (i.e. a TGC scheme) would (Infrapont, 2010, p. 57).

3.2.4. Innovation Promotion

The utilization of renewable energy sources, as an industry, is rather innovation intensive. Technologies have made enormous progress during the last 20-30 years thanks to experience from their application and their becoming more and more widespread. The most spectacular of all has probably been the advancement in wind turbine technology.[17] Serial production first started in 1979 in Denmark; at the time, wind turbines' capacity range, around 20-30 kW (!), was significantly lower than today. Due to their spreading in Germany, Denmark and Spain, as well as the expansion of production capacities, the unit cost of wind-generated electricity in Germany dropped from 80 eurocent/kWh (1990) to 39 eurocent/kWh (2004) (Fouquet-Johansson, 2008, p. 4084).

Today, an „average" wind turbine has a capacity of 2-3 MW (!), i.e. hundred times that of the initial value; what is more, some 7-8 MW turbines have already been installed, as well, on an experimental basis (EWEA, 2012).

[17] Source: http://www.alternativenergy.hu/kategoriak/temakorok/szelenergy

As a result of technological development, wind turbine manufacturers' marginal cost curves are today quite far away from where they were in 1990s. Clearly, it was the three countries already mentioned before (each employing a feed-in tariff scheme) that drove the wind power industry; even today, leading wind turbine manufacturers all come from Germany, Denmark and Spain. FiT schemes are often criticized for being anti-competitive and hence not sufficiently efficient, as the feed-in tariff acts to shield technologies from being exposed to the free market. Which does hold true to a certain extent, yet one should emphasize that it is exactly these features through which they can help premature technologies develop, become more cost efficient and be finally introduced to the market (International Energy Agency, 2011).

In England, for example, neither the initial tender nor the green certificate system introduced in 2002 managed to generate results and growth rates comparable to those of the FiT-countries – in terms of neither installed capacity, nor manufacturing base. The reason might have been that the country's domestic manufacturers, still in their early development phase, were forced into market competition by the British government too soon, and therefore it was the more experienced Danish manufacturers that supplied England with wind power generation equipment (Menenteau et al. 2003).

TGC schemes have been proved to only support sufficiently efficient and market-ready technologies, because those are the only ones that can make a profit under market conditions. This is illustrated in Figure 5:

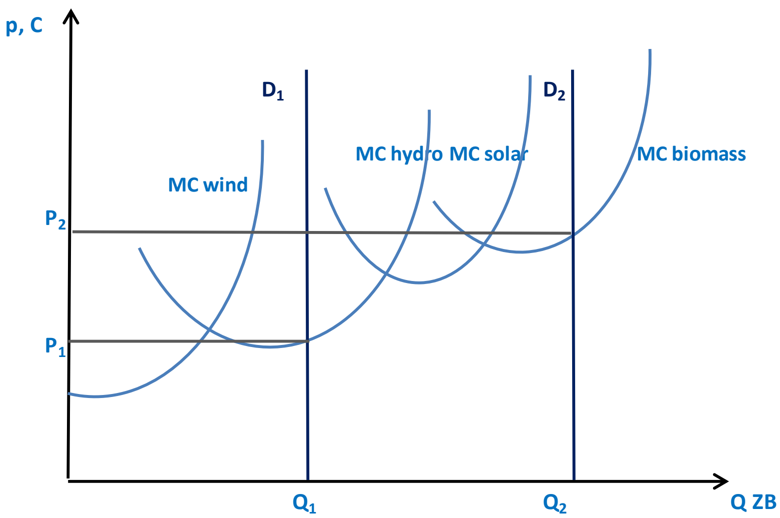

Figure 5: The selection of technologies in a green certificate system

Source: based on Ringel, 2006 p.12, with additions by the author

If we determine the common technological marginal cost curve by adding up the individual marginal cost curves of the individual technologies (types of renewable power stations), and plot all of them on the same quality-price(cost) coordinate system, then we can add up the individual marginal costs to arrive at the aggregate supply curve of green energy production, which passes along the minimum points of the MC curves. Whereas the demand curve is, in a TGC scheme, a vertical line at the value that corresponds to the quota. The figure shows us that if this value is Q_1, for example, then the equilibrium point and the price P_1 (energy+GC) associated with it appear in a section of the aggregate supply curve that only allows for the cheapest technologies (those with the lowest marginal costs – wind turbines and hydropower plants in this very case) to operate.

Technologies that are more expensive than that will not enter the market until the policymaker increases the quantity of certificates to e.g. Q_2, which already enables biomass and solar power stations to operate economically, as well. Or until the marginal cost curves of the individual technologies sink to a level where the price they can achieve under the lower quota turns acceptable. Owing to the above mechanism, TGC systems do not facilitate such a shift. Ringel concluded that TGC schemes concentrate on certain specific energy sources rather than supporting a wide range of renewable energies (Ringel, 2006, pp. 11-12).

If a guaranteed feed-in tariff of P_2 was introduced to the above figure[18], that would allow for more expensive technologies to already enter the scene in lower quantity ranges. Naturally, this would cost more than if these technologies only had to be supported in a later stage of maturity. Obviously, the first wind turbines would not have been viable, either, with the feed-in tariffs that correspond to today's technologies; but had FiT schemes not guaranteed higher prices for them, they could never have made it to their current technological level. „The political instrument 'feed-in tariffs' is very useful to get a technology off the ground, as the income is secured and, thereby, the risk for the developer is reduced." (Ackermann et al. 2001).

[18] Another important difference between the two schemes is that even though they have the same outcome at point Q_2-P_2 theoretically, in a FiT scheme, P_2 is known to the producer and they can count on it, while in a TGC scheme, they only know Q_2, but not the price associated with it, as that will be determined by the market, and thus its value is subject to uncertainty.

By serving as a sort of incubator, the „anti-market-exposure shield” that FiT schemes provide is better suited for the fostering and development of technologies that are not yet mature for the market.

The IEA arrived at a similar conclusion in its analysis, which distinguished between three stages of penetration/maturity with respect to renewable energies: market initiation, market take-off and consolidation. Regarding the first stage – formation, development, appearance on the market –, the primary goal is to create a safe environment for investors to ensure that the first investments and research and development activities are actually started. For this very purpose, FiT schemes are definitely better suited, as they create a safer atmosphere; and they have already demonstrated that they are indeed capable of setting the development of technologies into motion (IEA, 2011, p.22).

3.2.5. Responsibility of the Policymaker

One should also make a difference between the two types of schemes based on the extent and „quality” of policymaker involvement. In a TGC scheme, the role of the policymaker is to determine the targeted share of renewables and to update (ideally: gradually increase) it year by year. The operation mechanism itself – how the prices of electricity and the green certificates are determined – is left to the market.

In order to protect both those who are obliged to buy and the investors, it has become common practice to set a minimum and a maximum price for green certificates. The role of the price cap is to prevent the price from rising to unrealistic levels, from exceeding a certain value even if the supply of green certificates happens to lag behind the amount demanded/targeted in any given year. Should the price increase above this level, obligors are granted the option to „buy out” (a part of) their TGC obligation at this buy-out/substitution price. The minimum price of TGC, at the same time, protects investors from excessively low price levels, as this type of regulatory system does not prevent an excess supply from occurring in the TGC market (possibly due to new entrants or a higher amount of renewable energy production as a result of weather conditions exceeding expectations), which may act to push down the price to near-zero levels. Also, there may be green certificate owners who simply cannot sell their certificates any more, which renders them practically worthless (Fristrup, 2003).

The costs of promoting renewable energy production (the bonus price that the certificates offer) are ultimately paid for by electricity consumers, i.e. residents and businesses. Consequently, the policymaker is also responsible for keeping their burden under control. In TGC systems, limited quantities and market (thus efficient and non-excessive) prices keep the burden on end consumers between certain limits, so the risk of their getting out of control is rather limited (Butler - Neuhoff, 2008).

In TGC schemes, it is the determination of quantity where the policymaker may make a mistake, setting it too low/high; however, since this is a flexible, market-based system, the mistake can be corrected within a certain period of time. Is the quota too low, there will be excess supply in the renewable market, acting to depress the price of certificates and to keep new investors away from the sector; but the policymaker can adjust the quota for the next year. If the quota is too high, however, that will generate excess demand, an increase in the price and an inflow of investors, which then again will act to increase supply and reduce the price.

From practical experience, the operators of some TGC schemes have realized the fact that renewable technologies have differing marginal cost curves, and that a uniform green certificate system only facilitates the promotion of certain technologies (those with a more competitive price). Therefore they decided to differentiate between technologies by issuing differing amounts of green certificates per unit of production. More costly power stations (PV, for example) receive not one but more than one certificate for each unit of electricity produced. Obviously, these per unit TGC values also need to be laid down by the policymaker for each technology.

The role of the policymaker is quite different in a FiT scheme, as it is the feed-in tariff that they have to determine, and the market „gives" a quantity in return. Is the price too low, there will be no remarkable expansion in renewable capacities. The policymaker has two options: either they increase the tariff in order to motivate the investors, or they wait until technological progress ensures that renewable power plants can be operated economically without changing the initial tariff.

If, on the contrary, prices are set too high, that might induce an investment boom of unexpected proportions. Recent years have seen several examples for this in the field of PV generation, for the most part; some countries (the Czech Republic, Spain, Germany) failed to systematically adjust their feed-in tariffs in line with the technology's progress on its development path and, as a consequence, introduced tariffs that even obsolete (in comparison to the then state-of-the-art) technologies found encouraging. Less surprisingly, that meant extra profits for new, more mature technologies, and hence an unprecedented surge in the number of projects. This problem will be explicated on in detail in the next chapter.

The quantity of electricity eligible for the guaranteed price being unlimited in a FiT scheme, the above events put a significant burden on both the grid and the charges included in the price of electricity. Such an error is difficult to correct, as the capacities have already been deployed, they are in operation, the investors hold valid long-term purchase agreements. This is a possible case of regulatory failure, insofar as the run-up in production and the technology mix will differ from what was intended by the policymaker, and thus they will have to actively manage the situation afterwards. Therefore, in FiT schemes it is of utmost importance that the policymaker be informed and knowledgeable about the market, that they follow technological progress on a nearly day-to-day basis and that this progress be reflected in the feed-in tariffs (i.e. that they be decreased with time). A gradual reduction of the tariff ensures that later entrants are offered, instead of excessive profits, a pricing that corresponds to their own marginal cost curves (Haas et al. 2011b).

The dynamic – and even unintentional – expansion of renewable power generation capacities implies a remarkable increase in the funding needed to finance the promotion scheme. Part of the responsibility of the policymaker is, in such a situation, that the distribution of the system's costs through the electricity bill will lay a larger burden on end consumers, and thus the price of electricity will be higher in the entire economy. And it is hardly in the interest of the policymaker to place an excessive burden on residents and businesses, as that would ultimately harm the competitiveness of their own country.

Factors that might facilitate the avoidance of regulatory failure are an appropriate knowledge of the field, communication with the actors of the industry and an international perspective, which, through the knowledge of other countries' tariffs and systems, might assist the policymaker in elaborating tariff recommendations for their own scheme.

3.2.6. Differentiation Based on Technology, Energy Source and Other Factors

One of the advantages of FiT schemes is that they allow for defining different tariffs for differing technologies/types of power plant, while in a TGC scheme, one unit of green energy generated (1 MWh) is usually worth one green certificate, regardless of technology.

The TGC system in England, for example, only yielded noteworthy results in the utilization of wind power. The reason is that at the time, wind generation was the most economical, the cheapest technology (Fouquet-Johansson, 2008). Policymakers also realized this fact, thus in 2008 they suggested that the different technologies should, according to their level of maturity, receive different quantities of green certificates[19] per unit of production in order to give a chance for the technologies that were not marketable under the uniform certificate scheme to take off.

Differentiation by technology is a new element to the TGC system, therefore its effects have not yet been examined and discussed in the literature. Results will definitely be worth studying, as this step represents a shift from the original TGC logic towards the FiT scheme, and thus it may be able to mitigate TGC systems' deficiencies in effectiveness.

FiT schemes, on the other hand, are highly suitable for differentiation, as feed-in tariffs can be set for almost any arbitrary number of categories.

[19] The green certificate scheme introduced in Romania also assigns different amounts of green certificates to the various technologies. Power stations that are more capital intensive and that have to incur raw material costs (e.g. biogas, biomass) are issued more certificates than the ones that are less capital intensive and that utilize „free" raw materials (e.g. wind turbines).

Typical bases for differentiation are (Infrapont, 2010, p. 28):

- technology;
- special qualities (e.g. location);
- startup date;
- acknowledged payback period (i.e. the term of the guaranteed purchase agreement);
- time elapsed since installation;
- scale of operation.

Of course, further items can be added to the list according to the specific circumstances and preferences of the country in question. It is apparent that a FiT scheme can take into consideration the maturity of technologies and the changes they undergo with time, that is: the expectations of the market. Thus the estimated marginal cost curves can almost completely be translated into tariffs. Differentiation by location prevents capacities from being installed in the most favorable locations only, as a higher price may counterbalance the disadvantages arising from the less favorable characteristics of certain less attractive locations (Infrapont, 2010).

FiT schemes can not only differentiate based on various energetic aspects to adjust to power plants' specific attributes or the country's energy policy objectives – any other aspect, be it social, economic, etc., can be incorporated into the system (e.g.: employment effect, development of underdeveloped areas).

3.2.7. Possibility of Influencing the Regulation

In regard to the analysis of the two promotion schemes of interest to us, several sources emphasize the possibility of the regulation being influenced/manipulated.

In their article, Fouquet-Johansson draw atteniton to the risk that in a TGC scheme, large green energy producers that quasi-dominate the market (if there are any) may influence the price of green certificates through their own supply thereof. For such actors can restrict the supply of certificates by simply putting their investments on hold. That starts a temporary increase in the price of certificates, which makes the market more attractive to new investors, and thus generates new investments. The new power plants having commenced operation in hopes of high certificate prices – i.e. high revenues –, the dominant market actor will now flood the market with its own certificates, generating excess supply and hence a price drop. In a couple months' time, the small investors, due to the unmanageable cash-flow problems the low prices induced, will start to sell their capacities, which will most likely end up in the hands of the big players – which scenario, all in all, constitutes an enormous risk for smaller investors (Fouquet-Johansson, 2008, p. 4083).

Fouquet-Johansson also emphasize that feed-in tariff schemes exclude the possibility of such manipulation, as each investor and project owner can sell the green energy they produce for the very same fixed (and hence non-manipulable) price.

There is another aspect to the possibility of manipulation, as well: „An important characteristic of any regulatory instrument is the extent to which it can be influenced by the affected interest groups" (Infrapont , 2010, p. 42). The study identifies three groups of stakeholders:

- Traditional (fossil and nuclear) power producers, who are basically not interested in the promotion of renewable energies at all, as it is their own capacities that are being crowded out of the market by renewables.
- Those obligated to purchase renewable electricity are (partially) not interested in renewables, either, as the operation of green power plants means a priority dispatch obligation, extra workload and additional transmission regulation duties for them.
- The third group is that of renewable energy producers, who are, obviously, interested in the highest possible share of renewables and the highest possible price for green energies. Members of this group do not always take the same stance, either, the individual technologies often have their own interest groups [20] which strive to promote the interests of their own electricity generation method.

[20] Organizing associations and pressure groups along technologies is quite typical in Hungary, as well: in addition to the Hungarian Association of Renewable Energy Sources, we also have a Hungarian Windpower Energy Association, a Hungarian Solar Energy Society, a Hungarian Biomass Association, a Hungarian Biogas Association , etc.

The actual power of renewable energy incentives may largely depend on the comparative influence, size, lobbying power and social support of these three interest groups (Infrapont, 2010).

The chance for influencing the concept itself of the regulation and its details is bigger in the case of FiT schemes, while as far as already operating systems are concerned, it is TGC schemes that leave more space to manipulation through the market power of the individual interest groups.

3.2.8. Efficiency

Studies on renewable energy incentives prepared in the late 90s and at the early 2000s were, for the most part, centered around the rate at which the penetration of renewables was increasing, their impact on the market and technological progress.[21] The European Union's green energy requirements towards its member states were, as well, expressed primarily in terms of quantity.

With more and more renewable power plants in operation, the other most important issue (besides effectiveness) was pushed into the limelight: efficiency; that is, what the price – the total social cost – of achieving one's renewable energy objectives is. Given that the extra support (above the market price of electricity) to renewables is, in the end, paid for by the consumers in both the FiT and the TGC schemes, the growing share of renewables necessarily brought about an increase in both the amount and the „perceptibility" of the burden on end consumers, drawing attention to the need to keep these charges in check.

That was the time when the literature started to discuss questions related to the efficiency of macro-policy measures promoting renewable energy production[22], which Ringel, once again, defined in the form of a simple question: „is this aim reached at socially least cost?" (Ringel, 2006 p. 9).

[21] From amongst the sources employing this approach, see (Morthorst, 2000); (Menanteau-Finon-Lamy, 2003); (Lorenzini, 2003); (Komor-Bazilian, 2005).

[22] A similar approach is reflected in e.g. (Finon-Perez, 2002); (Ringel, 2006); (Fouquet-Johansson, 2008); (Mészáros-Bade-Zhou, 2010).

In economics, the concept of efficiency can be defined as „using economic resources in a way that yields the maximum welfare of economic actors given its technology and scarce resources" (Samuelson-Nordhaus, 2005, p. 717). Our interpretation of this definition could be: does the utilization of a unit of our social expenditure (~resource) yield the maximum amount of renewable energy capacity (~welfare)?

In a microeconomic sense, efficiency means that „the maximum possible output is produced from a given amount of resources or, the opposite way, a given output is produced using the least possible amount of resources" (Kopányi, 1993, pp. 8-9.). That is: if, given a certain amount of expenditure/subsidy, we produce the highest possible amount of renewable energy or if a given amount of green energy is produced with the lowest possible expenditure.

Lipp formulated it the following way in the relevant chapter of his study: „a common requirement for each country is that the promotion of renewable energies should not create an excessive financial burden for energy consumers/tax payers. Countries wish to generate the largest returns with the smallest cost. The typical measure of their success is the cost per unit of energy generated." (Lipp, 2007, p. 5485).

„A brief formulation of the efficiency criterion is: a policy is efficient if it attains the desired level of environmental quality with the lowest possible expenditure." (Kerekes, 2007, p 136).

Based on what has been said so far, one is probably tempted to agree with the statement of Ackermann-Andersson-Söder that TGC schemes are more efficient, because market exposure and market prices – being determined by the interaction of demand and supply alone – only allow for the most economical renewable energy projects to be deployed (Ackermann et al., 2001, p. 202).

FiT schemes, on the contrary, owing to their fixed (that is: not determined by the mechanisms of the marketplace) tariffs, are more prone to allow producers to earn some additional profit, thus the same amount of renewable capacity could probably be achieved with a somewhat lower amount of subsidy, as well.

Noteworthy is, as well, the remark of Mitchell-Bauknecht-Connor that the predictability of FiT schemes means a lower risk, and hence a lower cost of capital for investors, thus they can exceed our expectations in terms of efficiency (Mitchell et al., 2006, p.305). The uncertainty inherent in TGC schemes, at the same time, increases investors' risk and thus their return expectations, as well – resulting in a loss of efficiency.

The study of Infrapont distinguishes between two levels of static efficiency. **„Allocative efficiency"** is associated with the selection of technologies; that is, the subsidy spent should serve the promotion of the most efficient technologies. TGC schemes meet this criterion, as they allow for all but the most efficient, the most capable projects to enter the market. According to the authors, one might achieve a similar distribution by adjusting the uniform feed-in tariff to the technology with the lowest costs. Any other solution can only serve some other purposes, as efficiency will necessarily suffer (Infrapont, 2010, pp. 36-37).

The other type of static efficiency mentioned in the study is **technical efficiency,** which happens whenever producers are motivated to produce at the lowest possible cost not only by their own profit maximization goal, but some other mechanism, as well. The authors conclude that with the price of both electricity and green certificates being determined by the market, the chance of producers becoming „lazy" in terms of cost efficiency is lower in a TGC scheme than it would be in a FiT system (Infrapont, 2010, p. 37).

In summary of the above, one might presume that it is the market-based quantity-driven instrument that can ensure a higher level of static efficiency, as it allows for an excess profit to exist only temporarily. In the medium term, the market reacts with additional supply, and, consequently, with decreasing prices. This scheme, accordingly, motivates producers for efficient production. In a FiT scheme, at the same time, excessive profits can exist in the long run, project owners are not exposed to the same pressure as in TGC systems.

Renewable energy objectives can, however, only be achieved in the long run, thus the impact of the different incentives should not only be evaluated statically, either, but rather by considering a longer period of time. This is expressed by the requirement of **dynamic efficiency**, which assesses the extent to which the incentive in question facilitates innovation and the continuous improvement of technologies. Already the definition of long term/dynamic efficiency, the way Finon-Perez formulated it, is very telling: „the issue of differentiation of the [renewable energy] technologies” (Finon-Perez, 2002, p. 79).

There are two reasons why the dynamic efficiency of FiT schemes is considered more favorable than that of TGC systems. First, FiT schemes provide an opportunity for investors and equipment manufacturers to invest in research and development activities, as, in the absence of market competition, they do not have to reduce their operation costs to the extremes, and this way, they can also share the remaining profit. In a TGC scheme, in contrast, only a small portion of any potential extra profit stays with the producers, because market prices adjust to any potential excess demand, and project owners are less likely to share a smaller amount of profit with equipment manufacturers/innovators. Second, the higher level of effectiveness of FiT schemes allows for the learning curves of the technologies to change, and thus for the technologies to become more efficient and less expensive – that is, they ensure a higher level of dynamic efficiency (Finon-Perez, 2002).

Mitchell-Bauknecht-Connor arrive at a similar conclusion: „Although feed-in systems may still not be as efficient in the short term, they do provide long-term stability, incentives and resources for innovation leading to efficiency improvements in the long term (dynamic efficiency)” (Mitchell et al., 2006, p. 305).

Recent years’ studies already examine longer periods of time and, accordingly, their position on the dynamic efficiency of the schemes appears more justified. A number of authors take a solid stance and insist that feed-in tariff systems are more efficient (Lüthi - Wüstenhagen, 2012), (Verbruggen - Lauber, 2012), (Haas et al., 2011a). Other sources (International Energy Agency, 2011) underline, nevertheless, that by now, differences between the performance of different systems within the same category have grown larger than those between the efficiency of price-based and quantity-based instruments in general. Thus the truth lies in the details (as well).

3.3. Conclusion: Price-Based vs. Quantity-Based Policies

The question whether it is a price-based or a quantity-based regulation that is more reasonable to employ in managing a certain situation has been asked many times before in the history of environmental economics. The issue was first discussed in relation to achieving the optimum level of environmental pollution; a number of authors[23] examined the conditions of application of price and quantity control policies. In the 2000s, the emissions trading system and regulation inspired by the need to fight global warming once again brought up the price vs. quantity-based policy duel (Lesi-Pál, 2004, pp. 32-42).

Neither one of the two instruments is a clear victor – both are present in emissions regulations, as well (pollution taxes, emission limits); the operation of emissions trading systems is controlled through quantity-based instruments, yet the need to keep prices within a certain interval keeps returning, as well, whenever prices go too high or too low (Kocsis, 2002).

Based on our theoretical overview, the answer needs to begin with „it depends" in the field of renewable energy regulations, as well, for the differing preferences of the different countries concerning their various renewable energy objectives are likely to imply highly different priorities with regard to the requirements we mentioned. FiT schemes and TGC systems alike have their advantages and drawbacks – a summary is provided in Table 2.

[23] See (Pigou, 1920), (Coase, 1960) (Weitzman, 1974); (Kocsis, 1998); (Kerekes-Szlávik, 1996).

	Feed-in Tariff Systems	Tradable Green Certificate Systems
ADVANTAGES	Guaranteed prices, hence long-term predictability	Based on market mechanisms, competition between technologies
	Low investor risk	Flexible, prompt reactions to changes in technology/the marketplace
	Price differentiation by technology facilitates the promotion of a wider range of renewable technologies	Only supports the most marketable technologies
	Stimulates innovation, helps new technologies mature	Keeps the burden on end consumers in check
	Possible to differentiate according to the policy maker's preferences	
	Low administration costs	
	Effective in increasing the share of renewables	
DISADVANTAGES	Long-term possibility of producers earning an extra profit	Volatile, hard-to-predict prices
	Uncertainties in estimating the expected amount of renewable energy production	High investor risk
	Regulatory failure may induce a significant increase in the burden on end consumers	Facilitates the promotion of certain technologies only
	The responsibility of determining and updating the prices lies with the regulator; a mistake might lead to regulatory failure	Does not lead to a significant increase in the share of renewables
	Slow reaction to changes	Long-term agreements may prevent transparency and reduce liquidity in the certificate market

Table 2: Advantages and disadvantages of feed-in tariff and green certificate schemes

Source: author's compilation

In a market that is perfectly competitive in the economic sense (perfect information and competition), the price of green certificates would be equal to the feed-in tariff, and the two instruments would have the very same effect (Mészáros et al., 2010). Theoretically, a well-designed, sufficiently differentiated and properly maintained feed-in tariff scheme and a trustworthy green certificate scheme that is also differentiated by technology could equally constitute a well-functioning system.

In reality, the situation is, of course, much more complex – a typical market is characterized by information asymmetry and the presence of pressure groups. Furthermore, different countries may have differing motivations for regulating the renewable energy sector.

The ideal choice of incentive largely depends on the renewable energy objectives and other goals of the country. If the goal is to significantly increase the share of renewables and the current burden on end consumers is not yet too high, and if the policymaker is sufficiently knowledgeable about the renewable energy market, the FiT schemes are the recommended choice (International Energy Agency, 2011).

If, however, there is no solid commitment to expanding renewable capacities, and if keeping the burden on end consumers under control is a key priority and the policymaker is not sufficiently confident about their own knowledge of renewable technologies, then TGC schemes appear to be the more reasonable option.

As it will be apparent from the overview of the practice of EU member states in the next chapter, from among the renewable energy incentives available today, FiT-type schemes appear to be more successful and more effective, and they are becoming the „weapon of choice” in member states’ regulatory practice, as well. Even though no studies have been published on the topic yet, but today’s unpredictable economic atmosphere still dominated by the ongoing crisis is very likely to make these instruments even more popular; after all, current market processes tend to render prices even more volatile, forecasts even more uncertain and investors’ cost of capital even higher, that is: TGC schemes even less attractive.

However, that does not mean FiT schemes are a surefire method for countries to achieve optimum results in renewable energy production. Not quite all FiT models are in the same league in terms of maturity (and financial resources) as the German system, which is often set as an example. In order to lay down clear priorities for the renewable energy industry and to avoid their own characteristic pitfalls, FiT schemes, as well, need to be thoughtfully designed and meticulously implemented.

Following this theoretical overview, I will now cover the basic documents and requirements of the European Union’s renewable energy policy, as well as member states’ experience so far with the two models.

4. Renewable Energy Regulation in the European Union

The utilization of renewable energy sources is becoming more and more significant in the regulation and directives of the European Union. Several steps led from the White Paper of 1997 – which is considered the first community-level document on green energies – to the 2009 directive defining the goal of achieving a 20% share, on a community level, of renewable energies. In this chapter I will give an overview of the basic documents on green energy policies, including not only directives but long-term strategic roadmaps, as well.

Thereafter it is also worth to consider the share of the different promotion systems in the union, the experiences of the member states in the regulation of green energy and the challenges they currently have to face, as these may constitute a useful starting point for the evaluation of the Hungarian green energy regulation, and for the formulation of our recommendations for further improvement.

4.1. The Energy Policy of the European Union Goes Green

According to Fouquet-Johansson, the EU determined targets to promote the increase of renewable energy utilization in order to improve energy security, to decrease the emission of greenhouse gases and to support the competitiveness of European economies (Fouquet-Johansson, 2008). Meyer goes back as far as the Brundtland report of 1987[24], the document that laid the foundations of sustainable development, to the influence of which the demand for sustainability grew larger and larger, drawing attention to the greenhouse gas emissions of the energy sector, the reduction of which later became a fundamental requirement of sustainable development. In the author's opinion, this turned attention to renewable energy production, which enables the reduction of the sector's harmful emissions and reaching the targets of the Kyoto Protocol (Meyer, 2003, p. 666).

Meyer also highlights another important role of green energy production in energy policy. Assuming the current level of consumption, fossil fuel reserves (especially

[24] (World Commission on Environment and Development, 1987).

crude oil and natural gas) will be exhausted before the end of this century. At the same time, the population of the Earth is increasing, and the share of Asian countries, still underdeveloped in terms of energy consumption, is constantly growing. Therefore the demand for fossil fuels is highly likely to increase, however, with a shrinking share of the EU (Meyer, 2003).

The following figure illustrates the trends in global daily crude oil and natural gas demand 1990 onwards along with projected values until 2030:

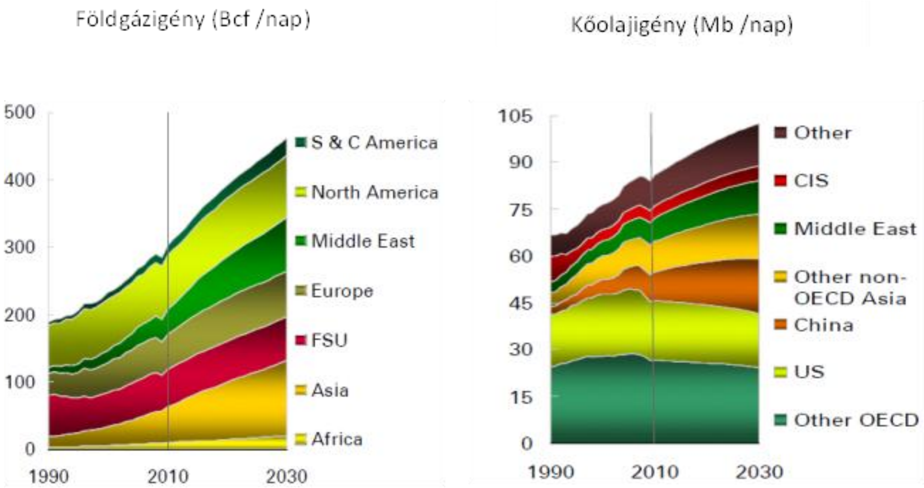

Figure 6: Global demand for natural gas and crude oil 1990-2030

(to the left: demand for natural gas, billion cubic feet per day; to the right: demand for crude oil, million barrels per day)

Source: World Energy Outlook 2010, BP Energy Outlook 2030; as cited in Bencsik, 2011 p.22.

With the help of the figure, the following conclusions can be drawn that are worth considering by the EU:

- An increased demand is expected for both fossil energy sources in question. The use of fossil energy sources is expected to further increase in the following twenty years, that is, until 2030, at the same rate as in the period between 1990 and 2010. By 2030 the daily consumption of natural gas may increase to 2.5 times its value in 1990, whereas the same expected proportion for crude oil is somewhat lower at 1.5. Consequently, **the available finite reserves of fossil fuels are being used at an increasing rate**, which means, the date of their depletion is rapidly approaching.
- The consumption of European countries is slowly expanding, and expected to rather stagnate between 2010 and 2030. A considerable increase, on the contrary, can be expected in the Asia region (China, India), the reason for

which is twofold. On the one hand, the lagging behind of and the expected increase in the level of per capita energy consumption; on the other hand, the population of these two countries (mainly India) constituting an ever growing percentage of world population. Therefore **the share of EU in the increasing consumption of fossil energy sources will decrease**, thus the pace of production will be determined by other countries.

– Production will accelerate in order to satisfy increasing demand, which may have an effect on the prices of fossil energy sources, escalating the exposure of member states with high energy imports.
– The need to satisfy increasing demand may result in the EU's previous supply sources becoming uncertain, as a growing percentage of their production will serve the increasing demand of other countries.

The high dependence of the EU on energy imports and the expected growth in the consumption of fossil fuels act to lay a greater emphasis on security of supply and the need to reduce our dependence on fossil energy imports within the energy policy of the EU. Nuclear and renewable energy resources are the only ones possibly capable of replacing fossil fuels, and only the latter might be considered a sustainable source of energy.

The recognition of the necessity of renewable energy production and the advantages of promoting green energies are receiving more and more emphasis in the EU's energy policy objectives. A separate chapter within the energy policy was devoted to the objective for the promotion of renewable energy production, the first milestone of which was a document from 1997 titled "Energy for the Future: Renewable Sources of Energy – **White Paper** for a Communication Strategy and Action Plan". From amongst the positive effects of renewable energies, the following ones were mentioned: reduction of import dependence, increase in security of supply, reduction of carbon-dioxide emissions and air pollution, employment expansion, technological innovation and improved competitiveness of Europe. To these ends, a 12% renewable share of total energy production (equivalent to doubling the figure of 1996) was targeted for 2010 (COM(97)599).

The white paper made it clear that in order to exploit green energies, a community-level strategy and action plan are needed to aid the promotion of all types of renewable energy sources.

The **Green Paper** "Towards a European strategy for the security of energy supply" of 2000 underlined that without a major change, the EU's energy dependence may increase from the then 50% to over 70% within the next 20-30 years (COM (2000)769).

Subsequently, in September 2001, the first directive specifically focusing on this area was endorsed: **Directive 2001/77/EC** on the promotion of electricity produced from renewable energy sources in the internal electricity market.

"The purpose of this Directive is to promote an increase in the contribution of renewable energy sources to electricity production in the internal market for electricity and to create a basis for a future Community framework thereof." (Directive 2001/77/EC, Article 1)

This directive has great importance for a number of reasons. First, that was the first time that mandatory targets with concrete rates were laid down for the individual member states (with their renewable share of 1997 as the base). On a community level, the goal was set to increase the initial rate of 12.9% to 21% by 2010. The reference values proposed for the individual member states were distributed across a relatively wide range, depending on their initial values and natural conditions. Hungary had the lowest target at 3.6%, whereas the expectation towards Austria was the highest one at 78.1%.

Second, the directive finally defined what qualifies as a renewable energy source: "renewable energy sources": non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. Thereby the directive eliminated the problem underlined by Reiche-Bechberger that there had been differences in how the individual member states defined renewable energy and hence the renewable shares they reported were not actually comparable. It was mainly large capacity hydropower stations (5-10 MW) and electricity from waste incineration the classification of which was not uniform across countries' support systems (Reiche-Bechberger, 2004, pp.843-844).

Third, the directive also drew member states' attention to the fact that in order to support the expansion of renewable capacities, the public administration procedures related to electricity generation will need to be simplified, accelerated and made transparent.

The fourth novelty was the introduction of an obligation requiring member states to regularly report on their progress and the steps taken towards their respective renewables targets.

And the last – but probably the most important with respect to my thesis – element of the directive to be highlighted is that it recognized the necessity of supporting renewable energies (as they are not yet mature for the market and their cost-effectiveness is behind that of fossil generation). It also accepted that the individual member states had implemented and were using different support systems; however, it did NOT formulate any recommendation on the ideal choice of promotion system, but encouraged governments to keep their then-current systems (until a community framework is set up). All later regulations reflect the same approach.

The Commission Communication **Renewable Energy Road Map** (COM(2006)848) – „Renewable energies in the 21st century: building a more sustainable future" from early 2007 served to demonstrate the EU's commitment to renewables and present its medium-term concept. The road map pointed out that climate change, our ever increasing dependence on fossil fuels, increasing imports and continuously growing energy costs render the society and the economy vulnerable; and stated that the renewable energy industry was the only sector capable of offering a solution to all of those issues. Therefore renewable energies are a key element to our sustainable future. It also articulated the necessity of implementing a regulatory framework for the promotion of green energies that generates investments similar in total volume to those that the traditional energy sector had once been built upon.

The Renewable Energy Road Map "predicted" a 10% share of renewables by 2010, and it considered the failure to reach the target of 12% to be a political fiasco brought about by the lack of adequate incentives. It did, nonetheless, make a proposal for managing the situation by stating the principles that should be taken into consideration in developing the political framework necessary for the intensive promotion of renewable energies.

The key principles to follow were:

- long term mandatory targets ensuring stability;
- increased flexibility in target setting across sectors;
- comprehensive approach (to include heating and cooling);
- removal of unwarranted barriers to renewable energies deployment;
- consideration of environmental and social aspects;
- commitment to cost efficiency;
- compatibility with the internal market.

As long as promotion schemes comply with the above, the target of a 20% share of renewables is still attainable by 2020; the Commission deemed this objective "feasible and desirable". To this end, the communication argued, it was necessary for each member state to set mandatory national targets, and to support those renewable technologies that best match their specific conditions, potentials and priorities. The methods were left to the decision of the individual countries, yet the Commission did highlight some areas where community-level action is required. From amongst these, the most important were: mitigation of the barriers to the integration of renewables into existing energy networks (grid connections, grid extension, simplification of licensing); internalization of the external costs of conventional energy production; exchange of best practices on renewable energy sources; prioritizing the research and development activities on green energy.

In order to overcome any potential barriers to energy production based on renewable energy sources, member states were called upon to:

1. Ensure that authorization procedures are simple, rapid and fair; establish, if necessary, a one-stop system in which the complete process is coordinated by a single authority.

2. Develop pre-planning mechanisms whereby regions and municipalities are required to assign suitable locations for renewable power stations.

3. Integrate renewable energy utilization in local and regional plans, i.e. green energies should constitute an additional section in the plans.

If both the EU and its member states keep to the above guidelines and principles, then, according to the Commission, it is feasible, both technically and economically, to reach the 20% target by 2020. The communication estimated that the green potential of electricity generation could even be increased to 34% by 2020, with a projected 12% share of wind energy; biomass, as well, was considered to have a great potential. Solar panels could only gain ground through a significant reduction of costs; the document, from 2007, expected a 50% fall in prices in this technology by 2020.[25]. The reduction in carbon-dioxide emissions these measures could yield would add up to approximately 700 Mt by 2020, the total value of which – considering carbon credit prices in the year of publication[26] – would more or less cover the part of green energy subsidies that would be charged to end consumers. The improvement in security of supply secured by the 20% renewable share would be equivalent to offsetting about 205 Mtoe of fossil fuel use in 2020. According to the Commission, these two objectives should provide considerable motivation for the promotion of the sector.

In the years following the adoptation of the 2001 directive, expectations towards renewables were already on the rise; focus was also extended to include opportunities to improve energy efficiency and energy savings, which could also facilitate the energy policy objectives we already mentioned. The commitment was further reinforced by the Renewable Energy Road Map. This process led to the directive setting the "triple-twenty" targets, that had been under preparation since 2005, finally being passed in April 2009.

The Directive 2009/28/EC laid down a 20% community-level mandatory target for 2020 in three areas:

I. 20% share of renewables in gross energy consumption;[27]

II. 20% improvement in energy efficiency;

III. 20% reduction in greenhouse gas emissions.[28]

[25] I will return to solar panels later on in a separate section; it will be apparent that the technology has already surpassed these expectations and has actually developed at a much higher rate.

[26] The communication calculated with a price of 25 EUR/ton, whereas currently, market prices are around 8 EUR/ton.

[27] Instead of electricity only, the requirement pertains to renewable production as a whole, including both heat and electricity generation. Member states are free to divide it across sectors according to their own priorities.

The document points out that in order to reach the above goals, the utilization of renewable energies and energy efficiency need to improve hand-in-hand, since the two of them together can better serve the reduction of greenhouse gas emissions and of our dependence on energy imports. Moreover, energy efficiency and energy savings are defined as the most efficient policies to increase the share of renewables; after all, an unchanged volume of green energy production coupled with a reduced total energy consumption necessarily results in a higher share of renewables.

Besides renewable energies, energy efficiency should also receive special emphasis and attention in our future energy policies. This area has great potential both on a community-level as well as in Hungary, the utilization of which may help meet renewable objectives, as well. Improvements in energy efficiency lead to a decreasing energy consumption, and hence also facilitate the reduction of import dependence. Furthermore, improving the energy management of buildings and/or re-insulating them also creates employment. Energy efficiency as a topic lends itself to an analysis just as wide in scope as one on renewables; the amount of potential questions, regulatory considerations[29] and relevant literature would easily suffice for a PhD thesis. Here and now, however, I will confine myself to pointing out that energy efficiency is essential for a sustainable energy economy, and it might also help us meet our renewable objectives.

According to the directive, a shift towards decentralized energy production is inevitable, due to its numerous advantages. These include, among others: utilization of local energy sources, increased security of local energy supply, local jobs, shorter transportation distances and reduced power transmission losses.

The directive also declared that energy prices should reflect the external (environmental, social and medical) costs of energy production and consumption, yet as long as electricity prices do not meet this criterion, state support for the promotion of green energies is a necessity.

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[28] In comparison to data from 1990.

[29] The proposal of the Commission to prepare an energy efficiency directive was endorsed in March 2011, and the directive was passed in Strasbourg in September 2012. It is expected that the directive, much alike the directive on renewables, will have to be transposed into member states' internal law in the form of national action plans and objectives.

The directive also outlines some expectations with regard to the licensing process of green power stations; procedures should be objective, transparent, proportionate and free from discrimination. The absence of these and/or insufficient cooperation between the various authorities may represent a serious obstacle to the spread of renewable technologies.

Member states were required to prepare and submit to the Commission by 30 June, 2010 their individual national action plans outlining the technologies through which they wish to attain the 2020 objectives and the related schedule[30]. The purpose of these national documents is to create a predictable environment for investors and to ensure the continuous promotion of the development of green energy technologies.

By the end of 2011 and every two years thereafter, member states had to report to the Commission on their progress on the targeted development path and on the measures they intend to take to overcome any obstacles to the promotion of renewables.

The directive also includes a so-called indicative trajectory showing the growth rates that the 2020 objectives should approximately translate into between the years 2011 and 2020 (see Directive 2009/28/EC Annex I./B). Member states should aim for surpassing the required annual percentage rates. Fouquet deemed it regrettable that there are no real sanctions in place for the failure to meet interim targets, since non-binding recommendations may not provide sufficient motivation for the member states as long as non-compliance does not result in prompt penalties, but lengthy infringement procedures only (Fouquet, 2012).

The community-level target of a 20% share of energy from renewable sources (and the expansion rate required to meet it) was broken down into national overall targets, set forth in the directive, based on a rather complex algorithm that took into consideration countries' GDP figures, their initial shares of renewables and projections for their future energy consumption such that each country would bear a burden that is in line with its own unique position. Table 3 below shows the national overall targets for the share of renewables in 2020, determined in accordance with the above:

[30] The directive includes a so-called indicative trajectory, which provides, with the help of a formula, specific figures for each year based on the prescribed growth path.

	Value in 2005	Target for 2020		Required increase (%)	2020 target / 2005 value
Belgium	2.2%	13.0%		10.8%	5.9
Bulgaria	9.4%	16.0%		6.6%	1.7
Czech Republic	6.1%	13.0%		6.9%	2.1
Denmark	17.0%	30.0%		13.0%	1.8
Germany	5.8%	18.0%		12.2%	3.1
Estonia	18.0%	25.0%		7.0%	1.4
Ireland	3.1%	16.0%		12.9%	5.2
Greece	6.9%	18.0%		11.1%	2.6
Spain	8.7%	20.0%		11.3%	2.3
France	10.3%	23.0%		12.7%	2.2
Italy	5.2%	17.0%		11.8%	3.3
Cyprus	2.9%	13.0%		10.1%	4.5
Latvia	32.6%	40.0%		7.4%	1.2
Lithuania	15.0%	23.0%		8.0%	1.5
Luxembourg	0.9%	11.0%		10.1%	12.2
Hungary	**4.3%**	**13.0%**		**8.7%**	**3.0**
Malta	0.0%	10.0%		10.0%	-
Netherlands	2.4%	14.0%		11.6%	5.8
Austria	23.3%	34.0%		10.7%	1.5
Poland	7.2%	15.0%		7.8%	2.1
Portugal	20.5%	31.0%		10.5%	1.5
Romania	17.8%	24.0%		6.2%	1.3
Slovenia	16.0%	25.0%		9.0%	1.6
Slovak Republic	6.7%	14.0%		7.3%	2.1
Finland	28.5%	38.0%		9.5%	1.3
Sweden	39.8%	49.0%		9.2%	1.2
United Kingdom	1.3%	15.0%		13.7%	11.5
average	**11.6%**	**21.4%**		**9.9%**	**3.2**

Table 3: EU member states' national renewable energy targets for 2020

Source: author's calculation/compilation based on 2009/28/EC

It is worth to examine not only the 2020 targets themselves, but their relation to the actual values from 2005[31], as well, therefore I added two more columns to the table included in the directive. The first one simply shows the difference between the figures for 2020 and 2005, that is, the required increase in the share of renewables expressed in percentage points, while the second is the quotient of those values, i.e. the 2020 targets expressed as multiples of the 2005 figures.

This way, it can be seen which countries pioneered renewables already as far back as 2005 (Denmark, Estonia, Latvia, Lithuania, Austria, Portugal, Romania, Slovenia,

[31] The reason for the initial values being those of 2005 was that it was the last year for which reliable data were already available at the time of passing the directive.

Finland, Sweden), and which were the ones that, considering their conditions and opportunities, did not manage to achieve any substantial result. While on average, countries are required to increase their 2005 figures by 10 percentage points, which is equivalent to tripling them (target is 3.2 times the 2005 value), certain countries (Belgium, Ireland, Cyprus, Luxembourg, Malta, Netherlands, United Kingdom) are expected to deliver far higher growth rates. England and Luxembourg should increase their share to (more than) ten times its 2005 value. That certainly requires very effective incentives, and it also suggests that the promotion systems they employed earlier were inadequate.

The values in the table do not pertain to renewable electricity production alone, but to total renewable energy production (heat plus electricity); however, these growth rates can still serve as a good guide concerning electricity production from renewable sources, as well, which is the focus topic of my dissertation.

An even stronger commitment to renewables is expressed in another document on long-term community strategy, namely the Commission Communication **Energy Roadmap 2050** from 2011 (COM(2011)885). The document discusses the challenges the 2050 decarbonization objectives pose in energy security and competitiveness. Because of its target to reduce greenhouse gas emissions by 80-95% (compared to their level in 1990) by 2050, the public often refers to this communication as the **decarbonization roadmap**.

The communication underlines that, given the rather long project cycles of the energy industry and the fact that it is this very decade when the power plant infrastructure/equipment that was deployed, for the most part, about 30-40 years ago will need to be replaced, the energy production and consumption structure of the 2050s is being formed right now.

The roadmap outlines several scenarios, exploring the various possibilities for decarbonization. Taking the reference scenario built upon the current tendencies as a starting point, the more than 80% reduction in carbon dioxide emissions can be accomplished in several different ways, depending on what our guiding principle is: increasing energy efficiency; technological diversification; a high share of renewables; carbon dioxide capture and storage or the lowest possible share of nuclear energy. The high-renewables variant assumes a 75% (!) overall share of renewables, and an even higher share, namely 97% in electricity generation, which means, that ***in order to meet the decarbonization target, almost the entire volume of our electricity consumption in 2050 will need to be covered by energy from renewable sources.***

The analysis of the various scenarios led to the following ten conclusions, included in the communication, with respect to the structural changes expected in the energy system by 2050:

1. **Decarbonization is possible**, and its costs can be lower than those of maintaining our current policies, mainly because of our reduced dependence on fossil imports and the resulting drop in our exposure to fossil fuel prices.
2. **Capital expenditure will be higher and fuel costs will be lower**, since large portions of our current energy supply capacities are nearing the end of their service life and thus need to be replaced, which necessitates a significant volume of investment, whereas the fading role of fossil fuels acts to reduce raw material costs.
3. **Electricity will play an increasing role;** its share in final energy consumption is expected to double to 36-39% in 2050.
4. **Electricity prices will rise until 2030, but decline afterwards,** according to the majority of scenarios, as old energy supply capacities will be replaced in the next 20 years, resulting in a temporary rise in capital expenditure, which will be intensified by the higher capital need of the new types of power plants. Following this period of increased investments, the new high-efficiency equipment will generate electricity at a lower cost.
5. **Household expenditure on energy will rise** and constitute a more significant share of total household expenditure at approximately 15-16%.
6. **Energy savings are an essential element** in all decarbonization scenarios; taking 2005-2006 as the base, energy consumption should drop 16-20% by 2030 and 32-41% by 2050.
7. **The share of renewable energies will rise substantially**, to at least 55% in 2050, which translates into a 45 percentage point improvement in about 40 years. The projected share of renewables is even higher in electricity

generation (in all scenarios), 64% on average, and the already mentioned 97% in the high-renewables scenario.

8. **Carbon dioxide capture and storage will play a fundamental role.**
9. **Nuclear energy will continue to provide a significant contribution,** given that it is one of the most important sources of low-CO_2 electricity production.
10. **The co-operation of decentralized and centralized networks will need to be harmonized,** for while more renewable generation means a shift towards decentralized production, large-scale, centralized systems will still be inevitable, and it will be essential for the two to operate in synergy.

Concerning the **gradual transition to renewable energy sources**, an issue that is central to my dissertation, the roadmap declared that the second most important prerequisite for the sustainability and the security of our future energy systems is, right after energy savings, to increase the share of renewables. On this path, it might constitute a political challenge to meet this goal at a reasonable cost; after all, the promotion of renewables is, currently, paid for by the energy consumers. Accordingly, incentives need to become more and more efficient, and be prepared for the mass production of renewable energy and its integration into the market.

The potential appearance of new technologies might become a key factor in this growth, as well as the increased demand for storage capacity arising from the non-controllability of weather-dependent renewables, especially because the communication expects wind power to have the highest share within green energy by 2050. The demand for flexible capacities, due to weather-dependent renewables becoming more and more widespread, might pose a further challenge. It is less foreseeable, furthermore, how the increased presence of wind and solar power stations will affect the price of electricity in the long run, as the marginal cost of these technologies may be very low, even near to zero, which may lead to a fall in energy prices in the longer term. The increase in the share of renewables makes deploying more intelligent distribution networks capable of integrating these new capacities inevitable; transmission, distribution and storage will have to be managed in an integrated approach. These requirements and the aforementioned replacement of end-of-life equipment necessitate a vast amount of investment, therefore it is crucial to have instruments in place to mobilize and motivate investors, in the field of both conventional and renewable energy utilization.

And the first step towards decarbonization is, obviously enough, to fully comply with the targets set for 2020.

4.2. Regulatory Practice and Experience of European Union Member States

The majority of European Union member states have had in place financial incentives for the promotion of renewable electricity production for several decades. Performance in this field, the increase achieved in the share of renewables, i.e. the success of their respective systems is different country by country. The definition of success is, however, ambiguous – the deployment of a significant amount of renewable energy production capacities may be considered a success just as well as a somewhat lower degree of expansion at a significantly lower cost to the society. With the wish to explore improvement opportunities for the Hungarian renewable energy regulation in mind, the experience of the various countries, the changes in their incentives, the causes for those amendments and the recent trends in promotion systems are all worth examining.

The EU continues to refrain from taking a stance and making a recommendation on the promotion of renewable energy production, that is, the decision between price-based vs. quality-based incentives is left to the discretion of the individual member states. The Commission, however, tries to facilitate member states' choice insofar as they prepare comparative analyses of the various support systems and communicate the conclusions to member states. Such a document was, for example, the Communication from the Commission of 2005 „The support of electricity from renewable energy sources"[32], which provided useful guidance for the member states by comparing the experiences in the promotion of electricity production from renewable energy sources and evaluating the effectiveness of the individual systems considered.

[32] See Communication COM (2005)627.

Experts with Infrapont point out that, according to the communication, green certificates proved out not to be effective at all as an incentive with respect to certain resources. This is particularly true for PV panels, a technology currently in a stage of its learning curve that is characterized, in comparison to other energy production methods, by a higher production cost. At the same time, the level of support that TGC systems can provide is, due to their exposure to the market, too low for this technology to grow or develop, and hence become more efficient and mature. Consequently, it was the feed-in tariff system that the Commission deemed appropriate with regard to technologies still in their high-cost stages (Infrapont, 2010, pp. 51-52).

As far as TGC systems are concerned, the document also notes that due to the volatility of market prices, investors' returns are indeed more uncertain than in fixed-price schemes, which, however, also includes the possibility of them being actually higher. The instrument of green certificates has not been in the market for very long yet, thus related experience is insufficient for drawing any substantive conclusions.

4.2.1. The Differing Conditions of Member States with Respect to Renewable Energies

It is not only the concrete share of renewables in energy production that needs to be considered in the evaluation of the success and efficiency of member states' promotion systems, but also how the development the individual countries have achieved relates to their own possibilities. As regards the utilization of renewable energies, the conditions of EU member states vary on a wide scale. In this case, by conditions we not only mean the natural resources that limit the spectrum and the effectiveness of the technologies worthy of consideration at a given location.

Reiche-Bechberger classified the factors that provide the framework for countries' renewable energy promotion systems – that is, the conditions that influence the ideal choice of incentive and its potential for success – as follows (Reiche-Bechberger, 2004, pp. 843-846):

– **Renewable energy definitions:** Before the aforementioned EU directive was enacted in 2001, there had been differences between member states in the energy production methods that counted as renewable and, hence, were eligible for support. Countries' positions and promotion policies were uniform concerning wind and solar power stations: each government considered them renewable. Hydro power plants, however, were only supported above/below a certain capacity level by some countries. The United Kingdom and Germany excluded from their promotion system those above 10 MW and 5 MW, respectively, while in the Netherlands, it was small-scale power plants that got unlucky. Another issue was the classification of waste incineration, which was excluded from the renewable category by a number of countries (e.g. Germany, Greece), but served as the strongest pillar of renewable production in others (Belgium, United Kingdom, Netherlands). All types of hydro power plants and the biodegradable fraction of industrial and municipal waste was declared by the directive to count as a renewable source of energy, and thus a common position was established.

– **Geographical conditions, initial share of renewables:** Apart from Denmark, the countries that boast the highest share of renewables in electricity generation are the ones the precipitation and topographical conditions of which are suitable for the deployment of hydro power plants. Before green energy incentives became common, hydropower had had a prominent share in nearly all the countries that had achieved the highest shares of renewables.

  The spread of renewables may be impeded by the availability of fossil resources within the country (Netherlands and United Kingdom: own crude oil and natural gas reserves) as well as by substantial subsidies to the coal industry, for these act to weaken the competitiveness of renewables. In countries that depend on energy imports (e.g. Portugal) or strive to phase out nuclear capacities (e.g. Belgium, Germany, Netherlands, Sweden), on the other hand, the motivation to go green in stronger. However, not all affected countries managed to take advantage of their favorable natural conditions to the same degree; for example, the most favorable locations for wind turbines can be found in France, the United Kingdom and Ireland, and still, Germany has more than ten times the capacity than the three of them together.

- **International obligations:** The momentum of member states' green electricity promotion systems may also be influenced by the different international policies (either the EU renewable directive or the Kyoto Protocol) prescribing differing targets for them. Also, the countries that had liberalized their electricity market earlier (Austria, Germany, Finland, Sweden and the United Kingdom) have an edge on the ones that postponed the move until the final deadline (2007) set by the EU.

- **Planning/licensing culture:** In a number of countries, the primary barrier to the growth of renewables is the complicated, tedious and lengthy licensing procedure for the deployment of power plants. In certain countries, the hardships of licensing (in Greece, for example, as many as 35 organizations have to give their consent) scare away investors, while others try to appeal to them by striving to simplify/accelerate proceedings (e.g. the one-stop system in Germany).

- **Public awareness concerning renewables:** Promotion systems may deliver very limited success if the utilization of renewables is not really backed by the society or if social support is accompanied by a strong NIMBY („Not-In-My-Back-Yard) attitude, that is, if people only support projects that do not affect their immediate environment. Each nation has a certain initial level of environmental awareness, which also affects the reception of renewables – nevertheless, using the appropriate means, the policymaker may be able to make a difference in that attitude. For example by relevant tax allowances, by supporting small investors in the sector, by green energy marketing[33] or by legislation that requires suppliers to provide in the electricity bill information on the energy generation method (Austria) in order to confront the consumer with the issue. The willingness to pay more for renewables, of course, also depends on the financial positions of the various social groups – yet motivation can definitely be influenced and enhanced by the policymaker.

[33] The conscious pro-green marketing campaigns of the policymaker had a great part in the success of the German system (Wüstenhagen-Bilharz, 2006).

- **Technical differences:** Here, Reiche-Bechberger primarily focus on grids' capacity to take in renewables and to control the operation of the entire network. It may be much more expensive to integrate decentralized, small-capacity renewable power stations into an electricity distribution network designed to work with large, centralized generation capacities than into a transmission network that was meant to handle distributed, local generation capacities to begin with. Today, there is a growing need to also integrate solar power stations, in addition to wind turbines, into the network, which necessitates very flexible and accurate transmission control. The production volume of these (weather-dependent) energy sources might significantly (by as much as 30% in the case of wind turbines, for example) vary from year to year (Meyer, 2003).

4.2.2. The Dominance of Feed-in Tariff Systems

Countries developed their renewable electricity promotion systems according to their differing characteristics, conditions and regulatory preferences. The dominance of FiT schemes was apparent right from the beginning, the reason for which is probably that it creates a more secure investment atmosphere in this relatively new industry.

Although the first support systems had already appeared in the end of the 80s (Portugal: 1988; Netherlands: 1989; Germany: 1990) (Ringel, 2006), what is more, some sources even say German renewables policies date back as far as 1974 (Lauber-Mez, 2006), it was after the liberalization of energy markets[34], i.e. the beginning of the 2000s, that the sector and, hence, the incentives became truly significant.

In 2001, six out of the fifteen EU member states operated a TGC system: Austria, Belgium, Denmark, Italy, Sweden and the scheme's most prominent advocate, the United Kingdom. Several of these, however, also had FiT models in place. *Those with a TGC system only were Italy and the United Kingdom*. With the accession of a

[34] The positive effects of the liberalization of electricity markets on the growth of renewable energies is probably and primarily a consequence of the drop in capital costs induced by the market opening (Szabó et.al., 2008).

number of new member states, the proportions have changed, yet the dominance of the FiT model is still unquestionable; three out of every four states operate a feed-in tariff scheme exclusively. „Mixed" systems are quite common, as well. The figure below shows the distribution of incentives today:

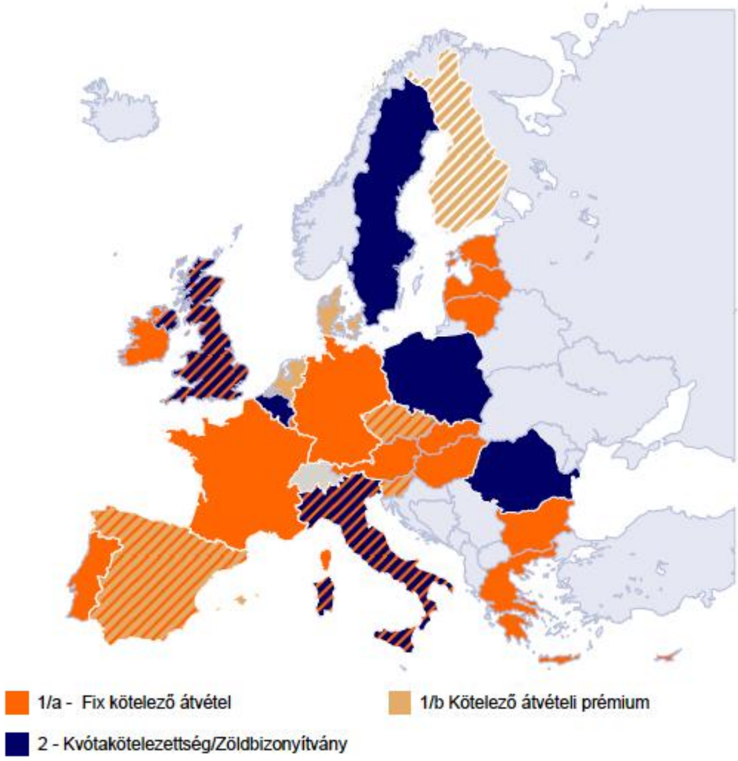


Figure 7: Promotion systems in the EU member states

(1/a – Fixed feed-in tariff; 1/b – Feed-in tariff with a price premium; 2 – Quota obligation/green certificates)

Source: Re-Shaping, 2011.p.35.

If Green Premium systems are defined as a sub-type of FiT, then, as it can be seen from the figure, the number of countries that employ a feed-in tariff system only is twenty. There is one single country that has neither one of the two, but only uses tax allowances as an incentive: Malta. Six countries (Italy, England, Poland, Romania, Sweden and Belgium) have a green certificate scheme in place, yet two of them (Italy, England) also operate a feed-in tariff program. These two are exactly the countries that were the primary advocates of green certificates initially, but the last couple of years have had to witness their partial transition to a price-based regulation. The example of Italy supports our earlier note on the relatively low maturity of solar panels, since even though they were a proponent of green certificates originally, they now have a pure feed-in tariff system in place for this very technology, while use a mixed FiT/TGC scheme for all others (investors are entitled to choose from the two). In 2010, England introduced a feed-in tariff program for small-capacity power plants, because previously, their share of renewables always fell short of the target (Haas et. al. 2011a). Accordingly, *only four member states are left that exclusively use a TGC system.* This trend might be interpreted as the self-criticism of the TGC system.

One may form an opinion on the success of the various incentives by looking at how the share of renewables in electricity consumption has changed between 1999 and 2010 in the countries considered:

Country	1999	2010	Change %	Change 2010/1999	Incentive in place
Austria	71.4%	61.4%	-10.0%	-14%	FIT
Belgium	**1.0%**	**6.8%**	**5.8%**	**580%**	**FZB**
Denmark	**12.1%**	**33.1%**	**21.0%**	**174%**	**FIT/GPR**
Finland	26.3%	26.5%	0.2%	1%	FIT/GPR
France	16.3%	14.5%	-1.8%	-11%	FIT
Germany	**5.2%**	**16.9%**	**11.7%**	**225%**	**FIT**
Greece	9.5%	16.7%	7.2%	76%	FIT
Ireland	**5.1%**	**12.8%**	**7.7%**	**151%**	**FIT**
Italy	16.7%	22.2%	5.5%	33%	FZB/FIT
Luxembourg	1.9%	3.1%	1.2%	63%	FIT
Netherlands	**2.4%**	**9.3%**	**6.9%**	**288%**	**FIT/GPR**
Portugal	**20.4%**	**50.0%**	**29.6%**	**145%**	**FIT**
Spain	**12.8%**	**33.1%**	**20.3%**	**159%**	**FIT/GPR**
Sweden	50.7%	54.5%	3.8%	7%	FZB
United Kingdom	**2.5%**	**6.7%**	**4.2%**	**168%**	**FZB/FIT**

Table 4: Share of renewable energies in electricity production in the EU-15

Source: Eurostat, 2012. p. 76, with additions by the author

Taking the figures from 1999 and 2010, I calculated their difference (Change %), which tells us how many percentage points the share of renewables in electricity production increased/decreased in the 11 years in question. The next column contains the quotient of the two values diminished by one, showing the increase in the share of renewables, expressed as a percentage of the initial value. The success of an incentive should not simply be equated with the numerical value of the increase alone, but one should also take into consideration the initial value, that is, how many times the „result" exceeds the „base". It is clearly not indifferent whether a 5 percentage point increase is added to a base value of 20% or 5% – as what it means is that the incentive achieved a „mere" 25% vs. a 100% increase, respectively. The last column informs about the support system of the given country – not only the present one, but all that had been employed during the 11 years,[35] with the more dominant one coming first (if there is/was more than one).

Eight states delivered extraordinary performance in terms of growth rate (near 150% and above): Belgium, Denmark, Germany, Ireland, Netherlands, Portugal, United Kingdom. Six of them basically had FiT schemes, thus there were only two TGC countries that scored so well: Belgium and the United Kingdom. If, however, we also incorporate the actual numerical growth of renewable shares (fourth column) in the analysis, we can see that in spite of their high growth rates, the actual increase in the share of renewables achieved by these two countries was 5.8 percentage points and 4.2 percentage points, respectively. Countries that achieved an increase of 10 percentage points or more in their share of renewables are highlighted in green in the table – their regulations are, with no exception, dominated by the FiT system. Thus based on the percentage point increases in values, it is FiT systems, and even more specifically, the promotion schemes of Denmark, Germany, Portugal and Spain that appear to be most successful, to be an example to follow.

It is the experiences of Germany and England that the pieces of the literature on the comparison and analysis of the two types of incentives most frequently evaluate[36]; it is these two countries, if any, that can be considered the „model examples” of the two systems.

The most important criticism and deficiencies of the English (TGC) regulation can be summarized as follows (Lipp, 2007) (Haas et al., 2011b):

- The initial system introduced in 1989 (Non-Fossil Fuel Obligation) primarily aimed at reducing the use of fossil energy sources, which in its first years basically meant the support of nuclear energy production; the possibility to meet one’s obligations through renewable energies was only introduced in 2002, along with renaming the system Renewable Obligation.
- Because of the country’s access to fossil energy sources within its own borders, no special priority was given to increasing the share of renewables.

[35] Based on (Nemzeti Fejlesztési Minisztérium, 2011) and (Regionális Energiagazdasági Kutatóközpont, 2012).

[36] See for example (Fouquet-Johansson, 2008), (Wüstenhagen-Bilharz, 2006), (Agnolucci, 2006), (Mitchell et al., 2006), (Lipp, 2007), (Smith, 2007), (Menanteau et al., 2003).

– The policymaker did not lay down long-term objectives and preferences, and hence the regulation kept changing rather frequently.

– The TGC system was not differentiated by technology, therefore it only facilitated the growth of the most cost-efficient technologies, and thus substantial progress was limited to wind turbines and the utilization of biomass – but then again, even those results were weak given the country's favorable conditions.

– Due to the small number of projects and the lack of differentiation, green certificates were held by a relatively limited circle of investors, the trade of which was, consequently, subject to individual agreements for the most part. This acted to deepen the uncertainty of price forecasts, raised investor risk and increased the administrative costs associated with the system's operation.

– Because of the small number of participants and in order to reduce risk, green power was often sold under long-term contracts. Which means that the model – theoretically built upon prices being determined in the marketplace, through competition – did not actually function as intended.

– Fines for non-compliance with the mandatory quota were too low.

– Banking, that is, the „storage" of certificates to be redeemed in the next year, was not permitted. Therefore it was reasonable for the investors to suspect that the closer they get to the quota, the lower the price of the certificates will be, which caused them to be not interested in growth ab ovo.

– The country did not simplify the licensing process in order to accelerate progress.

– As a consequence of all the above, production usually remained below the targeted annual green quota.

– Both the growth rate and the diversity of renewable generation capacities lagged far behind those of Germany and Denmark.

– The only reason why the actual achievements falling short of renewable energy targets did not put meeting the country's greenhouse gas emissions limitation commitment in jeopardy was the growth of nuclear energy in the meantime.

The factors of the successful operation of the German model were (Menanteau et al., 2003) (Haas et al., 2011b):

- The policymaker has been highly committed to the promotion of renewable energy production right from the beginning (1991), and they strived to convey the idea to the public, as well[37].
- Feed-in tariffs were guaranteed for 15 to 20 years in the German FiT scheme, which reduced investor risk significantly.
- Tariffs were differentiated not only by technology, but even by location, as well, to adjust to varying local conditions.
- Tariffs were differentiated not only by technology, but by startup date, as well, and they were degressive over time. With such a tariff structure, communicated 5-10 years in advance, innovation became an absolute must, and the opportunities to make extra profits were limited, as well.
- Predisclosed feed-in tariffs were typically not changed afterwards, that is, the policymaker created an atmosphere where plans/forecasts could be relied upon.
- The „shield" erected around green energies, the exclusion of market competition stimulated and, at the same time, created favorable conditions for innovation, which allowed for the German equipment manufacturing base to evolve and to gain a very strong foothold in certain industries (e.g. the manufacturing of wind turbines).
- Continuous innovation enabled technologies to reduce their unit costs.
- The appropriate differentiation of feed-in tariffs by technology allowed for a wider spectrum of technologies to grow and develop, with relatively large participation from small investors, which further improved the social acceptance of the program.
- With significant effort, the policymaker kept simplifying and shortening the licensing procedure for renewable projects.

[37] These efforts were greatly intensified after the Fukushima disaster, as Germany decided on the gradual phasing out of its nuclear power plants, opening up further opportunities for renewable energies.

– The administrative costs of the system are low, as is investor risk – accordingly, the German model not only managed to achieve far more remarkable results, but did so at a lower cost than green certificate systems (Lipp, 2007); (Fouquet-Johansson, 2008).

In summary of the above, we can conclude that as of now, it is feed-in tariff schemes that appear to be more successful in the promotion of renewable energies in the member states of the EU – a statement underpinned by the growing number of FiT advocates among member states, their superiority in performance and also the fact that certain TGC countries decided to introduce FiT-elements to their systems.

4.2.3. The Development of „PV Bubbles”

In the renewable energy production of the EU member states, it was the cheaper, more mature technologies that began to gain ground first, thus the 2000s witnessed wind turbines becoming more and more widespread. 2010 onwards, however, photovoltaic (solar/PV) systems took over the leading role with respect to the annual amount of newly installed renewable capacities. The solar capacities installed in 2010 only slightly exceeded the capacity expansion in wind power, with a yearly total for EU member states of 12.000 MW and 9.295 MW, respectively (EWEA, 2011, p.7). The difference grew significantly larger in 2011; solar panels, at 21.000 MW, accounted for 66% of the total amount of renewable capacities installed that year, while wind turbines reported a „mere” 30% at 9.616 MW (EWEA, 2012, p.7).

Solar power stations took over the leading role not only in renewable investments, but, by 2011, in total Community investment into energy production capacities, as well, as shown in Figure 8 below:

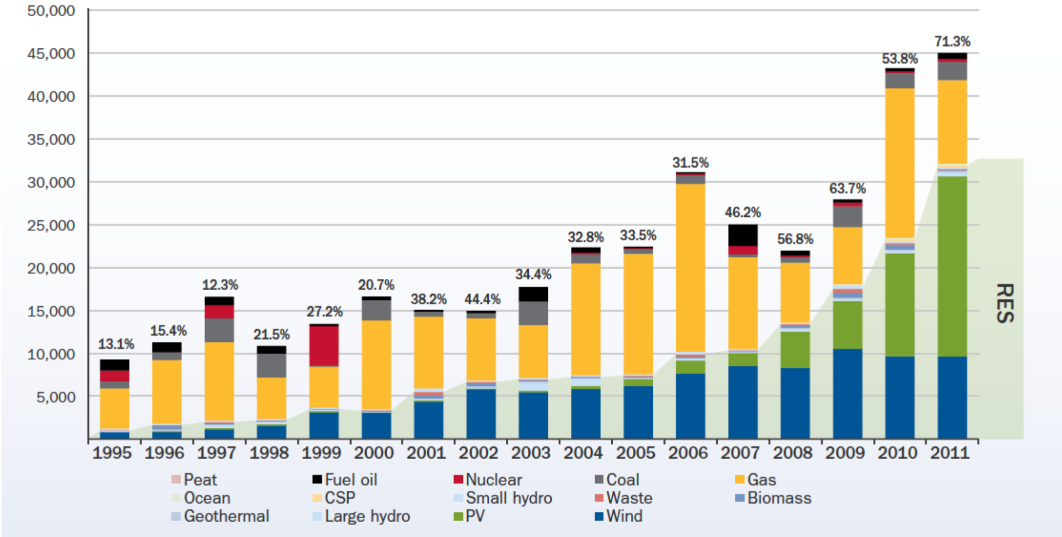


Figure 8: Energy production capacities installed in the EU

Source: EWEA, 2011, p.7.

2008 saw renewable energies becoming dominant in terms of newly installed capacities. Within the category of renewable power plants, wind turbines had held the first place until 2009, yet solar power stations took over the lead in 2010. In 2011, renewables accounted for 71.3% of total new power plant capacities; out of that, 41% were solar panels and 21% were wind turbines.

The growth of PV power stations in recent years has had two main causes. First, the continuous development and gaining ground of the technology, which has rendered the price of solar panels more and more competitive. Second, some countries with feed-in tariff schemes in place have achieved an expansion in PV capacities way beyond their expectations, resulting in the heavy criticism of FiT schemes.

Development in this technology is rapid and very intensive. Each time the amount of installed capacities was doubled, it brought a 20% drop in the price of PV panels (Jäger-Waldau, 2009). It was in 2004 that the installation of PV capacities truly began to gain momentum. The then global capacity of 3.9 GWh doubled in the course of the next three years to 9,5 GWh in 2007, then it doubled again within 2 years' time, by 2009, to 23 GWh, which also increased to almost double its previous value in 2010, into the 40 GWh range (REN 21, 2012, p. 35). Thus the growth rate is accelerating, the industry is developing at an ever higher rate, solar panels are becoming cheaper and cheaper, and the technology more and more competitive.

In Europe, average PV panel prices hovered around 4.2 EUR/Watt in 2000, which fell to 1.2 EUR/Watt, less than one-third of the initial value, during the next ten years, as detailed in Figure 9 below:

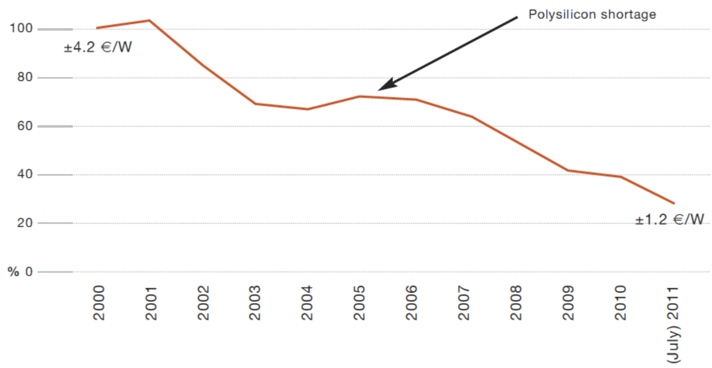


Figure 9: Average price of PV modules in Europe

Source: EPIA, 2011, p.14.

The downward trend in the price of modules is likely to continue (EPIA, 2011), (Wand – Leuthold, 2011). Given that the action plans of the member states set the target of nearly quadrupling their 2010 solar production capacity of 26.146 MW to 91.420 MW in 2020 (Jäger-Waldau et al., 2011), the regulation of this part of the sector will have to be an area of top priority in coming years.

Operating an appropriate promotion system in this rapidly developing sector constitutes a serious challenge. Problems may arise not only from the intensity of technological development, but from information asymmetry, as well; after all, it might very well happen that the policymaker, or even the investors, do not have perfect, up-to-date information on the current characteristics of solar panels. Therefore the marginal cost of solar modules is very difficult to estimate, hence it is more reasonable to establish a range, rather than one specific value as an estimate (Szabó et al. 2010).

In comparison to wind turbines, solar panels are much faster to manufacture, to install and to build a system from. And while by wind power stations, we mean vast steel structures and turbines with a relatively mature technology, solar modules are, in comparison to an average citizen's image of a power plant, far more simple and contain no moving parts. Therefore their development is much faster, less predictable and capable of producing much more impressive results. In recent years, several European countries have witnessed the installation, within a relatively short time, of a surprising volume of solar capacities, by far exceeding the expectations of the policymaker, and resulting in power grid management problems and in end consumer prices getting out of control. The IEA lists four major factors that may have caused this phenomenon, which the literature also refers to as PV bubbles (International Energy Agency, 2011, pp. 128-129):

- PV technology is modular, easy and quick to install and accessible to the public.
- PV investment opportunities were offered to both individuals and professional investors, as they constituted a long-term, low-risk instrument, with returns sometimes well in excess of that of government bonds.
- The central monitoring of installation costs by the policymaker was rather cumbersome, given that the installed solar panels exhibited an enormous variety in type and size and that, except for a couple of countries, system operators had neither the experience nor the means of integrating these into their network.
- Certain countries used excessive incentives for PV technology, which provided unnecessarily high returns for investors, resulting in a surge in the number of projects.

The phenomenon first became visible in Spain, where in 2008, the sum total of PV capacities in operation reached 4 GW, which was ten times the plan for that year. In Italy, the peak year of the rush was 2010, with 3.5 GW in operation and further 4 GW awaiting grid access. Yet the extent of the problem was the largest probably in the Czech Republic, as its 1.9 GW of solar PV capacity figure at the end of 2010 already exceeded the target set for 2020 in its national action plan. Germany, as well, experienced a striking expansion in PV capacities: the capacity growth in 2010 was double the target laid down in the action plan (7.4 GW). One surely has to admit, as well, that the country’s 2020 photovoltaic targets are indeed ambitious at 52 GW, out of which, however, 17 GW were already installed at the end of 2010 (International Energy Agency, 2011).

As a consequence of all the above, nearly three quarters of the world’s solar PV capacities were concentrated in these European countries by the end of 2010:

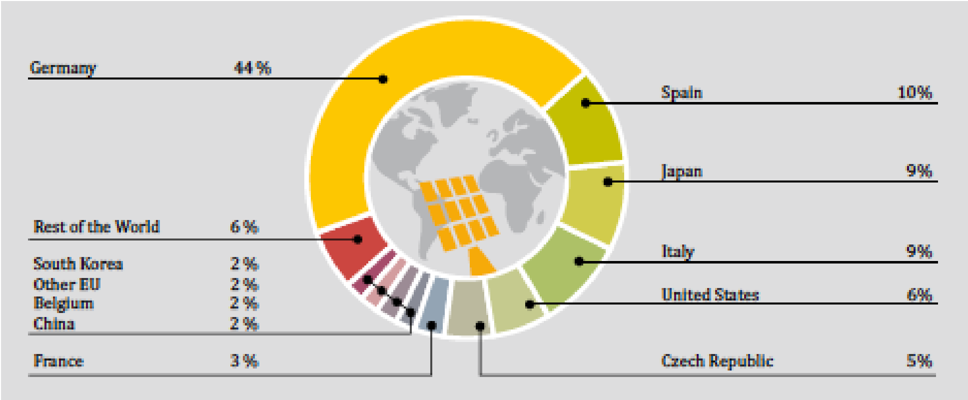


Figure 10: Distribution of PV capacities at the end of 2010

Source: REN21, 2012, p.23.

As evinced by the figure, Germany is known to hold nearly half of the world's solar PV capacities, Spain and Italy are coming next (as far as Europe is concerned), with about 10% each; the Czech Republic and France have 5% and 3%, respectively. A factor that has exacerbated the issue in the Czech Republic is that it has achieved this relatively high value in spite of the country's limited size and less favorable conditions (in comparison to Mediterranean countries), and to top it all off, the growth has been relatively sudden, i.e. expansion was not gradual. The peak occurred in 2010, when the country placed third, with 1.5 GW, in the global ranking on the yearly amount of installed PV capacities (CPSL-REKK, 2012); the cause was the relatively high value – in comparison to the rest of the countries – of the feed-in tariffs offered in 2009-2010 for ground-mounted solar power capacities (Regionális Energiagazdasági Kutatóközpont, 2012, p.73).

Given that all the countries we mentioned employed feed-in tariff schemes to promote photovoltaics, which are, if the policymaker is not sufficiently informed, prone to cause excessive feed-in tariffs and hence similar bubbles, the correction of this deficiency seemed to be „the way out" of the situation. An indicator of the severity of the deviation from the plan in the growth of solar PV and of the maturity of the country's regulation is the way how the policymaker handles the issue. Reactions basically took three forms (Regionális Energiagazdasági Kutatóközpont, 2012):

– reducing the feed-in tariffs in certain segments (mainly for large-capacity, ground-mounted power stations);

– increasing the frequency of scheme reviews in order to ensure that tariffs keep in line with technological progress;
– introducing annual volume limits on the capacities eligible for a guaranteed purchase agreement.

Spain introduced annual quotas, distributed on a quarterly basis, and feed-in tariffs were also reduced by nearly 30% for new projects. In 2010, the feed-in tariffs of existing projects were reduced by 10-30%, as well, which is sure to remain effective at least until 2014. Germany started a gradual reduction of the feed-in tariffs for new entrants in 2009, which have therefore become about one-third lower by now. The degree of future tariff reductions will depend on the volume of the capacities installed in the meantime. Italy reduced its tariffs by 20% from 2010 to 2011, and the feed-in premium system was replaced with a fixed-tariff scheme. The reaction of the Czechs may be considered the most drastic one: feed-in tariffs for new capacities were nearly halved, and a 26% income tax was introduced for all capacities installed since 2009 with retroactive effect (Regionális Energiagazdasági Kutatóközpont, 2012); (Jäger-Waldau et al., 2011).

The above steps managed to curb the PV boom by 2011, except for Italy, where capacity expansion in 2011 was still very high (three times the amount of 2010).

Most striking for the industry were the policy changes having retroactive effect – investors can, however, adapt to tariff reductions for new entrants if communicated in advance. As we have seen, inappropriate tariff values may lead to very serious problems and create an unpredictable environment. The governments of Spain and the Czech Republic were sued by several groups of investors over retroactive legislation, and capacity expansion in 2011 was practically zero.

The literature often refers to PV bubbles as an inherent flaw in FiT schemes. However, as we have already established in our theoretical overview, policymakers have to assume broader responsibilities in a FiT scheme, and a technology with rapidly changing marginal costs may be easily diverted from its intended path by an obsolete tariff. And the particularly rapidly developing technology of solar panels proved out to be particularly fertile ground for such derailment. Worth mentioning is, however, that similar problems have recently surfaced in two countries with differentiated certificate schemes, Romania and Bulgaria; after all, the proportions of the per unit numbers of green certificates issued to the different technologies need to be determined by the policymaker in this sort of scheme, as well. In Romania, a proposal to reduce the number of certificates for PV from 6 to 4 is currently pending a decision, while Bulgaria introduced a near 30% network access fee for solar power stations already installed during 2012, thus the industry has significantly lost in attractiveness (Florea, 2012). Thus PV bubbles did not only develop in FiT countries, but under TGC policies, as well.

Given that the national action plans suggest a substantial expansion in PV capacities in coming years, as well, it is essential that the regulation be prepared to correctly handle the phenomenon. Policymakers may avoid such issues by ensuring they are sufficiently informed, by having an active dialogue with the industry and, concerning FiT schemes (the category that the Hungarian regulation falls into, as well), by rigorously updating and reducing tariffs with time, along with adding a tiny bit of a quantity-based approach (annual quota, tariffs changing with total installed capacity).

4.2.4. Barriers to the Growth of Renewable Energy Production

Recently, the renewable energy sector has been growing faster than the rest of the economy, both in Europe and globally (Jäger-Waldau et al., 2011). In the beginning, the largest barrier to the spread of green technologies were their high costs, in comparison to conventional energy production methods, because that made them economically non-competitive. In order to promote their spread, countries introduced political measures and incentives to make sure renewable projects yield appropriate returns. This strongest, economic barrier should be handled by the policymaker creating a stable and profitable environment for investors and hence promotes further growth in the industry (Ragwitz et al. 2007).

With technological development, certain technologies have become capable of competing in the free market, given that the energy source and market conditions are both ideal. Thus, thanks to the incentives in place and to technological development, the economic barrier seems to become less of a problem (IEA, 2008). In a 2012 survey of 72 business executives from the energy sector, 80% agreed that by 2030, neither onshore wind farms, nor biomass power plants, nor PV power stations will need extra support from the state, as they will be competitive without (PWC, 2012).

In the absence of mandatory targets, and active policies and reliable support systems that would help us meet those targets, there is no market for renewables (Fouquet, 2012). In 2005, there were „only" 55 countries globally that had a political instrument in place for promoting renewables (REN 21, 2010); this figure grew to 109 by early 2012 (REN 21, 2012).

Nonetheless, with green energies becoming increasingly widespread and competitive, the **non-economic barriers** that originate in the very characteristics of renewable energy sources and the structure of energy systems and that may hinder future growth or lead to excessive/distorted prices keep on gaining in importance. Our analysis of the efficiency of renewable energy promotion systems led to the conclusion that the role of non-economic barriers in their success may be greater than that of the type of incentive (quantity vs. price-based) used to eliminate the economic barrier (International Energy Agency, 2011). Even the most motivating feed-in tariff system of the world could be in vain, for if non-economic barriers are substantial, then the development of the renewable sector will fall short of expectations, of what other countries with similar feed-in tariffs might possibly achieve[38].

Drawing from the above, we may want to give a summary of potential non-economic barriers; Lamers grouped them into the following categories (Lamers, 2009):

- ***Barriers arising from regulatory and political uncertainty:*** may originate in flaws in strategic plans or the insufficient transparency of political decisions and legislation.
- ***Institutional and administrative barriers:*** lack of strong, dedicated institutions, unclear roles and responsibilities, tedious and non-transparent licensing procedures.
- ***Infrastructural barriers:*** mainly depend on the flexibility of the power grid, largely influence the potential uptake of energy from renewable sources.

[38] We will come back to that issue later, when analyzing the Hungarian regulation in the empirical part of the dissertation.

- ***Financial barriers:*** lack of financial opportunities and instruments that suit renewables.
- ***Market barriers:*** which put renewable energies at a disadvantage to fossil fuels. May originate in subsidies to fossil fuels, asymmetric information and, of course, environmental and social external costs getting ignored.
- ***Barriers related to environmental awareness and training:*** insufficient knowledge about the availability of renewables and related opportunities, workforce not sufficiently trained in green technologies.
- ***Barriers related to reception and environment:*** society is often unduly mistrustful of new technologies, and planning requirements have a tendency of being too strict, as well.

The social acceptance of renewables in the European Union is considered to be favorable, for according to a 2011 Eurobarometer survey, it was the promotion of renewable energies that received the highest acceptance score (71%) among the European population. The 2020 target of a 20% share of renewables was perceived as feasible by 57%, too ambitious by 19% and 16% even believed it was too low (Eurobarometer, 2011).

In Europe, there are two main barriers worthy of our attention (Jäger-Waldau et al., 2011). Firstly, current economic and social systems are based on the centralized production of energy from conventional sources and matching distribution systems, which only allow for one-directional energy flow. Decentralized renewable energy production capacities, at the same time, would require a power grid capable of bi-directional energy flow in order to optimally exploit weather-dependent renewables. After all, whenever the sun is not shining, households with solar panels need to draw electricity from the grid, while at times when their PV generation exceeds their instantaneous use, the difference could and should be fed into the network.

The second main barrier, according to the study, originates in the somewhat special financing needs of renewable power stations. These investment are more expensive than conventional ones, that is, they require a high capital investment to start up, whereas their per-unit cost of operation tends to be relatively low and well-predictable. Their raw materials are cheap or even free, as they do not usually have to pay for the energy source they utilize (e.g. wind, sun). Fossil-fired power plants, on the contrary, require a lower investment per unit of capacity, but their operation costs are much higher and more volatile[39] due to their raw material expenses. Accordingly, the risks associated with these two types of technologies are different, as well, and efforts to compare them through standard net present value calculations are bound to yield inaccurate conclusions (Jäger-Waldau et al., 2011).

The strength of these barriers may vary between technologies[40] and countries, or even regions. The individual barriers might interact with each other, potentially even reinforce each other effect.

Thus implementing the right promotion system is not the only task of the policymaker, but they also need to pay attention to other barriers that arise with the spread of green energies, as those may undermine the success of even the most carefully designed promotion systems.

4.3. Characteristics of the Ideal Promotion System

„In practice well-designed FIT systems perform better than well-designed TGC systems on all criteria of relevance for [renewable energy] support mechanisms. Well-designed FIT support is specified by [renewable energy] category and accounts for the various characteristics of [renewable energy] supplies, stimulating technological diversity, dynamic efficiency and the development of a [renewable energy] equipment industry." (Verbruggen - Lauber, 2012, p.642).

This statement is, obviously, too general for a guide to developing an actual regulation, but it does highlight the primary requirements. In the theoretical overview, we discussed the criteria that are relevant to such support systems, and

[39] According to Meyer's estimate, investment expenditure accounts for more than 85% of wind turbines' total cost, while the ratio is only 50% for fossil power plants. Nonetheless, their raw material being free, the operation costs of wind turbines hardly ever exceed a share of 10%. In case of the fossil power plants only the fuel cost can consume the 50-60% of the revenues(Meyer, 2003).

[40] There are studies that expressly focus on the barriers to the growth of one specific technology. For wind power, see e.g. (Wind Barriers, 2011), for solar modules (PV Legal, 2011).

afterwards we saw that FiT schemes have turned out to be more popular with the member states of the European Union. It was hardly a coincidence, however, that the EU did not make either of the two types of promotion systems mandatory, but left space for the co-existence of FiT and TGC systems.

The need and the possibility of passing a community-level legislation has cropped up several times, mostly in the form of a community-wide green certificate system. It would be a mechanism similar to that of carbon credits, and there is a rationale, too, for trying to bring the ideal exploitation of resources and opportunities to a community level. It would be more efficient, for example, to deploy a Hungarian solar PV quota in Spain, simply because of its more favorable geographical conditions. Of course the idea poses a number of difficult questions, as it would require a higher degree of network integration, and it would be next to impossible to develop a sufficiently differentiated scheme (Jacobson et al. 2009). And given that the literature rather tends to favor feed-in tariffs, support for the proposal is scarce (Fouquet, 2012).

An interesting tendency in practice is that **the two systems are being blended together in more and more countries, they are becoming increasingly similar**. The reason is probably that both systems have their unique advantages that the other one cannot offer, and their unique drawbacks, as well, which can however be mitigated by approaching the other system. Feed-in premium systems constitute a step away from feed-in tariff schemes to begin with, since its prices move in line with the market, they „just" offer a certain guaranteed premium, as well. Out of the 27 member states 7 employ feed-in premium systems[41], even though 4 of them also have fixed tariffs in place for certain technologies. This way, investors already assume part of the risk associated with market mechanisms themselves – yet not in its entirety, as in green certificate systems.

The advantages of FiT schemes are investor certainty and effectiveness, whereas the volume of renewable capacity expansion is hard to forecast because of the lack of a quantity limit. Certain countries (France, Ireland, Denmark) manage the issue by launching calls for tenders for the guaranteed purchase of a given total volume, hence avoiding spikes in capacity expansion (Infrapont, 2010). We have already seen

[41] Czech Republic, Denmark, Estonia, Spain, Finland, Netherlands, Slovenia

that because of PV bubbles, several FiT countries resorted to adding quotas to their systems and/or to introducing tariffs that depend on the volume of installed capacities (Germany) or to granting FiT-eligibility to a given annual amount of capacity only (Spain).

The primary advantage of TGC schemes is their market-like operation mechanism, which makes it easier to keep prices and the burden on end consumers in control; furthermore, the amount of renewable capacity to be installed can be regulated through the quota determined by the policymaker. Concerning the higher level of investor risk arising from market exposure, more and more countries are trying to reduce it by introducing a minimum and/or a maximum price for green certificates. Both the Polish („substitution fee") and the English („buy-out price") system incorporate a maximum price. Minimum prices were introduced by, among others, Poland and Belgium, that is, price determination is not entirely left to the market.

The other disadvantage usually attributed to green certificates, besides high investor risk, is the lack of differentiation, which only allows for the most competitive, most mature technologies to grow. Several types of response have been developed here, as well, all of which constitute a step towards price-based incentives. One solution is to issue differing amounts of green certificates to the different technologies, with more expensive technologies receiving a larger number of certificates per unit of production; in Bulgaria and Romania, for example, solar power stations are entitled to approximately double the amount as wind turbines. What could be considered another solution is the Italian or the British system, where policymakers recognized that the promotion of the more expensive technologies they would like to prefer cannot be managed within the framework of a uniform certificate system, and hence introduced feed-in tariff schemes for these technologies (small-capacity systems and solar power stations that have higher per unit costs).

The question of whether it is price-based or quantity-based schemes that are the ideal choice of incentive is discussed most comprehensively, from amongst the pieces of the literature I am aware of, by the IEA's annual Deploying Renewables studies. The most recent report evaluates the performance of FiT and TGC systems according to three indicators developed by the IEA (International Energy Agency, 2011).

The effectiveness of the regulation (policy impact indicator, PII) in a given country and a given year is measured as the extent of progress made in the expansion of renewable capacities towards the fulfillment of a later objective. The IEA prepared an own estimate for the energy mix to be achieved by 2030[42] in order to ensure a maximum carbon dioxide concentration of 450 ppm, which is required to keep the extent of global warming below 2°C, and equates effectiveness with the extent of progress made on that path.

The indicator quantifying the **adequacy of earnings provided by the scheme (remuneration adequacy indicator, RAI)** is an expression of how appropriate the level of income earned by the generators is. Compares the earnings of different countries, compensating for the effects caused by their differing conditions.

Finally, **the total cost indicator (TCI)** tells us how much premium the state has to pay for the additional renewable generation achieved that year.

The three indicators provide a comprehensive evaluation of the promotion schemes of the various countries. They reveal all possible deficiencies: if the scheme does not deliver the desired stimulating effect or if it does but at (temporarily) excessive prices. Using the indicators above, the study evaluated the promotion systems of 56 countries, including all EU member states, with respect to several types of technology. Based on the analysis, the authors drew the following conclusions (International Energy Agency, 2012, pp.130-132):

- Promotion schemes for renewable energies do work, but large differences in performance exist. There are policies that 1) are very effective and cost efficient at the same time, 2) are effective but at a very high expense and 3) offer relatively high tariffs and still lack effectiveness.
- In general terms, FiT systems are more cost efficient; from amongst the TGC schemes, that of Sweden is worthy of special attention, as it is both effective and cost efficient.
- TGC schemes that are effective with respect to wind power (Italy, Belgium, United Kingdom) are less cost efficient than FiT schemes, which may however be due to severe non-economic barriers.

[42] For details see (International Energy Agency, 2010).

– Even though the most effective and most efficient systems are all of the FiT type, there are certain countries, where no substantial expansion in renewable capacities has been achieved in spite of the relatively high feed-in tariffs they offer.

– ***The difference in performance between FiT systems and TGC systems appears to be smaller than the differences between countries with the same type of system.***

In summary of all the above, I would like to draw the conclusion that the success of a country's policy does not only depend on whether they decide for a price-based or a quantity-based support system, but also – what is more: primarily – on how they proceed after that decision has been made. It is of utmost importance that the priorities of the system reflect the country's renewable targets, that the policymaker regularly reviews and, if necessary, updates the tariffs (FiT) or the price floors and the price caps (TGC) and that the regulation be sufficiently differentiated according to energy source, technology and capacity volume. With respect to differentiation, in addition to natural endowments, other targets of the green sector that the given country has committed to also need to be taken into consideration.

With the gradual gaining ground of renewables, the policymaker also needs to be prepared to face substantial barriers to further development, such as issues of network development or flexibility, which must be identified and attended to in due time.

The policymaker may facilitate success by actively monitoring the practice and the experience of other countries. There are several databases available in the internet[43] that provide current information on the details of member states' regulations. Active communication with the actors of the industry may also help the policymaker keep themselves up-to-date on industry developments. Should the policymaker still be uncertain whether the instrument they decided for is operating as intended, they might want to have a good look at the other type of incentive (price vs. quantity-based), take some of its elements and blend them into their own scheme. The

[43] Useful sites are, for example: http://www.reshaping-res-policy.eu/; http://res-legal.de/; www.energy-regulators.eu.

introduction of an annual quota may well be able to keep a FiT scheme in check (especially with respect to solar modules), while minimum and maximum prices might be successful in limiting investor risk in a TGC scheme.

Another important remark is that given today’s crisis-ridden macroeconomic atmosphere overwhelmed with uncertainty, feed-in tariff systems are likely to become even more popular because of the extra security they offer. Trust in such a system may, however, be completely undermined by a retroactive change to the regulation, for what is questioned thereby is the system’s greatest virtue itself: predictability. Unfortunately, recent years have witnessed several examples of that (Czech Republic, Spain, Bulgaria). In order for any given scheme to deliver the advantages it promises, its basic principles of operation must be respected.

5. Promoting Renewable Energy Production in Hungary

From among the two types of promotion system discussed above, Hungary employs (in line with some three-fourths of the EU countries) a feed-in-tariff system. This chapter introduces the principles, characteristics and achievements of the Hungarian promotion system and the current share of renewable energy production. The 2020 objectives of the domestic energy sector included in our National Renewable Action Plan (hereafter also referred to as NMCST) and the milestones and challenges of the growth path laid out in the plan will also be discussed.

5.1. Principles of Operation of the Hungarian System

In Hungary, the possibility of promoting renewable and cogeneration energy production[44] was established by Act CX of 2001 on electric energy, in order to "enforce environmental protection requirements and diversify energy sources" (Article 19 of the Electricity Act). The feed-in-tariff system, introduced in 2003 after the liberalization of the electricity market, supported these methods of energy generation in two ways:

– on the one hand, the local electricity supplier or the public utility wholesaler were obliged to purchase the electricity produced (guaranteed purchase);

– on the other hand, an incentive price above the market price was also guaranteed for the electricity produced (price compensation – also called KÁP –, the difference between the market price and the feed-in tariff).

Producers received their share of the **KÁP compensation** from the transmission system operator (Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zrt. - Hungarian Independent Transmission Operator Company Ltd, hereinafter MAVIR), and it was financed by a fee ("KÁP fee") incorporated in the transmission-system operation fee charged to the electricity bills of end consumers. Consequently, the

[44] Cogeneration energy production: the production of electricity and heat within the same technological process. This method of electricity production is a typical area of support in energy policies (GKI – Economic Research Co., 2005) due to its high efficiency achieved by generating two types of energy at the same time. In Hungary, it was supported in a way similar to renewables, just with different feed-in tariffs, from the beginning right until the end of 2010.

incentive was paid for by the end consumers through their electricity bills instead of being financed from government resources.

As of 2008, the operation and the settlement mechanisms of the promotion scheme of renewable and cogeneration energy production were thoroughly transformed by Act LXXXVI of 2007, that is, the new Electricity Act (also known as VET), but the guaranteed purchase and the feed-in tariff in excess of the market price were kept.

Renewable and cogeneration energy producers entitled to a purchase guarantee joined an individual electricity settlement unit, a so-called balance group, which was supervised and handled by MAVIR; this is the feed-in-tariff (KÁT) balance group. Renewable producers have to submit a production schedule to the transmission operator for the upcoming production period/month. Having aggregated these data, MAVIR distributes the green energy amongst the members of the balance group in proportion to their estimated sales, and they are obliged to purchase (and sell to their consumers) their share of green energy at the set tariff.

The operation of the balance group is illustrated by Figure 11:

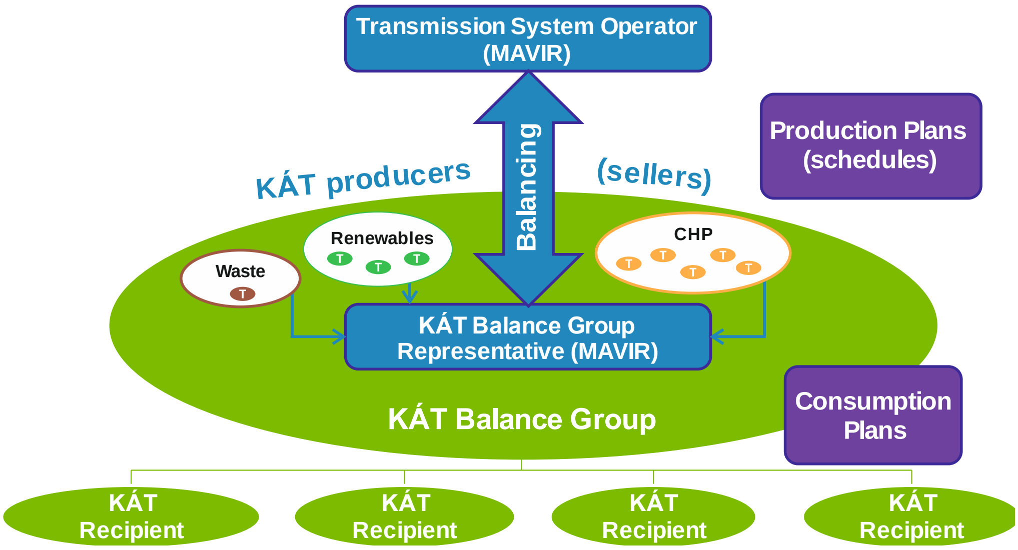


Figure 11: Operation of the KÁT balance group

Source: Magyar Energia Hivatal, 2011. p.14.

MAVIR basically distributes all costs related to the operation of the KÁT balance group (amounts paid due to feed-in tariffs, additional costs of balancing and regulation due to the producers' deviation from their schedules, administrative costs) amongst the balance groups supplying the consumers. MAVIR must not make a loss, nor a profit, on the operation of this settlement system (Magyar Energia Hivatal, 2009a).

Even after the reform, it is end consumers who bear the costs of the feed-in tariff scheme; just not through fixed transmission-system operation fees, but through the price of electricity (with a KÁT-fee/kWh incorporated in it), in proportion to their energy consumption. Balance group representatives/retailers purchase the monthly amount of energy that MAVIR allocates to them, at the tariff that is also set by MAVIR, and charge the KÁT-expenses to their own consumers.

In the new promotion system producers no longer collect their income from two sources (market price + KÁP premium) but they obtain revenues in one amount, which is their monthly production multiplied by the feed-in tariff. The maximum tariffs of electricity from renewable sources were set by the Electricity Act of 2007 at the start, thereafter the feed-in tariffs of different energy production technologies were regulated by the so-called KÁT-regulation (*Government Decree* No *389/2007* "on the feed-in obligation and feed-in tariff of electricity produced from renewable energy sources or from waste and electricity generated in co-generation facilities"). Tariffs are increased yearly by the rate of inflation, or 1% less in case of certain technologies.

From the introduction of the promotion system until the end of 2010 – until cogeneration producers were KÁT-eligible – the majority of the KÁT subsidy (60-70%) went to cogeneration producers[45], and it was only the remaining one-third that promoted the growth of renewables. Therefore merging two types of energy production into one item on end consumers' bills is an unfortunate solution, for customers may believe the subsidy on green energies to be higher than it actually is by equating the KÁT-fee with green energy promotion.

KÁT tariffs are fixed by the authorities in governmental regulations. However, the term and the amount of energy generated to the extent of which a power plant is entitled to the feed-in tariff is at the sole discretion of the Hungarian Energy Office. That is, Hungarians have "smuggled" a hint of a quantity-based regulation into their price-based promotion scheme, and thus the authorities can still keep the quantity-

[45] See (Magyar Energia Hivatal, 2011); (Energia Klub, 2010)

side in check. General rules of procedure on setting the term of KÁT-eligibility are specified in the KÁT-regulation (Article 6, paragraphs 6-8).

MEH use a payback-period based approach to determine the term and the quantity of the guaranteed purchase agreement. The amount of energy to be sold under the KÁT is determined in a way ensure that the power plant yields adequate returns. The rate of return is established by energy sources and by production methods with the help of actual domestic and international investment data. In essence, a comparative analysis has been created for each type of power station containing the rates of efficiency and the expected rates of return.

The payback period is calculated based on the mandatory business plan to be submitted with the KÁT application, using the discounted cash-flow method to calculate a net present value. The term of the agreement is defined to ensure that the project is of positive net present value during the given period of time (15 years with renewables) and to guarantee the payback period achieved by the benchmark projects, usually between 8-15 years depending on the technology (Magyar Energia Hivatal, 2012b).

In case a project is allocated an investment support or any other multiple-year subsidy, MEH will consider these as corrections in their discounted cash-flow calculation. It is deducted from the investment amount at present value and therefore the rate of return is calculated on the investment amount reduced proportionally. Thus a smaller KÁT quantity / shorter term is determined in comparison to a non-subsidized investment.

The judgment of the individual evaluation process in Hungary is quite diverse. (Infrapont, 2010, p. 101) Amongst its advantages is that it enables policymakers to prioritize or take individual considerations into account, and it also improves their knowledge on the profitability of projects. Given the rapid technological development and the information asymmetry between investors and policymakers, this “side-effect” should be appreciated, as it can help the policymaker improve their knowledge. The main disadvantage of this procedure is that “one-man” decisions in MEH are uncertain and unpredictable, and hence increases the uncertainty of the future profitability of investments, as well, which acts to reduce predictability and transparency.

After its introduction in 2003, the regulation specified an 18 HUF/kWh tariff on most technologies, which was increased annually by the inflation rate or 1% below that. The application of unified rates partially creates the same situation as the green certificate scheme since it only promotes the expansion of technologies that are profitable with the tariffs in place at the time. The KÁP system was therefore developed with caution partly due to the lack of knowledge and experience on the regulation of renewables, and partly because no previous political preferences had been set in relation to the technologies (Kaderják, 2011). The tariff was increased to around 23 HUF/kWh by the amendment to the Electricity Act in 2005, but it remained more or less uniform and has been following the rate of inflation in each year ever since.

Table 5 below contains the current (2012) feed-in tariffs:

<table>
<tr><th colspan="3" rowspan="2">Power category</th><th colspan="3">From 1st January 2012</th></tr>
<tr><th>Peak[2]</th><th>Valley[2]</th><th>Deep valley[2]</th></tr>
<tr><td rowspan="8">Produced from renewable energy sources</td><td rowspan="2">Based on resolution of Hungarian Energy Office (HEO) if it was adopted or the application was received before 01. 01. 2008. [except hydro power station units >5 MW] [GD 4. § (1)]</td><td>Solar, Wind [GD Suppl. Nr. 1. pt.1. b)]</td><td>31,91</td><td>31,91</td><td>31,91</td></tr>
<tr><td>Other than Solar and Wind [GD Suppl. Nr. 1. pt. 1. a)]</td><td>35,65</td><td>31,91</td><td>13,03</td></tr>
<tr><td rowspan="5">Based on resolution of HEO[6] adopted after 01. 01. 2008. (except hydro PSU >5 MW, other PSU > 50 MW) [GD 4. § (2)-(3), (6)]</td><td>Produced by Solar PSU of 20 MW or less [GD Suppl. Nr. 1. pt. 2. b)]</td><td>30,71</td><td>30,71</td><td>30,71</td></tr>
<tr><td>Produced by PSU of 20 MW or less (except Solar) [GD Suppl. Nr. 1. pt. 2. a)]</td><td>34,31</td><td>30,71</td><td>12,53</td></tr>
<tr><td>Produced by PSU of >20 MW - max. 50 MW (except Wind from 30th Nov. 2008.) [GD Suppl. Nr. 1. pt. 3. a)]</td><td>27,45</td><td>24,57</td><td>10,02</td></tr>
<tr><td>Produced by Wind PSU of >20 MW - max. 50 MW from 30th Nov. 2008 [GD Suppl. Nr. 1. pt. 3. b)]</td><td>34,31</td><td>30,71</td><td>12,53</td></tr>
<tr><td>Produced by PSU comprising used equipment[3] [GD Suppl. Nr. 1. pt. 4]</td><td>21,34</td><td>13,66</td><td>13,66</td></tr>
<tr><td colspan="2">Produced by hydro PSU > 5 MW, other PSU >50 MW [GD 4. § (4), Suppl. Nr.1. pt. 4]</td><td>21,34</td><td>13,66</td><td>13,66</td></tr>
<tr><td>Produced from waste</td><td colspan="2">[GD 4. § (5), Suppl. Nr.1. pt. 5]</td><td>32,19</td><td>22,18</td><td>11,57</td></tr>
</table>

Table 5: Current electric energy feed-in tariffs (excl. VAT), HUF/kWh

Source: http://www.eh.gov.hu/hatosagi-arak-2/villamos-energia/kotelezo-atvetel.html

The above table shows the **differentiation principles** of the Hungarian regulation as follows:

- by **technology** (wind, solar PV, waste);
- by **start-up date** (before/after 1 January 2008);

– by **capacity** (limits at 5, 20, 50 MW);

– by **time of day**, that is, by when exactly the generated power was sold; Higher prices can be obtained during the day in peak hours when demand is the greatest, while lower prices apply in the mornings and evenings in the valley periods, and the prices are the lowest in the deep-valley period at night due to the low electricity demand.

Seemingly the degree of differentiation is not very remarkable, as prices are set within a narrow band. In case of wind and solar power stations licensed before 2008 the price base is 31.91 HUF/kWh. Any other types of power station (that are a bit easier to schedule and control) receive a 10% higher price during the peak period, the same prices in the valley and 40% less in the deep-valley period, in order for them to adjust their production to the daily fluctuations in the demand of electricity.

Differentiation in prices is similar in extent with power stations that applied for KÁT eligibility after 2008, too, with a maximum difference of about 20% within any given period, except for the high price base of solar power stations and power stations operating used equipment.

In the practice of European Union member states, the differences between the individual tariffs tend to be much larger, especially between certain technologies (e.g. wind vs. PV), and solar power tariffs are 2-3 times higher than in Hungary (IEA, 2011), (www.res-legal.de). There is no considerable difference in our tariffs related to wind power stations in comparison to those of the surrounding countries. Due to the low differentiation of the Hungarian FiT system, only technologies with the most competitive prices became wide-spread here (wind and multi-fuel biomass power stations), more expensive technologies (modern biomass and solar power stations) are not viable at these prices yet.

5.2. Achievements Since the Introduction of the KÁT System

During the years of the KÁP system, a major increase was experienced in the share of green electricity production. As shown by the figure below, the share of only 0.8% in 2003 jumped to 3.9% by 2007, exceeding the EU's expectation (for 2010) of 3.6% as early as in 2005.

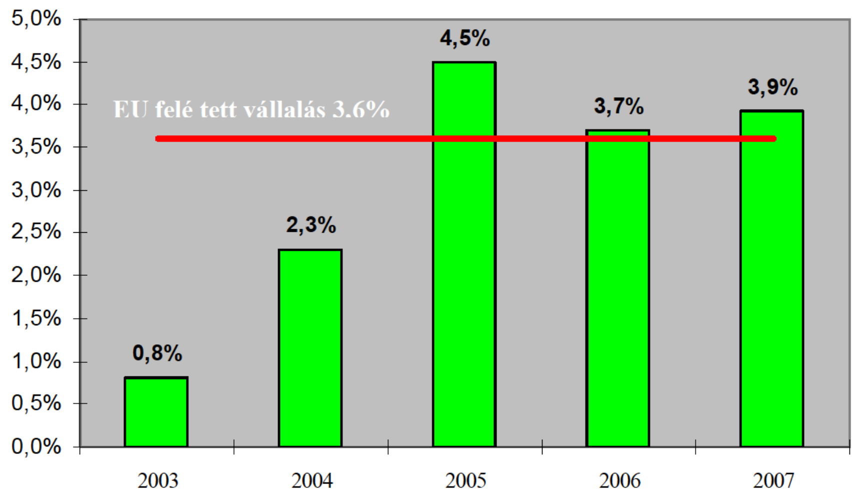


Figure 12: Share of renewable electricity production in total energy consumption

(the red line represents our commitment made to the EU)

Source: Magyar Energia Hivatal, 2008a. p. 6.

Nevertheless, if we also consider the distribution of development among the various energy sources, that will certainly change our impressions about the achievements. Figure 13 clearly shows that this growth was driven mainly by biomass energy production and was achieved by the transformation of six old, large coal-fired power stations into multi-fuel biomass power plants during 2004 and 2005. The total capacity of these altered power stations was 354 MW, and their annual production was between 1-1.5 TWh (Magyar Energia Hivatal, 2008a, p. 7).

Apart from biomass plants, only wind turbines showed a considerable growth in 2007, the production in all other plant types basically stagnated.

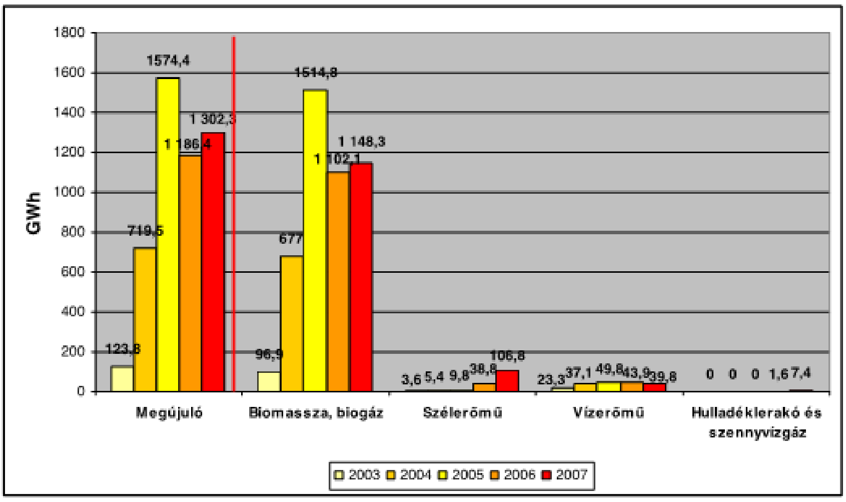


Figure 13: Amount of renewable electricity dispatch at KÁP tariffs (GWh)

Source: Magyar Energia Hivatal, 2008a, p. 11.

In effect the description biomass/biogas basically meant biomass in the years considered, as only one biogas plant was in operation during this period. Besides, it became a common practice that 70% of the KÁP subsidy and KÁP production was "covered" by cogeneration production (natural gas CHP), and only the remaining approximately 30% was used to promote renewables, mainly multi-fuel (coal + biomass) power plants.

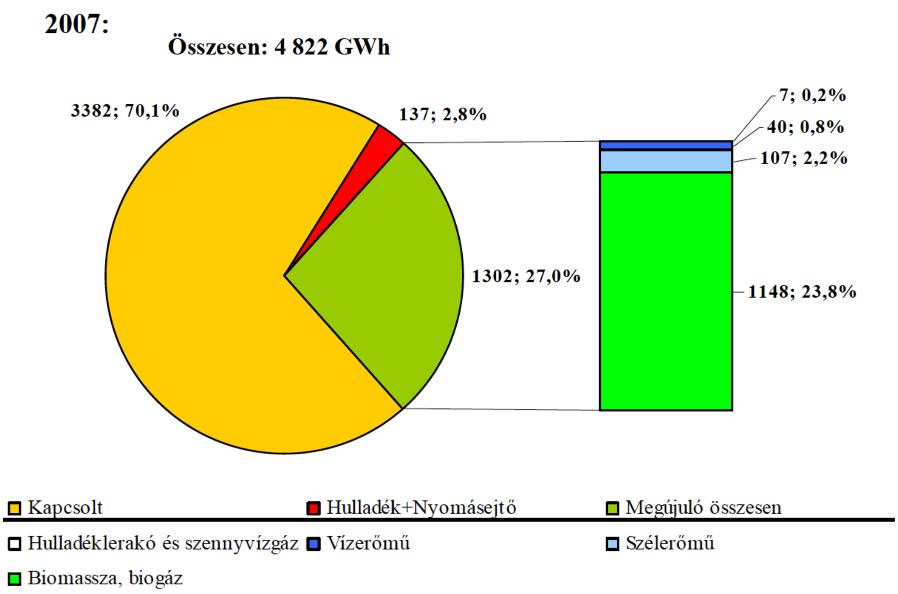


Figure 14: Distribution of KÁP production in 2007 (GWh)

(above the line: yellow – cogeneration; red – waste+pump station; green – total renewable;
below the line: white – landfill and sewage gas; blue – hydro; light blue – wind; green – biomass, biogas)

Source: Magyar Energia Hivatal, 2008a, p. 4.

After the conversion to KÁT in 2008, the capacity of green power plants and the renewable production continued its growth, mainly due to the expansion of wind turbines.

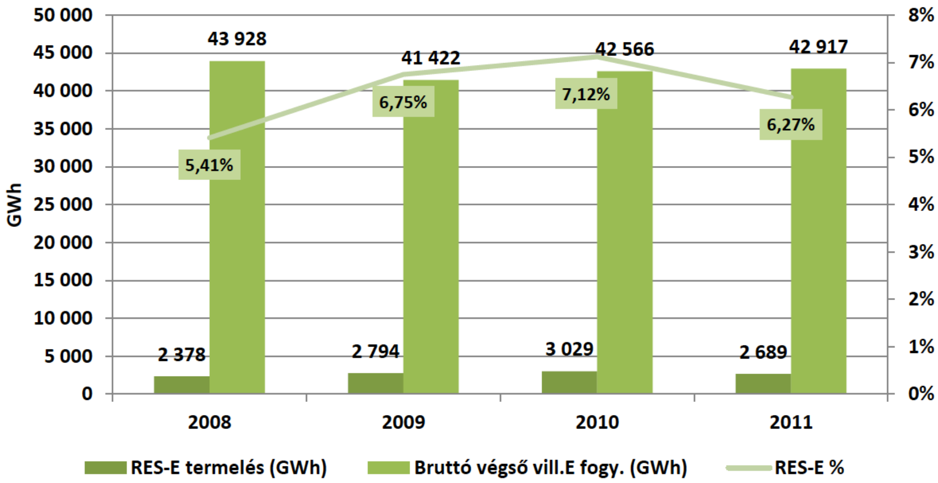


Figure 15: Renewable electricity production, gross final electricity consumption and the share of renewables within, 2008-2011

(dark green column: renewable electricity production; light green column: gross final electricity consumption)

Source: Magyar Energia Hivatal, 2012a. p. 51.

Domestic renewable energy production increased by 27% from 2378 GWh in 2008 to 3029 GWh in 2010. It is obvious though that renewable production decreased by 2011, due to which the share of renewables reduced by almost 1 percentage point to 6.27% . The main reason for this was the drop-out of the production of four biomass power plants from KÁT. Two such plants have suspended their operation due to financial difficulties (Szakoly, AES Borsod), and the KÁT quota of further two plants (Bakony, Mátra) expired at the end of 2010. Both of the latter were included in the establishment of the multi-fuel biomass capacity in 2004-2005 mentioned earlier. The KÁT eligibility of all the other similar plants will also expire gradually, therefore these will need to be replaced in order to meet the targets set for 2020.

The analysis of the latest KÁT production and support data, and their deviation from the typical 30 / 70% distribution between renewable and green energy might be misleading, as the KÁT entitlement of cogeneration gas engines has practically been ceased from July 2011. Therefore their production is included in the 2011 statistics for only 6 months with a reduced (85%) tariff, and "only" 43% of the KÁT amount was spent on their support in comparison to a 66% share in 2010. Cogeneration production also dropped to the level of previous years due to the half-year data. The support of cogeneration production was taken over by a new fee (restructuring fee for cogeneration products) on electricity bills from July 2011, thus only renewable power plants remained in the KÁT system and balancing from 2012.

Diversification of the energy sources within green electricity production has changed in the past two years as follows[46]:

Production (GWh)	2010	2011	Distribution 2010	Distribution 2011	Change %
biomass	2051	1539	71%	60%	-25%
wind	534	626	19%	24%	17%
hydro	188	222	7%	9%	18%
bio-, landfill and sewage gas	112	183	4%	7%	63%
Sum total	2885	2570	100%	100%	-11%

Table 6: Distribution of renewable electricity production by technology 2010-2011

Source: author's compilation based on Magyar Energia Hivatal, 2011

Despite its decrease, the share of biomass is still dominant with a 2.051 GWh (71%) share of the total green electricity production of 2.885 GWh in 2010. Due to the calculations partially excluding the production of the above-mentioned four plants, the production from biomass has dropped by 25%, from a 71% share in renewables in 2010 to 60% (1539 GWh) in the following year. The production of wind power stations increased by 17% from a 19% proportion in 2010 to 24% in 2011. Production of hydro power plants increased similarly to the wind turbines with a share of 7-9% during this period. A significant expansion of biogas plants in 2011 initiated a substantial 63% growth of biogas, landfill gas and sewage gas power stations (Magyar Energia Hivatal, 2012a), in which investment subsidies to these plants played a major role.

The promotion system of renewable electricity production in Hungary led to the above-mentioned production capacities and share of power station types in the first 9 years of its existence. A 6-7% proportion of renewables was registered in the past three years. Biomass is the most significant type with its 60% share, together with a growing importance of wind turbines providing a quarter of the green production in 2011. The 330 MW of wind energy production in accordance with the KÁT quota allocated in 2005 (Magyar Energia Hivatal, 2009b) was almost fully deployed by the end of 2011, therefore further expansion of this technology is impossible without a new tender.

Having completed the analysis of facts let us move on to the plans for 2020 outlining the growth path of Hungarian green power stations to be followed in the next nine years.

[46] Differences in comparison to Figure 12 are caused by the exclusion of energy production from waste, which can, to a certain degree, count towards the share of renewables, yet that would require a special methodology to determine.

5.3. The 2020 Objectives of the Hungarian Renewable Energy Sector

The 2009 EU Directive on renewables has targeted a 20% proportion of renewable energy by 2020 on a community level while setting an objective of a 13% share for Hungary. The Directive also required each member state to create their own action plans, in which the 2020 goals and the steps to be taken are outlined.

In accordance with these expectations, the Ministry of National Development developed our Nemzeti Megújuló Energia Hasznosítási Cselekvési Terv (National Renewable Energy Action Plan - NMCST) at the end of 2010, which summarized the expected development and growth of the renewable energy sector in the following ten years. The action plan defines the objectives, priorities and future prospects in the use of renewable energy in Hungary.

The reasons for the need to use renewable energy introduced in chapter 2 can be summarized as follows:

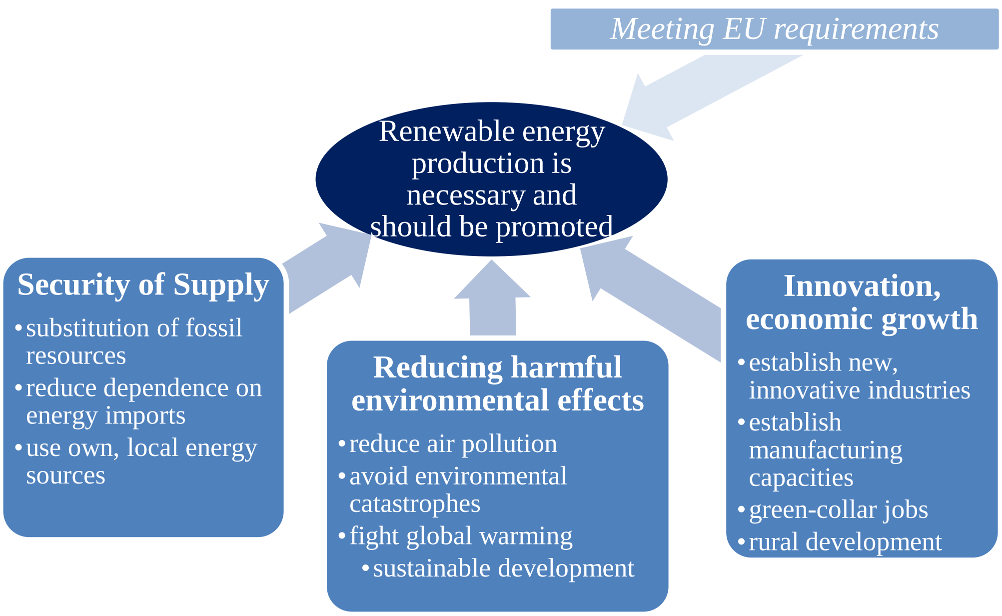


Figure 16: Primary motivators of renewable energy production

Source: author's own illustration

A very similar message is put forward by the NMCST's formulation of the five key areas of Hungary's renewable energy policy (Nemzeti Fejlesztési Minisztérium, 2010):

1. **Security of Supply:** this is probably the most important objective considering Hungary's dependence on crude oil and natural gas imports, in excess of 80%. Furthermore, resources mainly come from Russia, that is, our sources are not diversified. However, renewable energy sources are domestic sources which can decrease Hungary's energy dependence.
2. **Sustainable environment, climate protection:** the most important area within this category is the reduction of carbon dioxide emissions.
3. **Agriculture – rural development:** harnessing agroecologically favorable biomass, organic matter from livestock farming and agricultural by-products for energy production may contribute to the competitiveness of the industry as well as to the protection and expansion of jobs in the sector
4. **Development of green economy:** the construction and operation of renewable power stations and related industries (e.g. equipment manufacturing) could lead to the birth of a new sector in the country's economy.
5. **Contribution to Community objectives:** ***The 14.65% share of renewable energy*** set as a target for 2020 in NMCST ***exceeds the 13% requirement of the EU***, which indicates that Hungary is fully committed to meeting the expectations of the EU directive.

NMCST describes the use of renewable energy as an exceptional opportunity for economic development, which greatly facilitates the 3 main objectives of Hungary's energy policy: **competitiveness, security of supply and sustainability.**

The determination of the NMCST to surpass EU requirements seems quite ambitious in light of the results achieved so far. The action plan states the expected domestic energy consumption until 2020 and quantifies the expected share of renewable energy used in different industries (heating/cooling, electricity, transportation). The 2010 and 2020 data of renewable energy production in different sectors are summarized in the below table:

	2010 ktoe	2020 ktoe	2020/2010 %
Renewable energy consumption in heating/cooling	949	1863	**196%**
Renewable energy consumption in electricity production	244	481	**197%**
Renewable energy consumption in transportation	150	535	**357%**
Expected total renewable consumption	**1 344**	**2 879**	**214%**

Table 7: NMCST targets for the shares of renewables in each industry

Source: NFM, 2010:27.

The data shows that the 2010 amount of renewable energy production is planned to be doubled, on average, within 10 years. The growth rate expected in the use of green energy in transportation is considerably higher, but since its share in the total consumption is smaller, its 357% growth raises the increase in the other sectors from under 200% to 214% altogether.

The analysis of the expected growth path of the individual industries in 10 years is also worth analyzing. The use of green energy is planned to reach the 2020 target of 14.65% from its initial value of 7.4% in 2010 according to the following table:

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Renewable energy heating/cooling (%)	**9.0%**	8.8%	8.6%	8.5%	9.1%	9.8%	11.8%	13.7%	15.7%	17.4%	**18.9%**
Renewable electric energy (%)	**6.7%**	6.5%	6.9%	7.5%	8.6%	8.1%	7.1%	8.6%	10.2%	10.7%	**10.9%**
Renewable transportation (%)	**3.7%**	4.6%	5.0%	5.0%	5.2%	5.4%	5.8%	6.4%	7.3%	8.0%	**10.0%**
Total share of all renewables (%)	**7.4%**	**7.3%**	**7.4%**	**7.5%**	**8.0%**	**8.3%**	**9.3%**	**10.7%**	**12.3%**	**13.4%**	**14.65 %**

Table 8: 2020 objectives and timing for the three industries and in total

Source: NFM, 2010:26.

The above table indicates a sharp increase from 2016 onwards, while the share grows only by less than 1% between 2010 and 2015. The graphic display of these data also shows a definite change in the rate of growth after 2015.

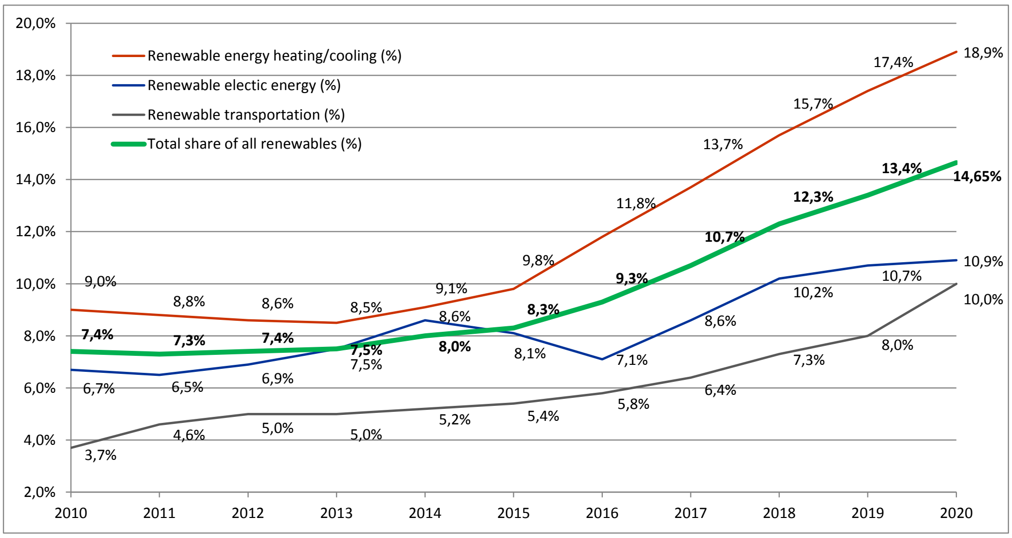


Figure 17: Graphic illustration of Table 8

Source: author's own illustration based on NFM, 2010:26.

My dissertation focuses on renewable electricity production, the share of which started from 6.7% in 2010 and aims at reaching 10.9% by 2020 (Nemzeti Fejlesztési Minisztérium, 2010, p.26).

The cause of the apparent standstill in the first couple years of growth is, partly, that power plant development projects are very time-consuming, may even take as long as 2 or 3 years sometimes, with a rather lengthy licensing procedure within. A power plant investment commencing in 2012, for example, will only begin to generate power in 2013 earliest,or maybe even 2014, if the technology is a more complex one. Licensing processes in Hungary are, in comparison to other EU states, among the most complicated, most time-consuming and involving the highest number of authorities (for details, see Energiaklub, 2010). Improving the situation has been a central issue of renewable energy regulation for years, but, unfortunately, there has not been any significant progress towards the one-stop, few-months German model.

The other reason for the trends seen in the graph is regulatory uncertainty, discussed in more detail in the following section (5.4). Even though the KÁT system discussed above constitutes an incentive to promote green energies, until now, this price-based promotion system only succeeded in fostering certain types of green power stations (biomass and wind power plants, for the most part).

Considering the growth expected in the next ten years, we need to take into account that the KÁT quotas of the biomass power plants that previously operated as coal-fired units will gradually expire during this 10-year period and therefore their capacity will need to be replaced. Two power plants already dropped out of the green category in 2011, whereas in 2010, their entire capacity operated under the KÁT system. The estimated total production of former coal power stations now operating as biomass power plants is 1,506 GWh/year according to a study by Pylon. (Pylon Kft., 2010a, p.31). By adjusting the 2010 renewable electricity production volume (actual) shown in table 6 accordingly, we arrive at an initial figure of 1.379 GWh instead of 2,885 GWh and at a 3.7% share of renewables instead of 7.12%. This is what we will have to increase – that is: to triple – to 10.9% by 2020.

And this gap increases even further if we consider the forecasts for electricity consumption, which suggest a continuing increase due to Hungary’s per capita energy consumption being lower than in other EU countries.

NMCST predicts a minimum increase of 24% in the use of electricity from 41.5 TWh/year in 2009 to 51.5 – 53 TWh by 2020 depending on the energy efficiency programs completed during this period (Nemzeti Fejlesztési Minisztérium, 2010, p.19). A study prepared by the Regional Centre for Energy Policy Research in the end of 2009 at the request of MEH also arrived at a similar conclusion, giving an estimate of 52 TWh for 2020 (Regionális Energiagazdasági Kutatóközpont, 2009, p.68). That is, forecasts predict a 25-30% increase in the figures from 2009 to 2020.

Therefore the share of 7.12% in 2010 must be increased to 10.9% such that the base value will have increased 25% by then, which corresponds to having to reach 13.6% (10.9% * 1.25) of the original base value. Considering the 3.7% share in 2010 mentioned above, arrived at by correcting for the biomass capacities that will be “lost”, the targets laid down in NMCST imply the need to achieve a near four-fold increase in the share of renewable electricity production.

In order to meet the NMCST requirements, the 2010 production capacities need to be almost doubled, both in terms of installed capacity (1537 MW from 755MW) and the amount of electricity generated (5597 GWh from 2843 GWh). NMCST breaks down the desired expansion of green energy production to different technologies, which gives an indication of the directions of strategic development the plan wishes to pursue. By comparing the initial figures of 2010 with the 2020 targets, we will get to know which power plant types are likely to have the largest share in this growth.

	2010		2020		Installed capacity
	MW	GWh	MW	GWh	2020/2010
Hydro	51	194	66	238	**129%**
Geothermal	0	0	57	410	**-**
Solar	0	2	63	81	**-**
Wind	330	692	750	1 545	**227%**
Biomass	374	1 955	600	3 324	**160%**
Renewable energy sources utilized in electricity production	**755**	**2 843**	**1 537**	**5 597**	**204%**

Table 9: NMCST targets for green electricity production by technology

Source: author's compilation based on NFM, 2010, pp. 200-201.

Or, in a graphic representation:

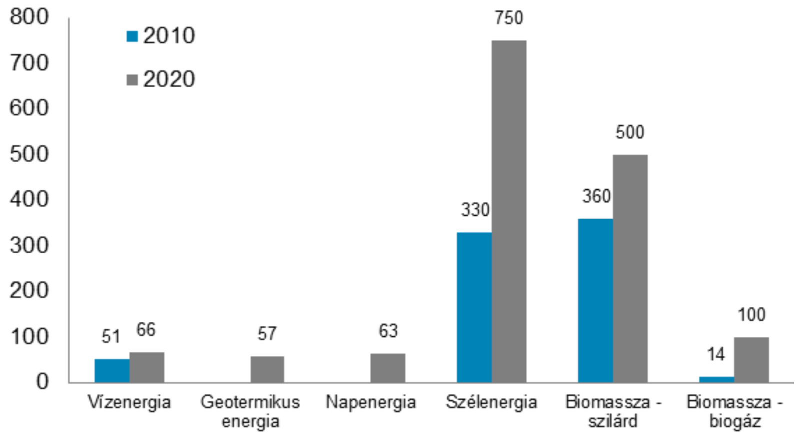


Figure 18: Targeted growth in installed capacity (MW) from 2010 to 2020 by technology

(from the left: hydro, geothermal, solar, wind, biomass/solid, biomass/biogas)

Source: author's compilation based on NFM, 2010, 200-201.

What the doubling of the green electricity production capacity within 10 years actually means is, because of the multi-fuel biomass power plants gradually becoming excluded from the renewable category, rather a three-fold increase. This is mainly expected from wind power stations by expanding the current capacity of wind turbines (330 MW) by 27% to 420 MW. The KÁT also has a quota in place for wind power stations, and the 330 MW capacity corresponding to the quota announced in 2005 has already been deployed. Another call for tenders was announced in 2009, which was withdrawn in 2010 though, leaving no further opportunities for the installation of additional KÁT wind power stations. However, our 2020 targets definitely suggests that further capacities will need to be deployed and, hence, licensed.

The second largest increase in capacity (60%, corresponding to 226 MW) is expected in biomass utilization. If however we take into account, once again, the correction for the gradual phasing out of former coal-fired units now serving as multi-fuel biomass power plants, which only qualify as renewable for a limited period, but nevertheless constitute some 75-80% of the current capacity and production volume, the 2010 capacity decreases to approximately 290 MW (Pylon, 2010), which already infers a targeted expansion rate of around 207% instead of 160%.

The expected capacity expansion of 60 MW in solar and geothermal resources within the course of ten years seems quite challenging, given that these technologies had zero installed capacity in the end of 2010. Even though in 2011, solar power stations already accounted for 47% of the total newly installed green power capacity in Europe, no significant solar power capacity has been installed so far in Hungary (EWEA, 2012). The reason probably lies with the feed-in tariffs for solar panels, which lag far behind the ones applied in other countries, and are, therefore, insufficient to induce investments (CPSL-REKK, 2012, p. 17). The expansion of geothermal power plants, at the same time, is delayed by a complicated licensing process (Infrapont, 2010).

Although the anticipated growth in hydroelectric power generation by 2020 seems less significant, considering that nearly 75% of the current capacity is deployed in the over-5MW hydropower plants in Kisköre and Tiszalök, which were installed in the 1950s and 1970s, achieving a capacity expansion of 15 MW will be anything but easy.

Whether the basic figures or the figures adjusted with biomass capacities are considered, current capacities need to be at least doubled, posing ambitious challenges to policy makers, as well as investors and financers. Several analyses set out to quantify the investment necessary to reach NMCST 2020 targets, based on which the amount of capital necessary could be anything between 800 and 1,949 billion HUF (GKI, 2011). Thus our incentive system must be very convincing in order to be able to get several thousand billion forints of investment capital going.

5.4. Current Situation, Challenges

NMCST is expecting a considerable increase in the renewable energy sector in the coming years. As explained above, the KÁT system was able to reach a 6-7% share of renewables within ten years but mainly with the dominance of biomass energy production and by using the maximum possible quota on wind power plants. The replacement of the old, large capacity biomass power stations with smaller, more modern and more effective ones is also more expensive and it involves higher tariffs, accordingly. The expansion of current wind power capacities is only possible through the allocation of further quotas, as this type of power station is not automatically eligible for a guaranteed KÁT purchase agreement. And not even the 2011 KÁT report contained any solar PV capacity in Hungary, because the hardly differentiated approx. 31 Ft/kWh Hungarian feed-in tariffs are insufficient to induce investments into PV capacities. Clearly, a tariff equal to that for wind turbines, a more advanced and more mature technology, will be insufficient to promote investments in solar PV capacities.

The feed-in tariff of electricity produced by solar power stations is 30.71 HUF/kWh. This price is not even differentiated by capacity limits or installation features (rooftop or ground mounted panels), which is a clear indication that the promotion system is in an early stage, too. Countries that pioneer the deployment of solar power capacities (Germany, Spain, Italy) offer tariffs around 250-300 EUR/MWh (ERRA, 2012. p.74), i.e. 70-84 Ft/kWh (converted at an exchange rate of 280 HUF/EUR) to smaller rooftop units, which is more than twice the Hungarian feed-in tariff.

Our geographic features provide little opportunity to an expansion of hydro power plants, whereas larger hydropower plants are impossible to be implemented in the medium term due to political reasons (CPSL-REKK, 2012, p.18).

Consequently, the current KÁT system needs a revision in every aspect in order to improve its “incentive power” and to achieve a sufficient capacity expansion.

Policy makers identified this as well and issued a document titled “Concept on the regulation of the feed-in-tariff system for heat and electricity from renewable and alternative energy sources” in September 2011 in collaboration with the Ministry of National Development, which collected the principles of a new promotion system

(METÁR) for renewables to replace KÁT. The name of the new concept suggests that the price-based feed-in-tariff system remains in place, but its terms and conditions will be amended. It is also important to note that renewable heat production is included in the new system as a novelty element. Renewable heat production has not had an own incentive so far, which gave rise to serious doubts about meeting the respective NMCST targets and about the required two-fold increase in capacities. The proposal offers a fair summary of the deficiencies in KÁT that should be revised in the new METÁR system.

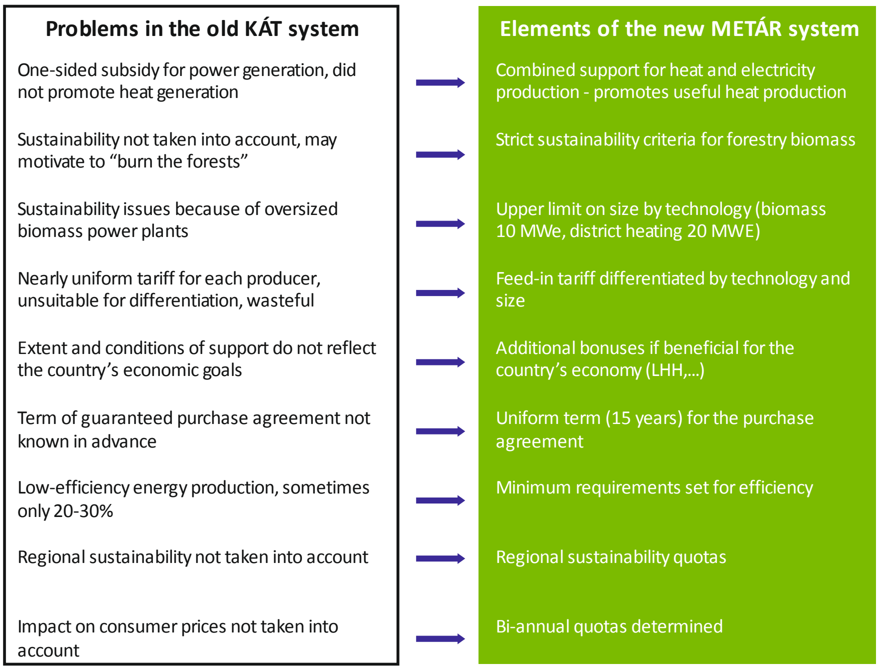


Figure 19: Suggestions for the correction of KÁT deficiencies within the METÁR framework

Source: NFM, 2011, p.9.

The concept aims to resolve all major issues brought up in connection with the KÁT system, and so it puts emphasis on the simplification of the licensing process, as well. The renewable sector is not pleased though, which has two reasons. First, the draft does not contain any feed-in tariffs, only the blank tables showing the subtypes of the power plants the tariffs would be differentiated by, but tariffs are yet to be published.

Another question that arose – and that is becoming more and more important – is when the new system would come into force. Policymakers already announced the arrival of METÁR in the end of 2010. After numerous preliminary studies, NMCST was finally prepared in 2010. Furthermore, the concept of the new promotion system, METÁR was presented in September 2011. The industry expected its introduction from the beginning of 2012 already, after which policymakers postponed it twice for six months, thus the new effective date was early 2013. With no further communication having been published by now, November 2012, an additional delay is certain.

The industry is anticipating a more significant promotion from METÁR (i.e. higher tariffs than in KÁT), therefore the renewable energy developments practically came to a halt in the end of 2010, because investors refuse to start up their project under the current system that is expected to be less advantageous than METÁR. This is because terms and conditions of the new regulation will be applied on all projects that submit applications for a MEH/KÁT license as soon as the new system takes effect.

All of the above and additional working papers, concept plans that were leaked keep project developers in uncertainty, as those involved are not aware of the expected tariffs or models and are therefore unable to accomplish project plans. Project developments in energy industry can take years and a project that is competitive under the current KÁT system might easily become unviable or might require modifications due to changing regulations during the development phase, and this might result in wasting considerable amounts of funds and having to restart the licensing processes. Investors would not take such risks under the current economic conditions. A consistent, predictable, economically sound energy policy is a must if we are to re-ignite investments into the sector (Grabner, 2010). Since the acknowledged, primary objective of METÁR is to achieve a significant increase in the use of renewable energies, an increase rather than a decrease of the current tariffs are expected.

These expectations were also confirmed by the rapid commencement of the preparatory work for the new system in late 2009 / early 2010. Numerous analyses[47] were prepared at the request of the Hungarian Energy Office in order to establish the

[47] Forecasts on energy consumption, estimation of renewable energy potentials and its most economical types, benchmark analysis of different power stations, estimations on external costs of the different renewable energy types. For example (Pylon, 2010 a), (Pylon , 2010 b), (Pylon, 2010 c), (Regionális Energiagazdasági Kutatóközpont, 2009), (Power Consult, 2010).

new concept. One of these (Pylon, 2011) was a suggestion on the revision of Hungarian feed-in tariffs for 2011-2012. The essay determines a justifiable tariff for the different technologies with the help of the GREEN-X model[48] , widely used and recognized in energetics. The model is based on the discounted cash-flow of investment and operational expenses throughout the term of the guaranteed purchase agreement. Researchers took into account data from Hungarian and foreign benchmark power stations, and presumption and capital surcharges resulting from the macroeconomic situation of Hungary. The suggested feed-in tariffs were compared, for each technology, to those of five other European countries by adapting the current tariffs of these countries to Hungary's own unique characteristics (different capital surcharges and inflation levels etc.). The summary of the results for a number of technologies is shown in the table below:

Definitions				Proposal	International feed-in tariffs in comparative terms				
Category No.	**Type of renewable source**	**Nominal capacity limits**	**Restrictions, special conditions**	**feed-in tariff at 2010 prices, Ft/kWh**	**Germany**	**Austria**	**Czech Republic**	**Slovenia**	**Slovakia**
1.1	Hydro	50.1 kW - 500 kW		33	36.32	15.9	30.02	21.88	30.61
1.2		500.1 kW - 5 MW		24.8	24.02	30.26	30.02	22.18	30.61
2.1	Wind	50.1 kW - 3 MW		28.6	25.14	24	21.88	22.54	22.71
2.2		3.01 MW - 20 MW		17.4	25.14	24	21.88	22.54	22.71
3.1	Solar	50.1 kW - 1 MW	free-standing	79.4	61.65	56.67	121.65	79.04	120.87
3.2			building-integrated "grid" system	93.9	77.52	74.32	121.65	83.5	120.87
3.3		1.01 MW - 20 MW		50.7	61.55	56.67	121.65	69.29	119.3
4.1	Geothermal	50.1 kW - 1 MW	without district heating supply	37.3	44.7	19.88	44.15	36.02	54.96
4.2			heat utilization in district heating	38.6	53.05	19.88	44.15	36.02	54.96
5.1	Sewage gas	above 50 kW		28	18.45	15.9	28.45	16.54	27.04
6.1	Landfill gas	above 50 kW		26.2	26.45	13.91	20.9	16.54	27.04
7.1	Agricultural biogas	50.01 kW - 500 kW		43.5	64.1	41.7	40.42	46.38	41.74
7.2		500.0 kW - 1 MW		38.2	44.39	29.3	40.42	43.25	41.74
9.1	Woody biomass	50.1 kW - 1 MW	electricity production	40.8	42.14	31.56	44.93	62.26	35.35
9.2			cogeneration qualification	44.9	51.23	31.56	44.93	69.25	35.35
10.1	Herbaceous biomass	50.1 kW - 10 MW	electricity production	30.6	24.57	27.18	44.93	46.72	35.35
10.2			cogeneration qualification	35.6	33.66	27.18	44.93	51.93	35.35

Table 10: Suggested feed-in tariffs for 2011-2012

Source: Pylon, 2011, p.68.

Data in the table are discounted to 2010 levels, therefore they would need to be adjusted for 2 years of inflation in order to make them comparable to 2012 KÁT tariffs (see Table 5 on page 100), but they are still suitable for an approximate comparison. The proposal suggested a considerable modification in a number of technologies in comparison to the current KÁT prices. In case of solar power plants, for example, the Pylon study suggests a 50-94 HUF/kWh price level instead of the current KÁT tariff of 30.71 HUF/kWh, which means a substantial increase, but the tariff would still be lower than that in the Czech Republic, the primary example for

[48] The model was established by the energetics group of Vienna University of Technology in order to evaluate specifically expansion of the promotion systems within the European Union. The software is available at www.green-x.at website.

the phenomenon of PV bubbles. Whereas in case of wind turbines, experts suggest that prices should be decreased in comparison to the 31.9 HUF/kWh KÁT tariff valid for plants established before 2008 in 2012. The document also concludes that there is a major difference in the tariffs of solar and wind power stations in certain countries; solar tariffs are approximately double the wind turbine tariffs. Biomass tariffs also tend to be way higher than wind power tariffs. On the other hand, differences between tariffs in the Hungarian KÁT system hardly ever exceed 10-20%, which Pylon would also recommend to revise.

But no changes have been implemented, the KÁT and its tariffs have not been considerably amended since the announcement of the future METÁR system. However, the publication of such proposals results in the complete uncertainty of investors who cannot foresee the tariffs related to their green investments. Thus the industry tries to "sit out"; and no significant renewable capacity expansion can be expected until the entry into force of the actual regulation.

The planned schedule of annual expansion between 2005 and 2020 was described in the estimations of NMCST as follows:

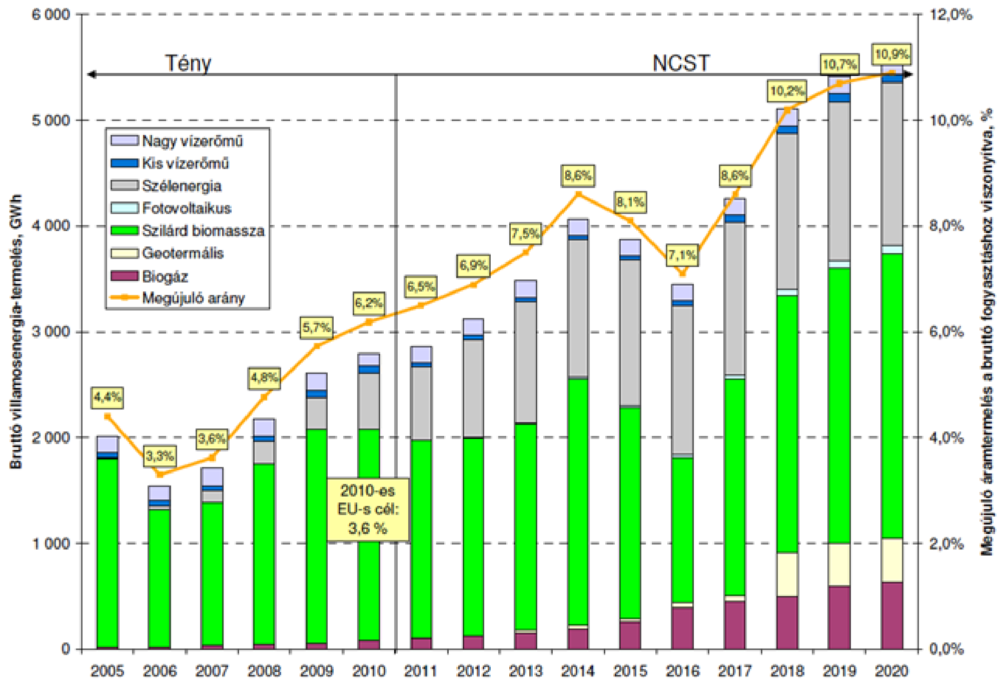


Figure 20: Forecast for annual gross renewable electricity production between 2005 and 2020
(vertical axis left: gross electricity production; vertical axis right: share of renewable electricity production in gross consumption; left hand side of the horizontal arrow: actual; yellow rectangle: EU target for 2010; in the legend, from top to bottom: large hydro, small hydro, wind, photovoltaic, solid biomass, geothermal, biogas, share of renewables)

Source: CPSL-REKK, 2012, p.17.

As demonstrated in the above chart, Hungary was already behind the required level of production in 2011, since NMCST expected 6.5% renewable share whereas only 6.27% was achieved. Looking at the targets of the following years, the document already predicts new capacities for 2013-2014, although these new plants will probably not start up during the course of the next 1 or 2 years, given that 2012 has (almost) passed without the new regulation taking effect. Biomass production, which is expected to suffer a setback in 2015-2016 due to the gradual phasing out of the old biomass power plants, should be increasing again by 2017 – the preparations for which should already have begun by now. And the targeted expansion rate of wind power cannot be attained, either, unless new quotas are allocated in the very near future.

The first study of GKI (GKI Gazdaságkutató, 2011) that drew attention to the necessity of the refreshment of preliminary NMCST analyses was published late 2011, and it also highlighted that new capacities planned for 2013-2014 are not viable any more due to the delays, and that interim targets very likely need to be reconsidered, as well. Because even if the new scheme enters into force early 2013, that only means the beginning of a multiple-year process of preparation, licensing and installation, which can be expected to suffer further delays because of current financing difficulties. Therefore plants can only start production in 2014 or 2015 the earliest, provided that projects are restarted / activated in the beginning of 2013.

Policymakers are also aware of the delay in meeting the objectives, as a result of which a government regulation issued in November 2012 requests the Minister of National Development to review NMCST with the following reasoning:

“The Government requests the Minister of National Development to review and suggest possible revisions of Hungary's National Renewal Energy Action Plan with special consideration to the utilization of the results in technological developments, the populations’ financial position and the possible effects of biomass utilization on agriculture and rural development.”

The above Government Decree 1491/2012 of 13th September 2012 set a deadline to complete this task by the end of December 2013. The probable conclusion is that METÁR is not likely to take effect in 2013, either, which means yet another lost year for the industry; what is more, even the growth path and the distribution of capacity expansion among technologies might change.

The fact that the promotion of green energies is financed by the end consumers of electricity (through the KÁT system) and that accordingly, an expansion in renewable capacities would trigger a rise in the price of electric energy is certain to have a role in the regulatory uncertainty we have experienced lately and in the lack of commitment to the introduction of METÁR. Furthermore, residential consumers can be extremely cost-sensitive in recession periods. In order to reach the goals outlined in NMCST, a consumer contribution of 2.2 Ft/kWh per unit of electricity consumption would be required in 2012, which would, however, increase to more than double that value: 4.6 Ft/kWh by 2020 (Ságodi, 2012). Moreover, keeping end consumer energy prices low and the freeze on public utility costs (CPSL-REKK, 2012, p.16.) seem to be a top priority to the government, which may seriously hinder the further growth of renewables.

The outlined objectives pose a tough challenge to the renewable electricity production sector, while regulatory uncertainty and the repeated delays clearly represent a waste of valuable time. Thus, in spite of the unquestioned need for renewable energies and the ambitious renewable targets Hungary has committed herself to, the entire Hungarian renewable sector, along with its remarkable growth potential and various other favorable conditions, has come to a complete halt – awaiting METÁR.

The policymaker has to take numerous aspects into account in the finalization of the new regulation, from the optimum energy mix to economic stimulus to the burden on end consumers. It may not be easy to find the optimum solution, yet delaying matters will not make the situation solve itself.

In the next chapter of my dissertation, I will formulate, drawing from what has been said so far and bringing in the findings of my empirical research, recommendations for the Hungarian regulation that may contribute to the success of the Hungarian feed-in tariff scheme and, at the same time, call attention to any potential traps or hindrances – but to promising opportunities, as well.

6. Regulating Renewable Energy in Hungary: Ways Forward

6.1. Identifying the Problems: the Road to My Hypotheses

The purpose of the empirical part of my dissertation is to explore possible avenues for the development and improvement of Hungary's renewable energy promotion scheme. Relying on theoretical studies by policymakers and the experiences of EU member states, I will assess the KÁT system currently in place as well as its performance in the past. I would also like to point out the way forward for any regulatory scheme whose goal is to help Hungary's green energy sector reach the 2020 targets spelled out in the NMCST.

My research is comprised of three main parts. First, I will explore the theoretical background of the "PV bubbles" seen in Europe, relying upon the logic of feed-in tariff systems. I will demonstrate the effects the slope of the marginal cost curve and the lack of information on the part of the regulator can have on the effectiveness of the stimulus system used. The hypothesis formulated in connection with this issue shows that in the case of Hungary's FiT system, an incorrectly determined solar feed-in tariff could lead to significant plan vs. actual deviations in quantity, due to the technology's marginal cost curve becoming flatter and flatter with time. Although no solar power plants operate under the KÁT in Hungary at this point (due to the low feed-in tariffs), the NMCST includes solar capacity in excess of 60 MW by 2020; thus, the stimulus system will soon be facing the same problems already encountered in other EU countries. My proposal would help avoid a PV bubble in Hungary by introducing annual quantity quotas.

Secondly, I will show that the items currently appearing on electricity bills generally support fossil fuel energy production over renewables. This hypothesis dispels any fears related to potential significant price hikes in electricity, a concern often voiced by those opposing renewables. I will also show that the gradual phasing out of the items supporting fossil energy production, and redirecting them to renewables would allow support for green energy production to increase three-fold. In other words, it would be possible to support three times the present amount of green energy production while keeping the burden on end consumers unchanged.

The third area of my research has led to several more complex and diverse conclusions. Through in-depth interviews conducted with stakeholders of the Hungarian green energy sector, I will describe the main characteristics, and stakeholders' assessments and gaps of the KÁT system, which has been in place for nearly ten years now. Based on these findings, I will describe ways to modify the current system, options which may also work toward the success of the METÁR system. In my empirical analysis, I will also examine the current situation of the sector and will conclude that the uncertainty surrounding the regulatory environment is currently a significant obstacle in the renewables sector. Unless this is recognized and treated, even tools that otherwise would be efficient will not help reach the desired results.

The METÁR system, then, will have to do more than just resolve the weaknesses of the KÁT system (e.g. through increasing price differentiation). Restoring or re-creating the predictability of the regulation is the most critical condition for METÁR to properly function as a regulatory system. The regulatory uncertainty encountered over the course of the last two years needs to come to an end, as this in no way helps move the industry closer to the 2020 targets.

6.2. Ways to Avoid Regulatory Failure (Validation of Hypothesis H1)

For the purposes of my dissertation, regulatory failure is when the impact of a renewable electricity incentive system on the promotion of green energy significantly differs from the intended outcome.

This line of thought was ”inspired” by the already mentioned excessive expansion in solar capacities in certain European countries. With regard to feed-in tariff systems, I have already underlined the responsibility of the policymaker to determine feed-in tariffs in an adequate way and to ensure they are regularly updated. Is the tariff too low, the expansion in renewable capacities will lag behind expectations; if it is too high, however, that will attract profit hunters, and thus result, within a short time, in a capacity expansion way beyond the intended extent (Infrapont, 2010).

This latter possibility is considered worse, as it is far more difficult to correct. After all, if the tariff happens to be too low and hence capacity expansion is too slow, that can be easily and quickly remedied by increasing the tariff to the appropriate level. Has the policymaker, however, set the tariff too high, the resulting investment boom is much more difficult to manage, and it might as well distort the country's energy mix in favor of one or the other energy source.

The study of REKK, having examined the case of the Czech Republic, the country that has been most badly affected by the excessive growth of PV power generation, underlines that there are several drawbacks to the over-subsidization and the resulting sudden take-off of one single technology, namely:

- may significantly increase end consumer prices;
- may crowd out cheaper renewable technologies and hence deteriorate the regulation's efficiency, because it is not the cost-efficient technologies that grow at the desired rate;
- may lead to unplanned changes in the regulation (to a retroactive special tax, for example, as was the case in the Czech Republic), which renders the country's investment environment less predictable (REKK, 2012).

In order for the Hungarian renewable industry, still lacking any remarkable PV capacities, to avoid this „trap", we need to explore and understand the very essence of the problem.

The question whether price-based or quantity-based regulations are more reasonable to employ has already been raised in relation to a number of different environmental matters. Widely recognized for having laid the foundations of the topic is the 1974 study of Weitzman, in which he derived, by mathematical means, that as far as environmental pollution is concerned, the choice between taxes vs. norms should be made according to the relative slopes of the marginal net private benefit curve and the marginal external cost curve (Weitzman, 1974). Plotted in the pollution level vs. costs/benefits coordinate system, the marginal external cost (MEC) function has a positive slope, while that of the function showing the marginal benefit of the producer (MNPB) is negative. The intersection of the two curves marks the socially optimal level of pollution. This is what the policymaker wishes to achieve; and they can actually do so, no matter whether they introduce a norm or a tax – as far as there is perfect information (Kerekes, 2007).

In reality, however, the policymaker can never be perfectly informed, neither about external environmental damages (and the respective functions), nor about producers' marginal benefits. „Accordingly, the question is not whether the policymaker will make a mistake, but rather what the extent of the mistake will be, and what the extent of the economic consequences of the regulation based on that erroneous estimate will be" (Kerekes, 2007. p. 138).

Under imperfect information and uncertainty, price-based (tax) and quantity-based (norm) regulations are not at all equivalent to each other, they might yield remarkably different outcomes (Cropper – Oates, 1992). Kerekes provides a telling illustration of Weitzman's mathematical reasoning, which makes it apparent that it is the relative slopes of the two curves that determine the extent of the „mistake" a price-based or a quantity-based regulation can cause under imperfect information (for example: incorrect estimates for marginal benefit curves).[49] If the slopes of the two curves are more or less equal (in absolute value), then the social damage caused

[49] For a detailed explanation see Kerekes, 2007. pp. 136-140.

by the policymaker having derived a false optimum will be the same, no matter whether they employ a tax or a norm – as evinced by the figure below:

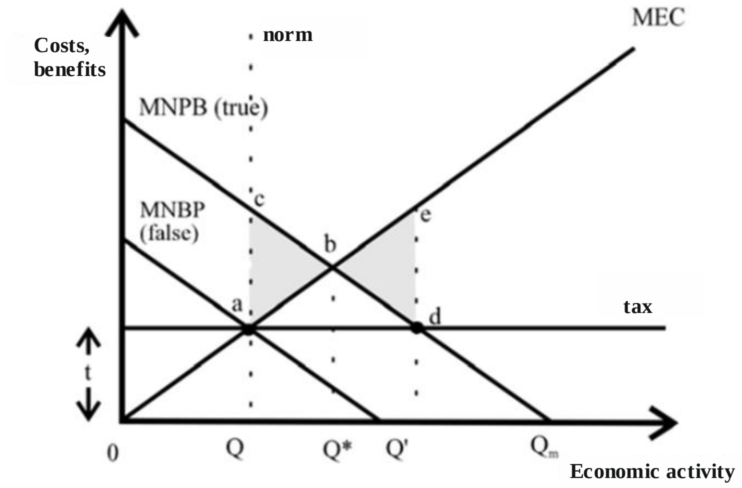


Figure 21: Equivalent effect of norms and taxes

Source: Kerekes, 2007. p. 138.

If the policymaker estimates, falsely, the optimum to be at *Q*, instead of *Q**, then the impact will be the same irrespective of whether they introduce a tax or a norm to achieve this level, for the two dark triangles (the damage caused by the divergence from the social optimum) are nearly equivalent. A tax of amount *t* implies an optimum of *Q'* instead of *Q*, in which case the total amount of external cost exceeds the producer's benefit by an amount equal to the area of the triangle *bde*. Whereas a falsely determined norm at *Q* results in the producer foregoing an income (in excess of social external costs) equal to the area of the triangle *abc*.

The situation is, however, quite different if the slopes of the two curves differ, as that will make the areas of the two aforementioned triangles (that is, the total amount of social damage caused) differ, as well. Here, I will restrict myself to illustrating only one of the possible scenarios:

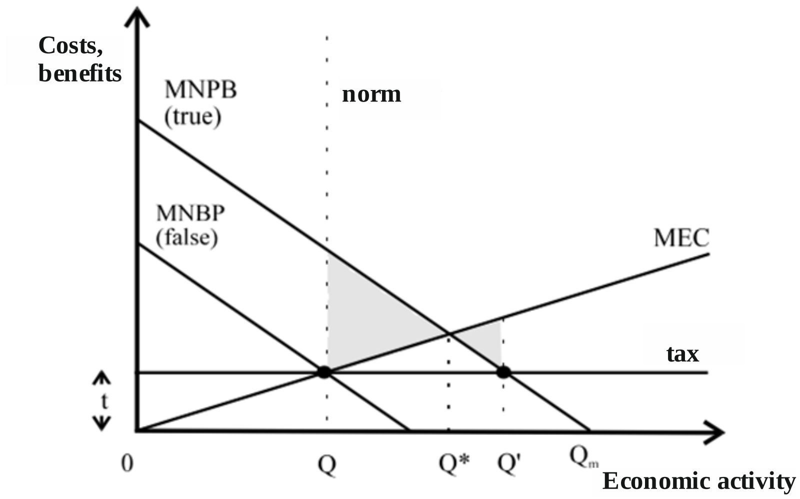


Figure 22: Differing effect of norms and taxes

Source: Kerekes, 2007. p. 140.

In this variant, the tax of *t*, believed to be the optimum level as a result of imperfect information, implies an optimum of *Q'*, while the norm implies an optimum of *Q*. Because of the differing slope of the two curves, as we can see, out of the two triangles representing the amount of damage caused, the one on the left is larger in area; that is, if the marginal external cost curve is the flatter one, then the policymaker should rather resort to taxes, for norms would be bound to cause more damage. The opposite – i.e. that if the marginal external cost curve is the steeper one, then norms are the more reasonable choice – can be proved in a similar way.

Hence, in summary of the conclusions of Kerekes:

1. **If the regulator is perfectly informed, price-based and quantity-based regulations are equally efficient.**
2. **If the marginal external cost curve is steeper than the producer's marginal benefit curve, quantity-based regulations perform better.**
3. **If the marginal external cost curve is flatter than the producer's marginal benefit curve, price-based regulations perform better.**

It may not be obvious how the above mechanisms are related to my research topic. However, if renewable energy production is interpreted as an opportunity for reducing/offsetting fossil energy production (i.e. environmental pollution), and the incentive as a negative tax on renewable energy production, then the above line of thought can already be applied to the issues related to the regulation/promotion of the various renewable technologies. Accordingly, it is the slope of the marginal production cost curve of the technology that our recommendation in regard to the choice between price vs. quantity-based incentives should be based on.

From amongst the pieces of literature I examined, the 2003 study of Menanteau-Finon-Lamy dedicates an entire separete section to discussing the asymmetry between price vs. quantity-based regulations under imperfect information (Menanteau et al., 2003). The authors take the promotion of renewable energies to be a means of avoiding climate change, as a form of environmental pollution, and conclude that if the marginal cost curve of avoiding the pollution is steep, then a price-based regulation is the right choice, whereas if it is flat, then a quantity-based scheme will perform better. They used the following figure to illustrate the idea:

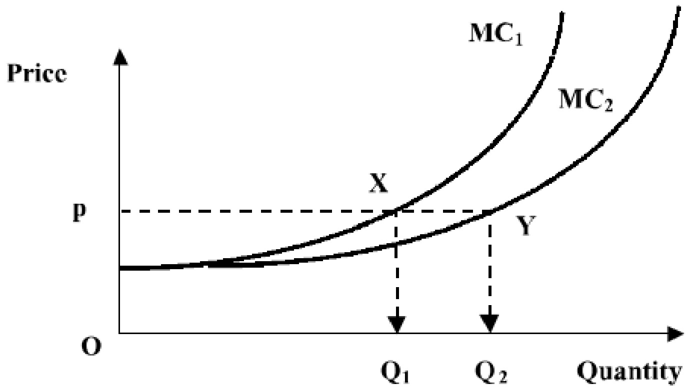


Figure 23: Prices and quantities under imperfect information

Source: Menanteau et al., 2003. p.804.

As a matter of fact, the figure illustrates the effect feed-in tariff regulations have whenever the marginal cost curve is flatter than what was expected by the authorities. If, in hopes of a production volume Q_1, they set a guaranteed purchase price p, but the actual marginal cost curve is MC_2, and not MC_1, as estimated by the policymaker, then the production volume induced by the price p will not be Q_1, but Q_2, a larger amount, which will act to escalate the financing costs of renewables, and hence the burden on end consumers.

In order to discuss the matter in more detail, I will blend in some elements of Kerekes's logic, and analyze several possible scenarios.

6.2.1. Difference Between Price vs. Quantity-Based Incentives – Technologies with a Steep Marginal Cost Curve

First, let us look at the case when, under imperfect information, the policymaker employs their price/quantity-based incentive for technologies with a steep marginal cost curve.

My line of thought is illustrated by Figure 24 below:

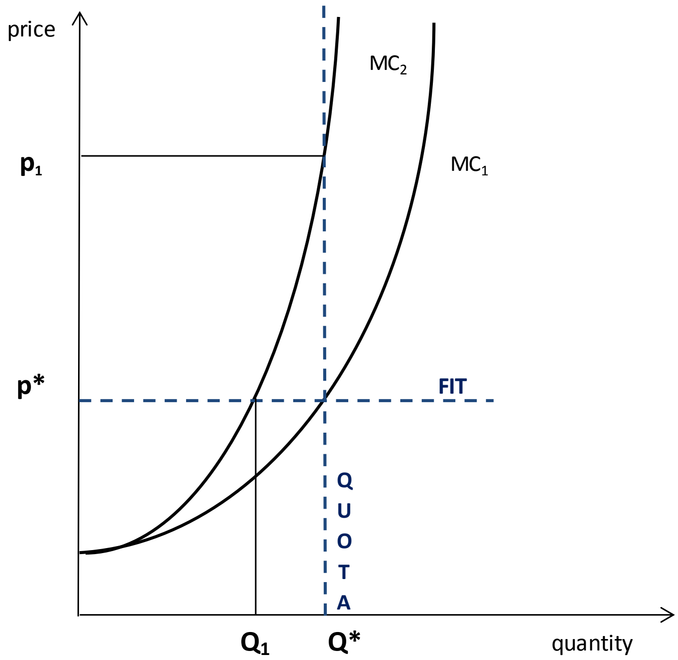


Figure 24: Price and quantity-based regulations – marginal cost curve steep and underestimated

Source: author's own illustration

Suppose the authorities believe the marginal cost curve of the technology in question to be less steep (MC_1) than it actually is (MC_2). Consequently, they introduce a feed-in tariff $p*$ or a green quota $Q*$, in hopes of achieving, in both cases, the equilibrium point at the intersection of the two dashed straight lines. Because, however, their estimate of the MC curve was false, and the actual curve is steeper than they assumed, the outcome would not meet their expectations, in neither case.

If the policymaker opts for a feed-in tariff system, then a tariff equal to $p*$ – the price they believe to be optimal – will not result in a production volume $Q*$, as expected, but in Q_1, that is, the expansion, at that given price level, in installed renewable capacities will be somewhat less than expected. Accordingly, the burden on end consumers will also remain below the expected level, for, given the feed-in tariff, a smaller total capacity requires a smaller amount of financing. The figure also shows us that, the technology's marginal cost curve being steep, Q^* and Q_1 are rather close to each other, and hence **the mistake made by policymaker is of moderate extent.** At the actual equilibrium p^*Q^*, the amount of necessary financing would have been the area of the rectangle bounded by the straight lines through p^* and Q^*, whereas the equilibrium point on the actual marginal cost curve will necessitate an amount equal to the area of the rectangle bounded by the straight lines through p^* and Q_1, which is less then expected, given that Q_1 is smaller than Q^*.

If the policymaker opts for a quantity-based incentive system, and introduces a quota Q^* – which they believe to be optimal – for the given renewable technology, the actual price of green certificates, along the actual marginal cost curve MC_2, will be p_1, thus far above the level expected by the policymaker (p^*). The policymaker originally calculated with a financing need of the area of the rectangle bounded by the straight lines through p^* and Q^*, but in reality, they generated a volume of production that requires way more than that: the area of the rectangle bounded by the straight lines through p_1 and Q^*. Due to the marginal cost curve being steep, the price determined by the quota running parallel to the vertical axis will significantly differ from the price that belongs to the optimum the authorities presumed, that is, **the mistake potentially made by the policymaker is more significant in this case**, and may even culminate in an unexpected boost in end consumer prices.

In both cases, what the regulatory instrument can „be wrong about" is the parameter that is left to the market. If the feed-in tariff is fixed, then, as a consequence of the marginal cost curve being steep and having been underestimated, the resulting production volume will lag behind expectations, yet the plan vs. actual difference will not be very significant. Given a quantity-based regulation, the underestimation leads to the price of the intended volume of production being higher than expected, and the difference in the price of green certificates is, in this case, rather large, because of the MC curve being relatively steep. The steeper the marginal cost curve, the smaller the difference between Q^* and Q_1, and the larger the distance between p^* and p_1, or in other words, the smaller / greater the potential error made by the feed-in tariff / quota scheme, respectively.

Also apparent from the figure is that the closer the two marginal cost curves are to each other, the smaller the error – for both types of regulation. Thus, obviously, the extent of the mistake made by the policymaker does also influence the extent of the deviation caused. The closer the two marginal cost curves are, the smaller the mistake of the policymaker, and the lesser the extent of any potential unintended consequences (differences between Q^* and Q_1, and p^* and p_1).

Drawing from the graphic illustration of Kerekes, the rectangles representing the actual resulting financing needs that „replace" the rectangle determined by the real optimum p^*Q^* can be plotted as follows:

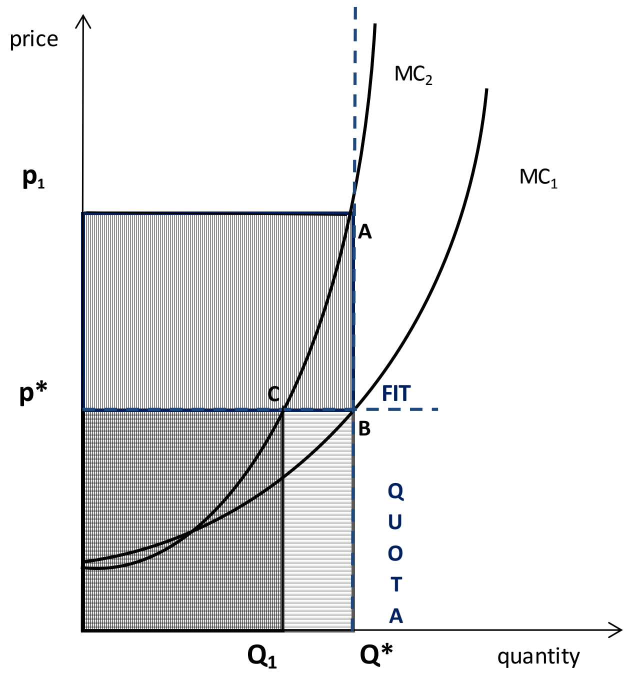


Figure 25: Differences in final financing need – marginal cost curve underestimated

Source: author's own illustration

Had the policymaker set the incentives (price/quantity) at the right level, the promotion of green energies would have required a total amount of financing (subsidy) equal to the area of the rectangle defined by points p^*, Q^*, B and the *origin*. Given the FiT tariff p^* and the true marginal cost curve MC_2, however, the actual amount of the subsidy – i.e. burden on end consumers – will be the area of the rectangle defined by points p^*, Q_1, C and the *origin*. Accordingly, what the regulatory failure means in terms of social cost will be a reduction in financing need equivalent to the area of rectangle Q_1Q^*BC, denoted by grey horizontal lines. A quota (TGC) will, at the same time, require a subsidy amount in excess of the rectangle defined by points *p**, *B*, *Q**; it will actually amount to the area of the rectangle defined by points p_1, *Q**, *A* and the origin. The amount of the additional subsidy required is represented by the rectangle p_1p^*AB, denoted by blue vertical lines, the area of which exceeds that of Q_1Q^*BC, that is, the deviation caused by the price-based instrument.

Apparently, the longer their sides, i.e. the greater the extent of the mistake the policymaker made with respect to the price or the quantity, the larger the areas of the rectangles representing the value of the errors caused. Therefore, I will hereafter only illustrate these distances. Their lengths are, however, also influenced by the slope of the marginal cost curve; and it is hardly indifferent, either, whether the deviation from the optimum means a financing surplus or a deficit. It is worth to break down our analysis into different scenarios according to certain key characteristics.

The situation when the marginal cost curve of the technology is similarly steep, but the policymaker happens to overestimate it (as opposed to the previous case), the impact of the flawed regulations may be illustrated as follows:

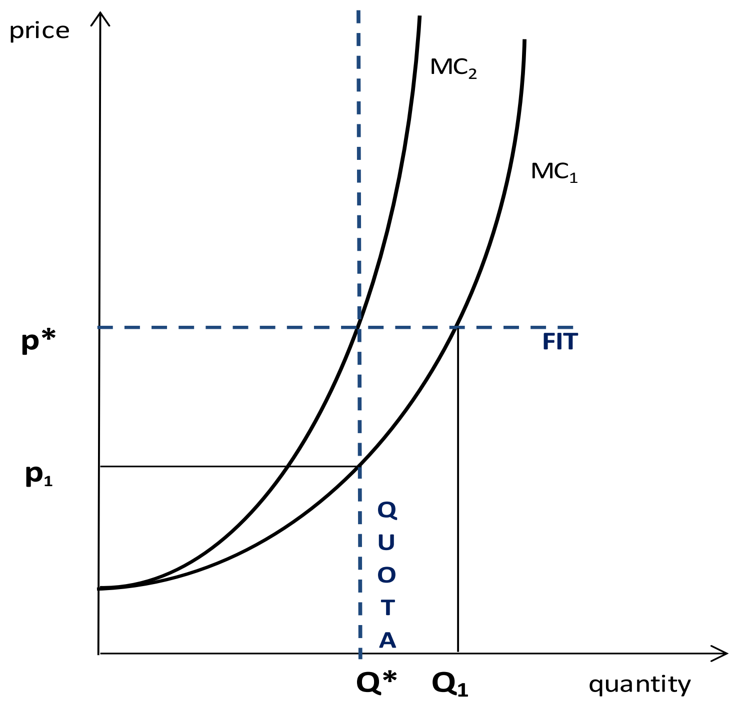


Figure 26: Price and quantity-based regulations – marginal cost curve steep and overestimated

Source: author's own illustration

The policymaker believes the marginal cost curve of the technology in question to be MC_2, but the slope of the real curve, MC_1, is smaller.

Let us suppose that the policymaker, once again, assumes the optimum to correspond to a feed-in tariff of p^* and the corresponding quantity Q^*. Now, if they use a price-based incentive, than the price p^* will induce a production volume of Q_1 instead of Q^*, that is, more than expected. Which is quite logical, as the overestimation of the cost curve means that they will use an excessive FiT tariff, which then again leads to a higher level of production. If the authorities opt for a quantity-based regulation, then their imperfect information will result in a price p_1 instead of the intended p^*, given the fixed quantity Q^*. Thus if the marginal cost curve has been overestimated, then a quota will deliver the required production volume at a price that is lower than what was expected by the regulator.

Thus, in summary, if a marginal cost curve that is considered steep is overestimated, then FiT systems will lead to a higher volume of renewable production, while quota schemes will achieve the desired quantity cheaper than expected. Instead of the rectangle defined by the vertical and horizontal lines through the actual optimum Q^*p^* and the two axes, the financing need generated by the FiT will be higher (rectangle bounded by Q_1p^*), and that of the TGC scheme will be lower (rectangle with diagonal Q^*p_1) than expected.

The figure already gives us a hint about what the next scenarios, in which the marginal cost curve is less steep, will look like; after all, if the curve MC_1 in Figure 26 is flattened (rotated clockwise), it becomes apparent that the error (deviation) caused by FiT schemes – and hence the area of the rectangle representing the total amount of subsidy – will grow larger and larger.

6.2.2. Difference Between Price vs. Quantity-Based Incentives – Technologies with a Flat Marginal Cost Curve

Considering technologies with a steep marginal cost curve, we have already seen that it is quantity-based systems that are prone to make the larger mistakes whenever the policymaker is not sufficiently informed to derive an accurate estimation of the marginal cost curve of the renewable technology in question. Knowing this and having heard about the PV power generation booms experienced under certain feed-in tariff schemes, we may already have a suspicion that the tide would turn as we switch to technologies with a flat marginal cost curve.

First, let us see the consequences of underestimating a flat marginal cost curve under a price vs. a quantity-based regulation.

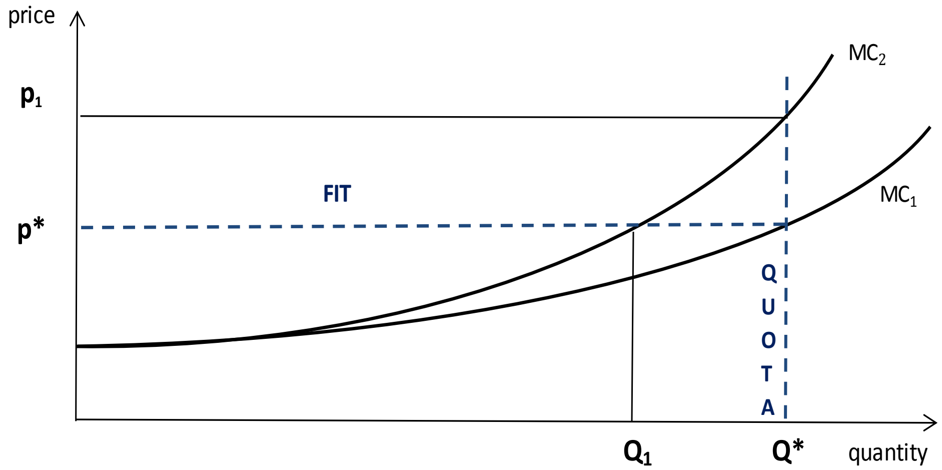


Figure 27: Price and quantity-based regulations – marginal cost curve flat and underestimated

Source: author's own illustration

The authorities assume a marginal cost curve MC_1, in reality, however, the technology is more costly than that, and thus has a marginal cost curve MC_2. Accordingly, a feed-in tariff of p^*, intended to generate a quantity Q*, will only yield less than that: a volume of Q_1. That is, the effectiveness of the regulation will lag behind expectations, and, as a result, the need for social support will also be less than the rectangle with diagonal Q^*p^*, and the difference will be the area of the rectangle defined by Q_1Q^* and p^*. Whereas a quota of Q^* will be met at a price (p_1) higher than what was expected (p^*), that is, the quantity-based incentive will cause the policymaker to incur expenses above the planned amount; the excess is represented by the area of the rectangle defined by section p^*p_1 and the amount of Q^*. The size of this area is quite large on the above figure already, yet if we further increase the distance between MC_1 and MC_2, it will grow even larger.

The flatter the curves, the more it is true that the potential error caused by a price-based regulation is larger; and the less accurate the estimate of the policymaker, the larger the distance between the two marginal cost curves, and between Q^* and Q_1, plus between p^* and p_1, as well, i.e. the more the renewable quantities and prices achieved will differ from their planned values. The real risk always lies in the scenario when either the quantity significantly exceeds expectations in a FiT scheme (for the price is fixed here), or the price at which the desired quantity can be achieved significantly exceeds the intended value in a quota-based scheme. In any of these two cases, the financing burden put on the end consumers of electricity may drastically increase, which might generate further problems to be managed by the policymaker.

Let us also examine the opposite scenario, when the policymaker happens to overestimate a flat marginal cost curve.

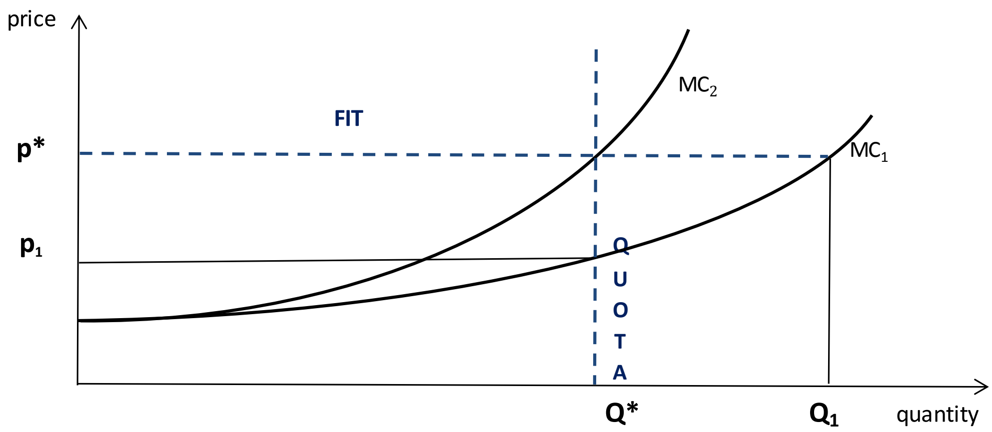


Figure 28: Price and quantity-based regulations – marginal cost curve flat and overestimated

Source: author's own illustration

The policymaker, based on the information they have, presume the marginal cost curve of the renewable power generation technology they wish to promote to be MC_2. However, the information available to the policymaker is either inaccurate or incomplete, and thus they overestimate the marginal cost of the technology – which, in reality, is represented by MC_1.

The authority in charge of the country's FiT scheme will introduce a feed-in tariff p^* for the renewable technology in question, in hopes of achieving a production volume of Q^*. Yet since they have overestimated the marginal cost curve (MC_2 instead of MC_1), that is, they believed the technology to be more costly than it actually was, the tariff will generate a production volume of Q_1 instead of Q^*. In a quantity-based scheme, at the same time, the policymaker will set a quota of Q^*, assumed to imply a price of p^*; but they have overestimated the marginal cost curve, so the desired production volume can also be achieved cheaper – at a price p_1.

Given a flat marginal cost curve, it is the feed-in tariff – which acts „along" the horizontal line – that can cause the larger error, and hence lead to a higher burden on end consumers. The flatter the marginal cost curve, and the less accurate the policymaker's estimate of the slope of it, the larger the distance between Q^* and Q_1 and the area of the rectangle defined by the section Q_1Q^* and p^*, representing the additional burden on society. Let us imagine that we rotate the true MC_1 curve further downwards, towards the horizontal axis. The closer it gets to the horizontal axis, the larger the distance between Q^* and Q_1 will be. The difference between the intended and the actual volume of green energy production (and between that of the related social costs) may take on shockingly high values.

The distance between p^* and p_1, at the same time, does not grow at such a high rate, because of the flat slope of the marginal cost curve; accordingly, in a regulatory scenario like this, it is price-based regulations that are characterized by a larger potential error, that are potentially more „dangerous". Especially because the „deviations" have different consequences. Under a quantity-based scheme, what might happen is that the desired volume is produced at a lower price; but the difference between planned vs. actual prices is not very large, either. That is, the „direction" (the sign) of the error is favorable, and its extent is not very significant, either. In a feed-in tariff scheme, on the contrary, the flawed price may lead to the installation of excessive capacities, and the deviation from the desired amount might be significant, as well. That is, the burden on end consumer prices will not only increase, but the increase will be a drastic one at that.

6.2.3. Conclusions; Ways to Avoid Regulatory Failure

In practice, policymakers are never perfectly informed about renewable technologies. This is partly due to the rapid development and the changes these technologies experience, and also to the fact that it is the investors and project developers who know the most about the shape of their respective marginal cost curves, and they might be interested in the policymaker not being perfectly clear about those, in high hopes of earning some additional profit thanks to a potential regulatory failure. It might even happen that investors are not perfectly up-to-date on the characteristics – the ones that affect their returns – of their technology, either (e.g. solar modules' lifespan and the expected decrease in efficiency during that period). Consequently, they use higher risk premia in their calculations, and thus expect higher feed-in tariffs than would be necessary. Therefore, in order for the tariff reduction potential to be correctly reflected in the actual prices, it is not only policymakers, but also investors, manufacturers and experts that should engage in active communication / the exchange of information (Szabó et al. 2010).

With the help of some graphic illustrations, I have shown that the slope of the marginal production cost curve of the renewable power generation technology to be promoted has an influence on the extent of the error that the imperfect information of the policymaker might lead to. Concerning steep marginal production cost curves, it is quantity-based regulations – acting „along" a vertical line – that may result in surprisingly high prices, while as regards flat marginal cost curves, it is the price-based, feed-in tariff type of system – represented by a horizontal line – that cause the bigger concern. In either case, the outcome may be that the policymaker has to face (because either the prices or the quantities exceed what has been expected) a green energy related financing need far above the expected level. If the difference is large enough to lead to resistance among end consumers, or if the intake of that increased amount of green power causes disturbances in the country's electricity grid, then we clearly have a case of regulatory failure. Based on our analyses so far, the following conclusion can be drawn:

H1: For renewable technologies with a steep marginal cost curve, it is the quantity-based, while for renewable technologies with a flat marginal cost curve, it is the price-based regulation system that carries a greater risk of regulatory failure.

The policymaker needs to be aware of this fact, and they need to design their incentive system accordingly. In practice, the accurate estimation of the marginal cost curve may be facilitated by the monitoring of technological developments, active communication with the investors and, of course, an international perspective, that is, studying other countries' promotion systems and, possibly, learning from their mistakes. For both types of incentive, there is a possibility and there are established techniques for avoiding the scenarios discussed above.

Under **a quantity-based scheme**, the risk lies in the required amount of green energy production possibly only being realizable at a price way higher than planned, and that the price of certificates may significantly exceed the level expected by the authorities. The solution might be, as already seen in a number of countries, a cap price/buy-out price, at which one can „escape" one unit of green certificate obligation. This price ensures that obligors have an opportunity to „buy out" their green energy obligation, if the price of green energy production happens to rise too high – because of the policymaker having been insufficiently informed or for any other reason. That is, instead of buying the overly expensive certificates, they may opt for paying the buy-out price/penalty. Accordingly, the policymaker can rely on this buy-out price to set an upper limit to the price of green energy, and hence to the extent of the (potentially) resulting regulatory failure, in addition to keeping the burden that the financing of the subsidies puts on end consumers in check.

Under **a feed-in tariff scheme**, the problem may become particularly severe if the marginal cost curve is flat or if the tariff set by the policymaker happens to be seriously far-fetched. In the Czech PV example we saw that the tariff they introduced was several times higher than in other countries, which was a clear predictor of soon-to-come regulatory failure. One of the reasons why photovoltaics is a very special field is that it is a technology with a raw material cost of zero; after all, solar energy is free, and therefore its marginal cost curve is flatter than that of the technologies that do have to incur raw material costs (e.g. biomass, biogas power plants).

Furthermore, recent years have witnessed a technological development of unseen proportions in the field, which acted to very significantly reduce the manufacturing costs of solar modules. The technology is becoming more and more efficient, that is, the per unit area energy output of solar panels is continuously on the rise. What is more, solar power stations are – in comparison to wind turbines, which have no raw material costs, either – rather quick to install, and thus the policymaker does not have very long to recognize the problem in its early stages.

As a consequence of all the above, the slope of PV technology's marginal cost curve is continuously flattening, and doing so at a very quick rate. Therefore, as far as solar power stations are concerned, a policymaker who is not sufficiently up-to-date may very badly miss the mark – as illustrated by Figure 29:

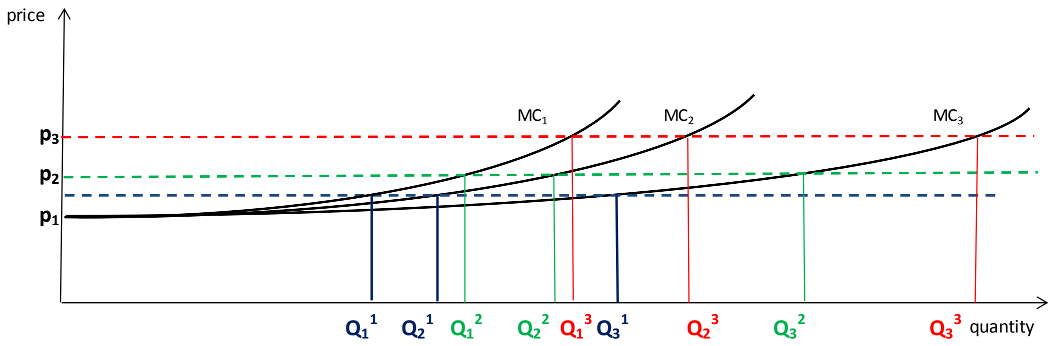


Figure 29: Effect of a flawed tariff with extremely flat marginal cost curves

Source: author's own illustration

The figure will help me explain the effect of flawed feed-in tariffs. I plotted three marginal cost curves of differing slopes (MC_1, MC_2, MC_3) and three feed-in tariffs (p_1, p_2, p_3) to be applied to the technology in question. Each quantity defined by the intersection of a marginal cost curve with a feed-in tariff is denoted by a capital Q, with the number of the marginal cost curve in the subscript and that of the tariff in the superscript. Thus Q_2^3, for example, is the quantity defined by the tariff p_3 on the second marginal cost curve (MC_2). I also used colors, in addition, to distinguish between the different cases: blue is for the quantities defined by the tariff p_1 (Q_1^1, Q_2^1, Q_3^1), green for p_2, and red for p_3.

If the policymaker employs a tariff of p_1, for they believe the marginal cost curve to be MC_1, then what they expect in response is a quantity Q_1^1. If, however, the real marginal cost curve corresponds to MC_2, then the quantity generated by the price p_1

will not be Q_1^1, but Q_2^1; if MC_3 is the correct one, then it will be Q_3^1. As clearly evinced by the figure, the difference between the expected and the actually resulting quantity is larger (the distance between Q_1^1 and Q_3^1 is larger than that between Q_1^1 and Q_2^1) in this latter case, simply because MC_3 is flatter. Thus the more inaccurate the policymaker's estimate for the slope of the marginal cost curve, the bigger the „surprise" that may await them in terms of quantity.

My graphic is also suitable for illustrating the extent of the shift in quantity (along a given marginal cost curve) induced by a flawed tariff. If the policymaker happens to introduce an excessive tariff of p_2 or p_3 – instead of p_1, which would actually yield the desired quantity –, then, given MC_1, the amount of green power produced by the technology in question will not be Q_1^1, but Q_2^1 or Q_3^1 instead, respectively. We can also see that if the marginal cost curve of the technology the policymaker wishes to promote is not MC_1, but MC_2 or MC_3, then the same mistake in the price level will already lead to much larger errors, for the flatter the marginal cost curve of the technology, the larger the deviation in quantity can get. The distance between Q_2^1 and Q_2^3 – associated with a price level modification of $p_1 \rightarrow p_3$ along MC_2 – is significantly larger than that between Q_1^1 and Q_1^3. But the difference between the planned and the actual quantity caused by the flawed price is the greatest (equivalent to the distance Q_3^1-Q_3^3) if it is MC_3 that happens to be the correct curve. Thus it has become apparent that:

> ***Under a FiT scheme, the larger the mistake made by the policymaker, be it related to the slope of the marginal cost curve or the tariff they introduced, the more significant the difference between the actual volume of renewable production and what was intended.***

And the excessive expansion in (e.g. PV) capacities a flawed tariff generates is quite certain to cause network and end consumer price issues, which are extremely difficult to correct – thus one should better strive to avoid the entire situation.

Of course, there is a solution. First of all, the monitoring of technological development is essential. Second, it should be clear to policymakers that this technology carries the risk of severe regulatory failure, the extent of which they should therefore try to keep within limits. A possible means might be a bit of quantity-based regulation, as it is the case with the wind energy quotas in Hungary: even though there is a set KÁT tariff, only a certain total amount of quotas is allocated to the actors. Another solution might be the German model, where the promotion of solar power plants is kept under control by decreasing the PV feed-in tariff as the amount of installed PV capacity increases. The tariff is reduced gradually, in a stepwise manner, with the next step always being „triggered” by a certain level of total installed PV capacity. The Spanish solution, on the other hand, was to introduce annual/semi-annual limits on the solar PV capacities to be installed and eligible for guaranteed feed-in tariffs.

An appropriate way of avoiding regulatory failure might be, therefore, to make the individual schemes see and extend a bit beyond their own mechanisms of operation, and integrate into themselves an element or two from the other (price/quantity-based) incentive system. This way, they may be able to complement and assist each other in avoiding regulatory failure.

My analysis explored the causes of regulatory failure and offered possible solutions, as well – on a theoretical level. In practice, the situation is far more complicated, of course. Each renewable technology has its own unique marginal cost curve. The marginal cost curves of wind power, solar power, biomass, geothermal energy, etc. all have different shapes and slopes. We might add them all up to arrive at an aggregate marginal cost curve, which encompasses all the renewable technologies. What is more, what we have seen above can only count as a simplified representation of even one single technology, as real marginal cost curves rather tend to have a step-like shape, which reflects the endowments of the given country with respect to the technology in question. Having tapped the most favorable locations (which are the ones that have the lowest marginal costs), we have to take a step forward, towards less favorable locations (for example towards lower wind speeds, in the case of wind turbines), which is where the value of the marginal cost curve „jumps” and continues to remain very flat afterwards (Haas et al., 2011).

Accordingly, my analysis mostly pertains to those FiT and TGC systems that are differentiated by technology, because those are the ones that take into account the differing marginal cost curves of the individual technologies. Considering a non-differentiated system, different sections of the curves arrived at by aggregating the marginal cost curves of the individual technologies may be characterized by differing slopes, thus it might even happen that the recommended incentive system is different for different sections of the curve.

Thus the task of the policymaker is not an easy one, knowing that real life is far more complex than the analysis I have just presented. I am convinced, however, that the basic conclusions are actually useful: it is important that the policymaker be clear about how the slopes of technologies' marginal cost curves are related to the extent of the mistake they can make with the incentive system they have in place, and that they decide on the measures to be taken with that knowledge in mind. Generally valid is the conclusion, as well, that the other type of incentive is a valuable source of „assistance" in such cases. Under a price-based (feed-in tariff) scheme, for example, it might be worth to limit the annual amount of capacity expansion for each technology, or to make the tariff itself degressive with total installed capacity; for example, by reducing the initial tariff by 5/10/15% after each 10 MW of installed solar PV capacity.

Another good solution is the one employed by the Hungarian policymaker with respect to wind power, that projects did not automatically become eligible for the guaranteed feed-in tariff; instead, projects in a certain stage of preparation were required to submit a tender, and it was only a part of the project development opportunities submitted within the given period that was actually granted eligibility for the guaranteed feed-in tariff. The 330 MW quota was determined on the basis of grid control and network load management considerations, back in 2006. Until mid-March of the same year, license applications were filed for a total wind power capacity of 1138 MW (Tóth, 2009). In such cases, the policymaker still has an opportunity to make their choice from among the applications based on the country's priorities.

The Hungarian regulation does not really differentiate between technologies in terms of feed-in tariffs, and thus the relative expensiveness of the PV technology has prevented investors from deploying significant solar power capacities in Hungary. However, should the METÁR prescribe a PV feed-in tariff above the current level, hypothesis H1 will at once become relevant to the Hungarian regulation, as well. Recognizing, developing an awareness of and avoiding the possibility of regulatory failure will be of key importance during the phase when the PV capacities laid down in the NMCST are being deployed – that is: in the years directly ahead.

Another related consideration worth calling attention to is that a correct tariff can only be correct for a certain period of time. Regular updates to the tariffs – that is, decreasing the tariff in line with technological developments – are particularly important with respect to rapidly developing solar PV technologies. Because a „sticky" tariff that remains unchanged for several years, even though changes in the technology would already allow for a 10-20% price reduction, is also a potential case of regulatory failure.

Accordingly, in order to avoid regulatory failure, the policymaker does not only need to be sufficiently up-to-date once – that needs to convert into a „constant state of up-to-dateness".

6.3. Fossil Cent vs. Green Cent (Validation of Hypothesis H2)

Be it a green certificate system or a feed-in tariff scheme, the promotion of green energy production will ultimately be paid for by the end consumers of electric energy through the fees included in their electricity bills. Accordingly, the extent of the burden put on end consumers needs to be taken into account, no matter which type of incentive is used. This issue might be of particular relevance in times when renewables are growing at an increased pace and when the financial situation of consumers, in general, tends to deteriorate.

As far as the share of renewable energies is concerned, Hungary is in the last quarter of the EU-wide ranking; accordingly, the one of the lowest targets set by the 2009 directive was the one meant for Hungary. In order to meet NMCST 2020 targets, we will need three times the green electric energy production capacity that we have now, which represents quite a significant increase in comparison to today’s figures, and the total amount spent on the respective incentives will need to be increased by a similar factor, as well.

In my analysis below, I will quantify the green subsidies provided through the electricity bill and compare their amount to the subsidies going to – via the electricity bill, as well – fossil production modes.

6.3.1. Line Items on the Electricity Bill

Electric energy, as a product, has some special characteristics, as it cannot be stored. Consequently, balancing the production side with the consumption side is an important task, which, in Hungary, is done by MAVIR Zrt.[50] The transmission of electric energy is a rather unique and costly activity, which the transmission operator and the network license holders are required to perform. For any given area, there is only one network license holder – but there are six in the country altogether –, which

[50] Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zártkörűen Működő Részvénytársaság

operates the electricity distribution network, that is, consumers can only draw electricity from the grid of the territorially competent company.

A categorization of the line items on our electricity bills practical for discussion purposes is as follows (Gáspár – Závecz, 2011):

1. **Product price:** this is the price we pay for the amount of electric energy we draw from the system. Is a single line on the bill (volume charges / electric energy retail), given as the product of the amount charged, i.e. consumed (kWh) and the unit price (Ft/kWh). Thus this is the one and only row that contains the compensation for the product itself, for the consumption – all the other items are just „bonuses". The price already includes the guaranteed purchase (KÁT) charge, used for the promotion of renewable energies; electricity retailers collect it from the consumers and then transfer the resulting amount to MAVIR Zrt. Electricity retailers rely on the MAVIR's forecasts, legislation and their own estimates in determining the amount to be received from the expected KÁT, and its price. The allocation of the expected green power production for the given month – which is the sum total of the schedules submitted by the renewable producers – to the balance groups is performed by MAVIR, based on their expected monthly consumer needs (universal service plus free market plus residential plus corporate sales). The green energy so purchased is used by the balance group representatives to supply their consumers, and they collect the amount of the KÁT subsidy they have to pay from the consumers through the price of electricity. An important note is that it is only the part of green power plants' guaranteed purchase price in excess of the normal market price of electricity that we have to treat as a subsidy, it is this part that puts an additional burden on consumers. Each year, the Hungarian Energy Office prepares their annual KÁT report, in which they publish the amount of subsidy per unit of green energy. I will take the annual sum total of green KÁT subsidies and divide it by the total yearly volume of electricity consumption to arrive at the amount of green KÁT subsidy per kWh of energy consumption.

2. **Use-of-System charges:** these cover the costs of delivering the energy to the places of consumption in due time and appropriate quality. It is the operation

of the electricity grid, of the entire system that we pay for through these items. These charges are laid down in laws, are payable in proportion to the volume of electricity consumption, and their per kWh unit price is determined in Decree No. 119 of 2007 (29 December) of the Minister of Economy and Transport. The line items, each with their own name, found on the electricity bill compensate for the various phases/tasks of delivering the energy from the power plant to the consumer; accordingly, they can be divided into several elements[51]:

- **Transmission-system operation charge**: covers the costs associated with the operation of the high-voltage transmission system, the physical losses of the network and the control of the nationwide power network.

- **Charge for ancillary services**: the costs of services necessary for the safe operation of the electricity network, uniformly provided to all users (including residential consumers).

- **Distribution energy charge**: covers the costs associated with the operation and the upkeep of the distribution network and with the services aimed at ensuring uninterrupted supply.

- **Distribution loss charge**: during the transmission of electric power, according to the laws of physics, one has to incur certain losses, which is why power plants have to produce more energy than what is actually consumed and paid for by the consumers. The resulting difference is the total amount of network losses, which all consumers have to pay for, in proportion to the amount of energy they consume.

- **Distribution time schedule balancing fee**: in case of a weather-induced change in consumption or any other deviation from the schedule, the transmission system operator restores the balance between consumption and generation – the costs of which are covered by this fee.

[51] Source of explanation: http://www.eon-energiaszolgaltato.com/index_eiroda.php?menu=211020401

- **Distribution basic charge**: different groups of end users pay differing so-called basic charges, irrespective of their actual energy consumption; this charge, therefore, needs to be distinguished from per-unit charges, and must be shown on the bill in a separate line, as well.

- **Distribution capacity charge**: must be paid for each connection point at the place of consumption, based on the contracted capacity of each connection point.

The amount of these Use-of-System charges is determined by the Hungarian Energy Office on a yearly basis, based on date from the network license holders. The concrete amounts of these charges also depend on the voltage at which the given consumer is supplied. The lower the voltage, the larger the amount of transformation costs incurred and thus the higher the use-of-system charge. The vast majority of residential consumers are supplied at low voltage, which is the most expensive one.

3. **Other, tax-like items:** within which we need to distinguish between the energy tax and liquid assets.

   - The **energy tax** was introduced and is regulated by Act No. LXXXVI of 2003. Its purpose is to incorporate external environmental damages into energy prices and to promote energy savings. Currently, its value is 0.295 Ft/kWh. No energy tax is payable on residential consumption (Act No. LXXXVIII. of 2003, 3.§/b).

   - The other group comprises the **liquid assets** as set forth in Act No. LXXXVI of 2007 on electric energy, which are intended to serve certain dedicated purposes as a form of social solidarity; their value is determined annually, in the budget act. Currently, there are three such items:

     a) **coal industry restructuring subsidy („coal cent"):** proceeds from this item support the operation of Vértesi Erőmű Zrt (approx. Vértes Power Plant Co.). Its purpose is to cover, out of social and employment considerations, those costs of coal mining that are not covered by the income from selling the electricity they generate. This subsidy, (theoretically) degressive with time, is meant to allow for the not-so-competitive coal-based electricity generation to gradually prepare for competing in the marketplace. Currently it amounts to 0.19 Ft/kWh.

b) **subsidy for preferential rates:** covers the discount from the original price of electricity granted to the employees and pensioners of the electric energy industry. The exact conditions of eligibility are laid down in Decree No. 116 of 2007 of the Minister of Economy and Transport; its current value is 0.07 Ft/kWh.

c) **restructuring fees of cogeneration products:** this „new" item, introduced on 1 July 2011, covers the price subsidization of district heat supply. Its introduction became a necessity because as of July 2011, cogeneration power plants (generating electric and heat energy at the same time, hence highly efficient, running on natural gas) got excluded from the KÁT system, which had allowed them to sell their electricity production at a tariff above the market price. This change forced the majority of such power plants to increase their heat price, which this new fee – given to district heat plants as a heat subsidy – is meant to mitigate. Out of the three, this item is the most significant, its current value being 1.2 Ft/kWh. As a matter of fact, this fee is meant to „replace" the subsidy that was previously provided to cogeneration power plants within the framework of the KÁT. As we have already seen in the analysis of the Hungarian KÁT system, before 2011, some two-thirds of the entire KÁT budget were used to subsidize cogeneration production.

Liquid assets are exempt from it, but the 27% value added tax needs to be paid on each and every other item on the electricity bill.

Between the final electricity bills of residential vs. industrial consumers, there are two basic differences. One of them is industrial consumers' (usually) lower use-of-system charges, influenced by whether they are supplied at low/medium/high voltage; and while residential consumers are almost exclusively supplied at low voltage, industrial consumers are more often served at medium voltage.

The other difference is that residential consumption is exempt from the energy tax, the current value of which is 0.295 Ft/kWh. It is the sale of electric energy, natural gas and coal to end consumers that is taxed, except for residential consumption. The tax also needs to be paid on the amount sold of electricity from renewable energy sources, except for the amounts that the producers use themselves. Proceeds from the tax go to the central government budget, therefore it does not constitute a dedicated production subsidy that could or should be quantified in our analysis.

Universal service prices for residential consumers are public; each year, they are laid down in a law, based on the resolution by the MEH. The prices valid from 1 January 2012 are comprised of the following charges/fees, as stipulated in Resolution No. 858/2011 of the MEH and in Decree No. 83/2011 of the Minister of National Development.

The final price of 46.89 Ft/kWh payable by residential consumers for the part of their yearly consumption below 1320 kWh comprises the following items[52]:

Power prices (Ft/kWh, net):	**19.69**	**Ft/kWh**
Use-of-System charges, liquid assets:	17.54	Ft/kWh
VAT	9.66	Ft/kWh
Total:	**46.89**	**Ft/kWh**

As we can see, out of the price of 46.89 Ft/kWh[53], it is only 19.69 Ft/kWh that is the price of electric energy itself, as a product. Next, I will divide the second row into two parts, by separating the value of (quantifiable) liquid assets (0.19 Ft/kWh for the coal cent, 0.07 Ft/kWh for the preferential rates, 1.2 Ft/kWh for cogeneration, i.e. 1.46 Ft/kWh in total), such that use-of-system charges are now in a separate row.

[52] The source of the data is the universal service price list published by E.ON, available at http://www.eon-energiaszolgaltato.com/index_eiroda.php?menu=2110201. There may be slight differences in the tariffs of the different network license holders.

[53] For the part of their annual consumption in excess of 1320 kWh, they need to pay a somewhat higher price (50,13 Ft/kWh). Thus the average price can be calculated as the average of these prices weighted by the respective consumption amounts. For the sake of simplicity, I will now use the lowest price level, which the vast majority of consumers belong to anyway.

Power prices (Ft/kWh, net):	**19.69**	**Ft/kWh**
Use-of-System charges:	16.08	Ft/kWh
Liquid assets:	1.46	Ft/kWh
VAT	9.66	Ft/kWh
Total:	**46.89**	**Ft/kWh**

The individual elements represent the following shares in the price of electricity:

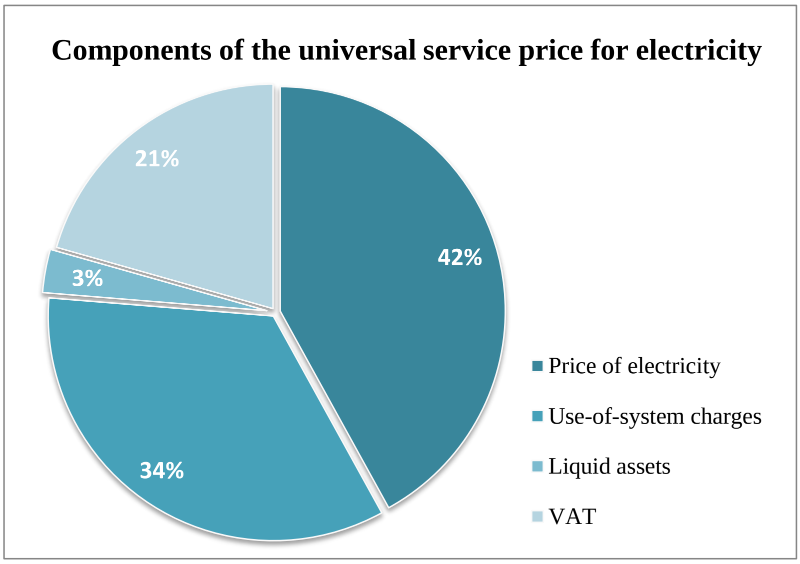


Figure 30: Components of the residential price of electricity in Hungary

Source: author's own illustration based on Universal Service Tariffs

Accordingly, electricity itself only accounts for some 42% of the universal service price paid by residential consumers. Use-of-system charges amount to a further one-third, liquid assets represent 3%, whereas the 27% VAT has a 21% share.

I will now allocate the items included in end consumers' electricity bills to the volume of energy production they are meant to subsidize, and hence calculate the absolute and the per unit amount of subsidy spent on promoting the individual generation methods. The resulting amounts are paid by residential and industrial consumers likewise, yet they represent different shares of the total amounts billed because of the differing levels of use-of-system charges.

6.3.2. Coal Cent Subsidy

The coal industry restructuring subsidy was introduced and is regulated by Government Decree No. 278 of 2007, effective January 1, 2008. It was reduced to its current value, 0.19 Ft/kWh, on 1 January 2011; back in 2010 and 2009, it was 0.23 Ft/kWh and 0.2 Ft/kWh, respectively. The appendix of the government decree provides information on the total amount of the subsidy in 2008-2010:

Year of payment	Maximum value of payment (Ft)
2008.	8 506 800 000
2009.	7 475 799 996
2010.	6 960 300 000
Total payments 2008-2010.	22 942 899 996

Table 11: The total value of coal cent subsidies received by Vértesi Erőmű Zrt.

Source: appendix of the Government Decree No. 278 of 2007

Government Decree No. 211 of 2011 (12 October) amends the above legislation and, in order to comply with EU legislation on state subsidies, lays down that the proceeds from the coal cent shall qualify as closure aid, the amount of which is calculated as the difference between the justified expenses of the coal mined by Vértesi Erőmű Zrt. or, more specifically, the justified expenses of the electric energy and heat energy generated from that source and the justified revenue from the sale thereof. As of 2011, the decree sets a maximum limit on the total amount of the subsidy for each year. For the two years 2011 and 2012, it is equal to the 2010 figure, i.e. 6,960,300,000 Ft, and then the cap shall be reduced to 5,220,225,000 Ft for 2013 and 2014. As of 2015, the closure aid is supposed to get terminated, or at least this is what the planned amount of 0 Ft for the years 2015-2018 implies.

The decree also includes rules on a special subsidy that is meant to cover the difference between the costs and the revenues from the closure of coal production units and hence unrelated to current energy production; which is, however, irrelevant to my analysis, as it is not a subsidy on current energy production.

I did not manage to find a source that would cite the exact sum total of the proceeds from the coal cents in 2011; its per unit of electricity (kWh) value did, however, not change during 2011, thus it can be taken to have been 0.19 Ft all year long. Each year, the MEH and MAVIR Zrt. publish a report titled „Statistical Data of the

Hungarian Power System”. The 2011 report contains data on the country’s annual net electricity consumption, which, by definition, corresponds to „gross domestic electricity consumption without the self-consumption of power plants, transmission, distribution and interconnection losses and transformer losses” (MEH, MAVIR, 2012. p. 9), that is, to the sum total of the amount sold to end consumers – which then again is the base for the coal cent. National net electricity consumption for 2011 was 36,358 GWh (MEH, MAVIR , 2012. p. 16.), thus accordingly, the sum total of the coal industry restructuring subsidy collected from consumers during 2011 amounts to 36,368 GWh * 0.19 Ft/kWh= 6,908,020,000 Ft, i.e. approximately 6.9 billion Ft. This value is rather close to the figure of 2010, as well, which is then again equal to the cap for 2011; I will hereafter use this value for 2011 in my calculations.

The annual and the sustainability reports of the MVM group include electric energy sales data from Vértesi Erőmű Zrt. It must be taken into account that the power plant also employs biomass co-combustion, therefore part of the power it generates is sold under the KÁT scheme, as renewable energy. Therefore I need to filter out this portion of their production when calculating the per unit of production value of the coal cent subsidy, for it is not covered by the coal cents, but by the feed-in tariff, as is the case with other power plants. The data are, no doubt, accurate, given that the reports already provide the following breakdown of production volume:

„Electricity generated and sold;

of which: sale of electricity subject to mandatory purchase (KÁT)”.

The difference of these two rows gives the annual volume of coal-generated electricity. The table below shows production data for the years 2008-2011:

	2008	2009	2010	2011
Electricity generated and sold, total in GWh	1 370	959	680	831
of which: sale of electricity subject to mandatory purchase, GWh	250	302	263	252
coal-generated electricity sold, GWh	1 120	657	417	579

Table 12: Electricity sales of Vértesi Erőmű Zrt.

Source: author’s compilation based on MVM, 2012. p. 37. and MVM, 2010. p. 58.

By dividing the total amount of coal cents collected and redistributed each year by the respective annual volume of coal-generated electricity, as calculated above, I will arrive at the per unit of production value of the subsidy. Given that 1 GWh = 1000 MWh = 1,000,000 kWh, proceeds from the coal cent are given in million forints, therefore the result of the division million Ft/GWh will be in Ft/kWh; that is, I will arrive at the per unit of production (kWh) value of the subsidy, which the end consumers of electricity pay for each unit of fossil-generated electricity from Vértesi Erőmű Zrt.

	2008	2009	2010	2011
sum total of coal cents (million Ft)	8 507	7 476	6 960	6 908
coal-generated electricity sold, GWh	1 120	657	417	579
per unit subsidy on coal-generated electricity production Ft/kWh	**7.60**	**11.38**	**16.69**	**11.93**

Table 13: Per unit subsidy on the coal-generated electricity production of Vértesi Erőmű Zrt.

Source: author's calculation

As we can see, by dividing the annual totals of these apparently negligible – as compared to other items on the electricity bill – 0.19 Ft/kWh items by the annual volumes of subsidized production, we arrive at rather striking per unit subsidy values. The subsidy started out at 7.6 Ft/kWh in 2008, increasing gradually through 2009 and 2010, mainly as a result of the drop in the volume of subsidized production; after all, the volume of coal-generated electricity in 2009 was only 59% of that in 2008, while the total amount of subsidy only dropped to 88% of the previous year's value. The per unit subsidy took on its highest value of 16.69 Ft/kWh in 2010, once again a consequence of the volume of production having decreased more than the total amount of the subsidy. Considering 2011, the per unit value of the subsidy was, though somewhat less striking than in 2010, still rather significant at around 12 Ft/kWh.

6.3.3. Subsidy for Preferential Rates

The amount of the charge meant to cover the costs of the preferential electricity tariffs offered to the employees, pensioners and widows of the industry is prescribed in the budget act, as well, as a Ft/kWh value to be collected for each unit of electricity sold to end consumers (i.e. national net electricity consumption). Based on these inputs, the annual total of this charge, collected through the electricity bill, can be easily calculated for the years 2008 through 2011:

	2008	2009	2010	2011
national net electricity consumption, GWh	37 127	35 254	36 007	36 358
subsidy for preferential rates, Ft/kWh	0.11	0.12	0.09	0.07
annual total of subsidy, million forints	**4 084**	**4 230**	**3 241**	**2 545**

Table 14: Total amount of subsidy for preferential rates 2008-2011

Source: author's calculation based on (MEH, MAVIR, 2012, p. 16.) and the respective budget acts

The amount of subsidy dedicated to this purpose, and paid for by the end consumers of electricity, was about 4 billion forints in 2008-2009, and then, as a result of the gradual decline in its per kWh value, it sank to 3.2 and 2.5 billion forints in 2010 and 2011, respectively. These results seem to be in the right proportion to the figures I got for the coal cent (hovering about 0.2 Ft/kWh); preferential rates accounted for about one-half of the coal cent subsidy amount in 2008-2009, and only about one-third in 2011, which change can be attributed to the change in the proportion of the two per kWh values to each other.

Eligibility for the preferential rate is regulated by Decree No. 116 of 2007 (29 December) of the Minister of Economy and Transport (on electricity price discounts available to those currently or previously employed in the electric energy industry). To the employees of the electric energy industry (employee, pensioner, widow), electricity is supplied at a price far below the universal service tariff. Dependent on the amount they consumer, they receive a progressive discount between 37% and 60% (Appendix 1 of Decree No. 116 of 2007 of the Minister of Economy and Transport). According to Article 37, the discounts offered to those currently employed in the sector and to the widows are paid for by their employers, thus the subsidy collected from end consumers is used to cover the preferential rates of the unions included in the list and the pensioners.

Given that the list of employers in Appendix 2 of the decree contains 78 companies, some of which are not directly engaged in electricity production (network license holders, energy traders, unions, system operators), and that I would have to filter out the consumption of pensioners company by company, which is next to, if not, impossible, I will not be able to calculate the per unit of production value of the subsidy for this item. To top it off, the list contains renewable as well as fossil production modes, thus I would even require company-level data on their headcount distribution in order to perform the renewable/fossil allocation. But this is not possible, either, as certain companies (power plants co-firing coal with biomass) belong to both groups. As a consequence of the above, I will not be able to analyze this item beyond what I have already done: the quantification of the total amount of the subsidy.

6.3.4. Subsidy for Cogeneration Energy Production

The essence of cogeneration energy production is that such power plants produce both electricity and heat energy at the same time, and therefore its efficiency is higher than that of other electric energy production modes. In Hungary, without any precedent in the EU (Magyar Energia Hivatal, 2010), electricity from natural gas cogeneration was managed under the same incentive system as renewable energies until 1 July 2011; CHP gas engines also belonged to the KÁT balance group, and received a feed-in tariff above the market price. Each year, about two-thirds/three-fourths of the entire KÁT budget was redistributed to cogeneration plants (Magyar Energia Hivatal, 2011; Magyar Energia Hivatal, 2010). The value of the KÁT subsidy (and the cogeneration plus the renewable subsidy within) is not a separate item on the electricity bill; the supplier incorporates these expenses into the price of electric energy. We may, however, calculate the per unit of electricity consumption value of the subsidy as the quotient of the total amount collected for this purpose and net electricity consumption.

As of 1 July 2011, cogeneration power plants were excluded from the KÁT system, and have had to sell their production in the free market ever since. The loss of revenue caused by the termination of this opportunity to sell at a higher price (the KÁT price, namely) would have resulted in an increase in the price of heat generated by CHP producers, which is why the policymaker introduced a new liquid asset item: the restructuring fee of cogeneration products, an additional 1.2 Ft/kWh item on end consumers' electricity bills. Proceeds from this item are redistributed among those district heat suppliers that utilize fossil energy sources, according to the rules stipulated in Decree No. 51 of 2011 (30 September) of the Minister of National Development on district heating subsidies. This new charge supports CHP producers in an indirect way, because the proceeds from the restructuring fee of cogeneration products may only be redistributed to district heat suppliers that purchase heat energy from a CHP plant that has not yet paid off and/or to district heat suppliers that sell heat energy to residential consumers (the amount of subsidy is proportionate to the amount of heat energy so purchased / sold to residential consumers).

For each year of the KÁT era, the Hungarian Energy Office prepared a KÁT report detailing the KÁT-eligible production volume of CHP producers, in addition to the sum total and the per unit values of the subsidy. The office derived the per unit subsidy as the difference between the KÁT feed-in tariff and the market price of electricity; accordingly, the resulting value will be equivalent to the premium above the market price only (and not the entire amount of the KÁT feed-in tariff). From the 2009 and the 2011 reports, I extracted the data for 2008-2009 and 2010-2011, respectively, and summarized them in the table below:

KÁT data of cogeneration power plants	**2008**	**2009**	**2010**	**2011**
Total KÁT subsidy, million Ft	47 943	54 567	56 680	17 783
production, GWh	4 242	4 640	4 826	2 154
per unit subsidy, Ft/kWh	**11.3**	**11.76**	**11.75**	**8.26**

Table 15: KÁT data of cogeneration power plants

Source: MEH, 2010. p. 12 and MEH, 2011. pp.20-22

The table shows that the subsidization of cogeneration production cost us 48, 55 and 57 billion forints in 2008, 2009 and 2010. The per unit subsidy, during the same period, increased from 11.3 Ft/kWh to 11.75 Ft/kWh, and there was a modest increase in production volume, as well. 2011 was somewhat odd, because a part of CHP producers were excluded from KÁT as of year-end 2010, while some were granted an additional six-month period, but only with a reduced feed-in tariff, equal to 85% of its previous value. Consequently, the 2011 production volume constitutes a more than 50% drop from the previous year, and the per unit value of the subsidy also decreased because of the 15% reduction in the feed-in tariff.

Subsequently, the amendment to the VET of 6 June 2011 introduced, in order to avoid a boom in district heating prices, the restructuring fee of cogeneration products, charged to the end consumers of electric energy at a rate of 1.2 Ft/kWh. If we are to quantify the total amount of subsidy from this source, we may arrive at a good estimate by multiplying one-half of the net electricity consumption for 2011 –

that is, 36,358 GWh / 2 = 18,179 GWh (MEH, MAVIR , 2012. p. 16.) – by a factor of 1.2 Ft/kWh. Which means an additional subsidy of 21,815 million forints for CHP producers in 2011. Given that the collected amount is redistributed in the form of a subsidy on heat energy[54], according to rules set forth in a separate decree[55], I will not be able to calculate a per unit of electricity value for the subsidy for 2011. Yet I can still determine the total amount of subsidy, if I correct the 2011 value in Table 15 by adding our estimate for the semi-annual (first half 2011) total of the restructuring fee of cogeneration products, as calculated above.

Data of cogeneration power plants	2008	2009	2010	2011
Total KÁT + cogeneration restructuring subsidy, million Ft	47 943	54 567	56 680	39 598
production, GWh	4 242	4 640	4 826	n.a.
per unit subsidy, Ft/kWh	**11.3**	**11.76**	**11.75**	**n.a.**

Table 16: Corrected data for cogeneration power plants

Source: Table 15 with additions by the author

As we can see, correcting the respective value by this item yields a total subsidy amount of 39.6 billion forints for 2011. Assuming that the country's annual net electricity consumption will remain in the 35,000-37,000 GWh interval (MEH, MAVIR , 2012. p. 16.) and that the charge in question will remain in place, with its value of 1.2 Ft/kWh left unchanged, as well, then the annual amount of subsidy the sector may expect to receive is approximately in the 42-44.4 billion ft range.

6.3.5. Subsidy for Renewable Electricity Production

At last, we are now about to quantify the amount of the subsidy that goes to green energies. Just like in the case of cogeneration, data were extracted from the KÁT report of the Hungarian Energy Office, and there is no need for any kind of correction, either, for the regulation did not change during the years examined.

[54] See the Act No. CLXXXII of 2011 on amendments to certain acts on energy matters.

[55] Decree No. 50 of 2011 (30 September) of the Minister of National Development on the determination of the price of heat energy sold to district heat supply companies, and that of the district heat supply tariffs to be paid by household consumers and distinguished institutional customers.

KÁT data of renewable power plants	2008	2009	2010	2011
Total KÁT subsidy, million Ft	18 363	23 292	28 007	23 336
production, GWh	1 772	2 127	2 236	1 841
per unit subsidy, Ft/kWh	**10.36**	**10.95**	**12.06**	**12.68**

Table 17: KÁT data of renewable power plants

Source: MEH, 2010. p. 12 and MEH, 2011. pp.20-22

Both in terms of production volume and subsidy amount, renewable electric energy production only amounts to about 50-60% of cogeneration production. Production volume (2,236 GWh), as well as the amount of the subsidy (28 billion ft) reached their maximum in 2010. It is apparent at the first sight that the per unit subsidy values of green energies are lower than the respective figures of cogeneration power plants (except for 2011, where the value for cogeneration could not be determined). The production setback in 2011 was caused by a drop in biomass-based production, by the closure of certain power stations.

With respect to renewable energy production, I have already discussed that green energy production modes have a number of advantages over conventional fossil-based generation methods. It is better for the environment, facilitates sustainability and it should be preferred over, for example, gas-based generation for security of supply considerations, as well. Renewable energy production methods, however, are still in an earlier stage of their maturity/learning curve than well-established fossil-based technologies, which is why they need support in excess of the market price. Hungarian electricity bills, however, do not really seem to reflect these principles.

6.3.6. Summary and Conclusions in Regard to the Burden on End Consumers

I managed to derive per unit subsidy amounts for three subsidized production methods. Considering the coal cent, which supports the coal-based electric energy production of Vértesi Erőmű Zrt., I know the per unit of production values as well as the item that is charged to the end consumers of electricity in proportion to their consumption in kWh. I do also have the total and the per unit of production subsidy values for cogeneration production and renewable energy production, yet I still have to calculate their per unit of electricity consumption values, which I will then compare to the amount of the coal cent. That is, I will determine the amount that we would have to pay – through the electricity bill, as a sort of liquid asset, for each unit (kWh) of consumption – if we wanted to „offset" the KÁT tariff. The table below provides a summary of what has been done so far:

Total annual amount of subsidy, million Ft	2008	2009	2010	2011
coal cent - Vértesi Erőmű Zrt.	8 507	7 476	6 960	6 908
cogeneration power plants	47 943	54 567	56 680	39 598
renewable power stations	18 363	23 292	28 007	23 336
Sum total	**74 813**	**85 335**	**91 647**	**69 842**

Subsidized electricity production, GWh	2008	2009	2010	2011
coal - Vértesi Erőmű Zrt.	1 120	657	417	579
cogeneration power plants	4 242	4 640	4 826	n.a.
renewable power stations	1 772	2 127	2 236	1 841
Sum total	**7 134**	**7 423**	**7 479**	**2 420**

Table 18: Total subsidy and production volume by production mode

Source: summary of Tables 12, 13, 15, 16, 17

The percentage values are also worth taking a look at:

Distribution of subsidies	2008	2009	2010	2011
coal cent - Vértesi Erőmű Zrt.	11%	9%	8%	10%
cogeneration power plants	64%	64%	62%	57%
renewable power stations	25%	27%	31%	33%
Sum total	**100%**	**100%**	**100%**	**100%**

Distribution of subsidized electricity production	2008	2009	2010	2011
coal - Vértesi Erőmű Zrt.	16%	9%	6%	n.a
cogeneration power plants	59%	63%	65%	n.a
renewable power stations	25%	29%	30%	n.a
Sum total	**100%**	**100%**	**100%**	**n.a**

Table 19: Percentage distribution of the data in Table 18

Source: author's calculation based on Table 18

As we can see from Tables 18 and 19, it was cogeneration production that received the highest share – nearly two-thirds – of the subsidies, about 25-30% went to renewable electric energy production, while the remaining ca. 10% was the share of the coal-based production of Vértesi Erőmű Zrt. Because of the missing cogeneration figure, the analysis of the data from 2011 can only be limited in scope. Except for this one year, there were no significant differences between the distribution of production volume and that of subsidies – nothing more than one or two percentage points. Except for 2008, when cogeneration power plants acquired a share of subsidies 5 percentage points higher (64%) than their 59% share of production. This was counterbalanced by the coal cent, the subsidy share of which (11%) was five percentage points behind its share of production.

These data already give us a hint that there will not be too much of a difference between the individual technologies in terms of per unit of production subsidy.

Subsidy per unit of production, Ft/kWh	2008	2009	2010	2011
coal - Vértesi Erőmű Zrt.	7.60	11.38	16.69	11.93
cogeneration power plants	11.30	11.76	11.75	n.a.
renewable power stations	10.36	10.95	12.06	12.68

Table 20: Subsidy per unit of production by production mode

Source: Tables 13, 16 and 17

In 2008 and 2009 it was cogeneration production that received the highest subsidy per unit of production. The per unit of production value of the coal cent was much lower in 2008 (7.6 Ft/kWh only), which however increased significantly, nearly 50% by 2009. What is more, 2010 saw another 47% increase, to 16.69 Ft/kWh – the maximum value for Vértesi Erőmű Zrt. During 2009-2010, the production mode subsidized by the coal cent received a higher per unit of production subsidy than renewable production, yet the situation changed in 2011, when renewables had an edge of 0.75 Ft/kWh. In 2008-2009 even cogeneration production received a higher subsidy per unit of production than green energies, whereas it then became somewhat lower in 2010. It is important to underline, however, that this per unit of production subsidy was multiplied by (and paid for) a production volume almost twice that of renewable energies (see Table 19).

The most telling and comprehensive way to illustrate the above would be to convert the subsidies of the individual technologies into a Ft/kWh item similar in nature to the coal cent, as if this would be the way how they should be charged to electricity end consumers. In order to do so, I will first have to divide the total amount of subsidy going to the given technology by the respective annual net electricity consumption figure – which is equal to the amount sold to end consumers, and which is the base used to allocate the coal cent, as well. I decided to call the cogeneration subsidy so distributed a „cogeneration cent", and the per unit of electricity consumption value of the subsidy of renewable energies a „green cent". In this case, it was already possible to calculate the cogeneration figure for 2011, as well, thanks to the estimate derived earlier from the KÁT and the restructuring fee for cogeneration products.

GWh	2008	2009	2010	2011
National net electricity consumption	**37 127**	**35 254**	**36 007**	**36 358**

Total annual amount of subsidy, million Ft	**2008**	**2009**	**2010**	**2011**
coal cent - Vértesi Erőmű Zrt.	8 507	7 476	6 960	6 908
cogeneration power plants	47 943	54 567	56 680	39 598
renewable power stations	18 363	23 292	28 007	23 336
Sum total	**74 813**	**85 335**	**91 647**	**69 842**

The three "cents", Ft/kWh	**2008**	**2009**	**2010**	**2011**
coal cent	0.23	0.20	0.23	0.19
"cogeneration cent"	1.29	1.55	1.57	1.09
"green cent"	0.49	0.66	0.78	0.64
Sum total	**2.01**	**2.41**	**2.58**	**1.92**

Table 21: Values of the coal cent, cogeneration cent and green cent

Source: author's calculation

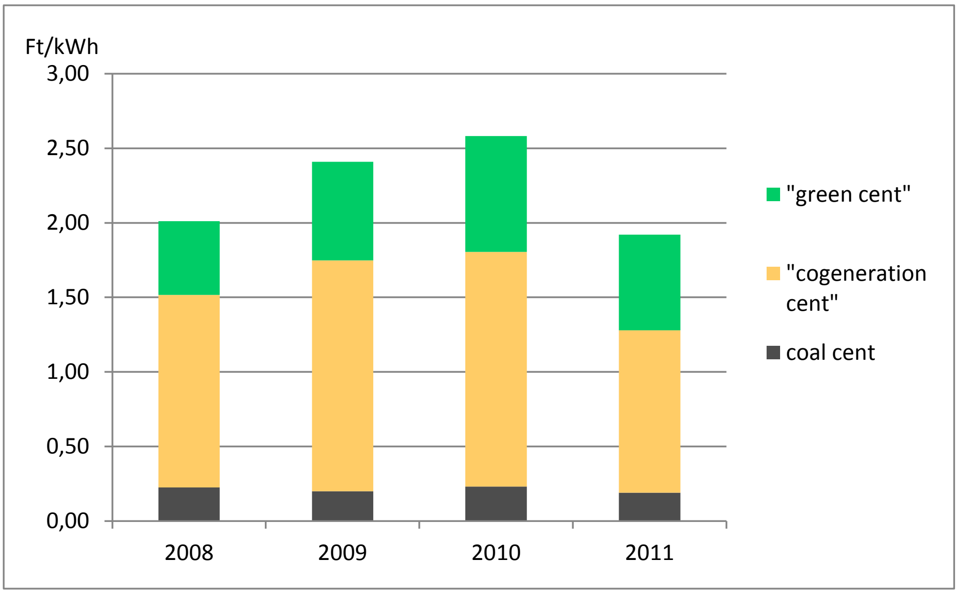


Figure 31: Values of the coal cent, cogeneration cent and green cent

Source: author's calculation

It is this approach that shows best that it was cogeneration production that we paid the most for (through our electricity bills) between 2008-2011. In each one of the years examined, apart from 2011 – when the KÁT tariff for cogeneration was reduced by the authorities and when the mechanism itself changed, as well –, the cost incurred by electricity end consumers for the subsidization of cogeneration production was more than double that incurred for green energies.

Even though the value of the coal cent remains below that of the green cent, at about one-half/one-third of that, it is still an amount worthy of attention.

A possible interpretation of these figures is that while the green cent supports renewables, the other two items support fossil energy production, thus the sum of these latter two might be considered some kind of „fossil cent". The value of the fossil cent was 3.1 times that of the green cent in 2008, and the corresponding proportions for 2009, 2010 and 2011 were 2.6, 2.3 and 2, respectively.

Thus the below statement has been confirmed with respect to both absolute figures and „centified" values:

H2: In Hungary, fossil energy production receives a higher share of the amounts collected for such purposes from end users through their electricity bills than renewable energy production does.

This „centification" also points out that if the subsidization of these privileged fossil energy production modes would be abandoned (which is going to happen to the coal cent in 2015), and if the two fossil cents would be added to the green cent instead, then the money spent on green energy production could be tripled without adjusting the relevant items (and hence the consumer price of electricity) on the electricity bill – for fossil production modes presently receive twice the amount and proportion of the subsidy going to green energies.

Another thought provoking aspect is that while no VAT is charged on the coal cent in the electricity bill (liquid assets fall outside the scope of VAT), end consumers do have to pay the now-current VAT rate of 27% on the subsidies meant to support green and cogeneration production, because these latter two are incorporated into the price of electricity. Producers receive the net subsidy amounts given by my calculations, thus my figures are correct under this aspect. But while no VAT is charged on the subsidy provided to Vértesi Erőmű Zrt., end consumers do pay the VAT charged on the other two „cents" to their respective electricity supplier, which is then forwarded to the tax office. Thus, as far as end consumers are concerned, these two out of the three „cents” need to be paid along with their VAT charges; that is: the generation modes that should theoretically be prioritized even suffer an additional tax charge, in comparison to the coal cent.

My conclusions are very likely to also hold true for 2012, given that the value of the coal cent remained unchanged at 0.19 Ft/kWh and that if the national net energy consumption does not differ too much from the previous year's level then the sum total of the collected amounts will also be approximately the same as last year (6.8 billion forints for a consumption of 36,000 GWh). The restructuring fee for cogeneration products, collected in order to support cogeneration production, has not been changed, either, but remained at 1.2 Ft/kWh, which, if multiplied by a rather average consumption level of 36,000 GWh, yields 43.2 billion forints. This will probably be even a bit higher than in 2011. No remarkable change is expected in the value of the green cent, either, given that the regulatory uncertainty discussed earlier prevented the deployment of any significant capacity this year.

Noteworthy is, as well, that out of the 46.89 Ft/kWh universal service tariff in 2011 (which has not changed since last year), it was only 0.64 Ft/kWh – that is, 1.36% – that was dedicated to green energy promotion purposes, which can hardly be considered a significant proportion/amount. In Germany, the country that has always pioneered green energies and that already boasts a renewable share of about 20%, the growth of green energies caused a 7.5% increase in the consumer price of electricity in 2008 (Frondel-Ritter-Schmidt-Vance, 2009). Out of the current end consumer price of 25.45 eurocent/kWh, the feed-in tariff charge constitutes 3.53 eurocent/kWh, the equivalent of a 13.87% share (Loreck, 2012). Accordingly, this proportion of ours amounting to about one-tenth of theirs is definitely anything but significant. ***In Hungary, as little as 1.4% of the proceeds from end consumers' electricity bills go to green power plants.***

Such „centification” of renewables' subsidies and listing them as a separate item on the electricity bill could also help make people aware of the extent to which they need to take part in the promotion of green energies. Industry actors usually estimate the KÁT charge to be around 2 Ft/kWh, which is, as we have seen, more correct than not – end consumers, at the same time, are not particularly clear about this, for they cannot see a related item on their electricity bills. And what they certainly do not know is that about two-thirds of those 2 forints are not even spent on green energies. „Centification” would, of course, require the present KÁT balance group settlement system, according to which MAVIR distributes the expected amount of KÁT production among the various balance groups, to be reformed. I am convinced, nevertheless, that such a switchover would be feasible, given that it is the Hungarian Energy Office that issues renewable power plants’ KÁT licenses and that the relatively long lead times of the projects would allow for the expected annual amount of renewable electricity production to be predicted with sufficient accuracy. Such a solution would greatly contribute to the correct information of the public, and to the confutation, once and for all, of beliefs that „electricity is expensive because of renewables”.

6.4. Findings of the Empirical Study on the Hungarian Regulatory Environment

In addition to formulating hypotheses based on theoretical foundations and calculations, I believed it was also important to formulate statements, as well as recommendations, regarding the practical operating environment of the Hungarian renewable energy industry. Furthermore, I also wished to gain an understanding of the opinion of stakeholders actively engaged in the industry. The third part of my research paper deals with these topics.

6.4.1. Methodology

I relied on structured in-depth interviews with industry experts to assess, and obtain opinions on, how the renewable electricity regulation in Hungary has played out in the preceding ten years – in other words, their assessment of the KÁT system itself, of the current state of the regulatory environment, and their key expectations vis-à-vis the METÁR system, to be introduced in the future.

I conducted interviews with twenty-five industry experts, representing various stakeholders of the Hungarian renewable energy sector: investors, banks providing financing, environmental economists as well as former and current regulators. When compiling this set of interview subjects, I strived to find experts that possess a thorough knowledge of the subject area and that had been involved with the industry for several years, possibly right from the introduction of the scheme. My areas of focus covered the assessment of the KÁT system (strengths, weaknesses, most destructive and most constructive changes), the description of the current regulatory and industry environment, the reality of meeting targets by the 2020 deadline and, to that end, formulating recommendations for METÁR.

I decided in favor of the qualitative research method for several reasons. In spite of even reconsidering the decision at the suggestion of one of my opponents at my thesis proposal defense, I ultimately decided to forgo implementing a questionnaire-based approach, which would have made a quantitative analysis possible, for the following reasons:

1. **The size of the sample does not make statistical analysis possible.** The 2011 KÁT report contains a total of 110 power plants selling into the KÁT; in several cases[56], however, the same corporate name includes several power plants, or one entity obviously covers several plants. Thus, the number of potential respondents is fewer than the number of power plants. The actual number of power plants, broken down by managing corporation and by technology, where applicable, is described in the following list (MEH, 2012a, pp. 30-42):
   - 43 wind power plants/wind farms, representing a maximum of 30 companies;
   - 16 hydro power plants, belonging to 10 companies;
   - 5 biomass power plants owned by 5 companies;
   - 31 biogas power plants owned by 29 companies; of these, approx. 20 are agricultural enterprises which received subsidies for 40-60% of their investments for the construction of biogas plants in the framework of a tender announced by the Ministry of Agriculture and Rural Development, for the modernization of animal husbandry operations, as well as in the framework of the Environmental Protection Infrastructure Operative Program. In this set, then, the motivation to build power plants, as well as the general understanding of the KÁT, is lower or is at least different when compared to other investors who are active and who are stakeholders in other technologies of the energy sector.
   - 14 small landfill gas power plants owned by 6 companies;
   - 1 sewage gas power plant;

   Thus, the list includes a total of 110 power plants; when examined by corporate names, the sample can be narrowed down to 81 units. This does not yet include those omissions from the list where it was impossible to tell based on company name whether several power plants may belong to the same group. ALTEO

[56] See Appendix 1 for a full list, broken down by type.

Energy Service Provider Nyrt. – where I serve as Director of Finance – for instance owns five power plants and four companies appearing on the list; these are all under the same management, and suggest that the company's CEO would be an ideal interview subject. There are several other investor companies which appear on the list under different project companies and company names[57], and there are also overlaps among the companies when broken down by type of technology. On the whole, then, the total number of potential subjects to be examined through questionnaires is between sixty and seventy.

In terms of questionnaires, there is significant uncertainty as far as response rates are concerned: many PhD dissertations receive only a few percent of questionnaires back[58]; even a response rate of 10% can generally be considered good. In my case this would mean fewer than ten questionnaires to analyze, which would by no means provide sufficient data for classical, i.e. mathematical-statistical analysis.

At the same time, I was also concerned that with the continuous postponement of METÁR, investors would be upset and would lose their motivation to fill out the questionnaires, yielding fewer results yet.

2. **Sample distribution among various technologies.** The relatively high share of wind power plants (43 power plants, 30 companies) may be a problem, as in their case, what is theoretically a price-based KÁT regulation is coupled with quantity restrictions, and the regulator's quota determined how many wind power plants may be constructed. In 2005, the Hungarian Energy Office determined 330 MW for the total capacity of wind power plant licenses to be distributed (Magyar Energia Hivatal, 2009b, p. 1); this capacity was reached by the end of 2011. In 2009, a new call was put out for wind power plants, with bidders competing against one another in the tariff offered. This tender was withdrawn in 2010, and no new tender has been announced since. Wind investors are, thus, in a unique position, with their opinion possibly reflecting this and differing from that of the owners of other types of power plants.

[57] E.ON Group, ELMIB Group, Ibedrola Group, etc.

[58] See, for instance, doctoral dissertations by Szilvia Luda and László Péter Lakatos.

The relatively high share of biogas plants established by agricultural enterprises may also throw off the results and preferences somewhat: a large number of these plants were built in 2010-2011 using significant project funding and with the goal of fulfilling requirements mandating the utilization of animal husbandry by-products (fertilizer). These enterprises generally are unlikely to possess comprehensive experience with the KÁT system spanning many years.

3. **Reaching the appropriate interview subject.** Several of the businesses appearing on the list are no more than project companies; many power plants under the same ownership have one operating center. It is also possible that company managers would not be the most appropriate interview subjects: ideally, it would be the business development director or CEO of the center who would fill out the questionnaire. I also found it important that I solicit the opinions of those who know the most about regulations – these individuals, however, are unlikely to fill out a questionnaire they receive in the mail, and one that is perhaps not even addressed to them personally. Personal requests for responses were the surest way of reaching the most informed interview subjects.

   It had also occurred to me that – in addition to companies appearing on the KÁT list – experience from businesses that intended to invest into the sector yet in the end decided not to realize their projects would also be of use. Some of these may have been pursuing their goals for years; their experiences could therefore serve as a lesson when exploring options on the improvement of the KÁT system.

4. **Current problems of the sector.** Hungary’s renewable energy sector has been in a rather unique situation for two years. At the end of 2010, the policymaker announced that the KÁT system would soon be terminated and would be replaced by the METÁR system, also based on guaranteed purchase agreements, but incorporating new factors. Unfortunately, this has not come to fruition in these two years. Several new dates of implementation were announced; recently, however, there has been little communication about the matter. Now, in November 2012, the official date of entry into force is still

early 2013; this, however, is no longer possible, especially since the relevant pieces of legislation have not even been adopted yet.

At the same time, industry players' confidence in the future may have been shaken by several new special taxes [59] as well as by the government's communication suggesting renewable energy is out of favor (freezing or reducing residential utility prices, supporting the Paks expansion). In such a situation, without regulations, trust becomes an even more important factor in the industry; in-depth interviews are the best tools to gauge and describe these issues.

Based on the above, I opted for the method of in-depth interviews. The approach I ultimately used was far more structured than described in my thesis proposal: that is, it contains more specific questions in several areas. I also decided to change the plan of seeking out only those investors and financiers who would become important actors as a result of the financing needs required to meet 2020 goals. In order to present a broader perspective, I have also included experts and policymakers in my list of interview subjects. Thus, statements and conclusions drawn in the theoretical part of my paper are repeated more clearly in the empirical chapter than if I had only solicited the opinions of investment-minded interview subjects. Respondents formerly and currently serving as policymakers provided what I found to be an especially valuable – and oftentimes novel – perspective on the issues.

6.4.2. Interview Subjects – Population to be Examined

When selecting subjects for the in-depth interviews, one important consideration for me was to select individuals whose familiarity with the operation of the regulatory system reaches back as far as possible. Because I myself have been working in the Hungarian energy industry, and the renewables sector, for four years, I knew several of the interview subjects personally, making it much more likely that they would agree to my request and participate in the study. Another group of interview subjects

[59] On the one hand, the revenue tax imposed on energy providers (the so-called Robin Hood tax), introduced in Act LXVII of 2008 on increasing the competitiveness of district heating services; and, on the other hand, the special sectoral tax, introduced in Act XCIV of 2010 on special sectoral taxes.

I compiled relying on the opinions of those[60] who are more intimately familiar with the industry than I am, as well as using the same resources I referred to for my theoretical research.

Interviewing a total of twenty-five individuals, I placed them in one of the following three categories, based on experience as well as former and current workplace:

– **experts, policymakers:** individuals who earlier had played a role in the establishment of the KÁT system on the policymaker side and/or who work in the field as researchers or experts;
– **investors:** this category includes individuals who have already invested in the Hungarian renewable energy market or who were or are planning to do so;
– **bankers:** bank seniors responsible for the financing of renewable energy projects.

In my in-depth interviews, I solicited the opinions of the following respondents (see Appendix 2 for more detailed information on interview subjects):

	Respondents	Employer	Position	Group
1	**Ada Ámon**	Energiaklub Climate Policy Institute	Director	experts
2	**Sándor Antal**	Dalkia Energia Zrt.	Director, Energy Services Branch	investors
3	**István Bakács**	Accenture	Director, Energy Resources Division	investors
4	**Zsolt Bertalan**	Mavir Zrt.	CEO	experts
5	**István Borbíró**	Jutasi and Partners Law Office	Attorney	investors
6	**Attila Chikán**	Alteo Energy Services Plc.	CEO	investors
7	**Ákos Csobádi**	Raiffeisen Bank Zrt.	Department Head, Project Financing and Syndication	banks
8	**Attila Erhardt**	MKB Bank Zrt.	Department Head, Project, Structural and Corporate Finance	banks
9	**József Fucskó**	Hungarian Environmental Economics Center	Economist	experts
10	**Péter Gombkötő**	KH	Department Head, Project Financing	banks
11	**Péter Gordos**	MOL Nyrt.	Director, Corporate Relations Hungary	experts
12	**Péter Grábner**	MEH	Former Vice President	experts
13	**Balázs Jávor**	Unicredit Bank Hungary Zrt.	Department Head, Structured Financing	banks
14	**Péter Kaderják**	Regional Centre for Energy Policy Research	Research Center Director	experts
15	**Csaba Kiss**	E.ON Hungária Zrt.	Director, Energy Production	investors
16	**Tamás Kovács**	Kovács Tamás Ügyvédi Iroda	Head, Lawyer's Office	investors
17	**Csaba Nagylaki**	Raiffeisen Energy Hungary	Managing Director	investors
18	**István Németh**	ING Bank	Department Head, Structured Financing	banks
19	**Zoltán Pápai**	Infrapont Kft.	Managing Director	experts
20	**Éva Révész**	OTP Bank Nyrt.	Department Head, Energy and Infrastructural Projects; Project Financing and Acquisition Directorate	banks
21	**István Szabó**	IPS Power System Kft.	Managing Director	investors
22	**Zoltán Trombitás**	Erste Bank Hungary Zrt.	Section Head, Infrastructure and Energy Financing	banks
23	**Csaba Varga**	Saphire Sustainable Development Zrt.	Financial Director	investors
24	**László Varró**	International Energy Agency (IEA)	Director, Gas and Electric Market	experts
25	**András Vinkovits**	Budapest Power Plant	Deputy CEO, Business	experts

Table 22: In-depth interview respondents

Source: in-depth interviews

[60] I wish to express my sincere thanks at this point to Attila Chikán, Jr. and Péter Kaderják, who with their advice and contacts provided invaluable assistance in expanding my range of interview subjects to include several additional key respondents.

Of the twenty-five interview subjects, seven were bankers, nine were investors and nine were experts. Eighty percent (twenty individuals) have been working in the industry ever since the introduction of the KÁT system; the remaining 20% generally have experience in the sector spanning an average of five years. Thus, the sample includes individuals with well-founded experiences and opinions.

6.4.3. In-Depth Interview Content, Administering the Survey

I commenced the in-depth interviews in mid-September 2012, and – with one exception – completed all of them within one month. I found it important that the interviews take place as close in time to one another as possible, because I was afraid that any announcements of potential regulatory changes would affect respondents' answers. This was a real possibility as, theoretically, the roll-out of METÁR was planned for January 2013, yet no official announcement had been made by early September. Unfortunately, however (although fortuitously, at least in terms of collecting information under identical conditions), there has still been no communication on the subject to date. In other words, industry outlook did not change while the interviews were being conducted, eliminating any potential warps in respondents' answers.

Prior to commencing the in-depth interviews, I came up with a more concrete and more structured list of the questions presented in my dissertation proposal. I included significantly more closed questions and, in some cases, I also asked respondents to rank-order or score their responses, so as to make them more quantifiable during my analysis. Interviews generally lasted 1-1.5 hours. Initially, I also asked respondents to provide feedback on what I might improve, change or add. At the same time, I also included one completely open-ended question, in which each respondent was able to describe anything they believed important to mention in connection with the sector and which I might have neglected to ask. Thus, it is my hope that I was able to obtain a full understanding of each interview subject's opinion about the sector. In several of the interviews, answers I received were novel and unexpected, pointing me to new perspectives and conditions. These would have been less likely to emerge in a more traditional, questionnaire-based survey; accordingly, and in hindsight, I am glad I relied on structured in-depth interviews for this study.

Appendix 3 contains the list of the exact questions and the outline of the interview. My questions may be divided into three general categories. The first group of questions pertained to the performance of the KÁT system in the past and asked respondents to assess the system's operating mechanisms. We also touched on the system's strengths, weaknesses and results achieved during the previous ten years. Then, we moved on to questions dealing with the current state of the industry, focusing primarily on obstacles to the growth of renewable energy production, as well as how these impediments may be removed. As a third area, we explored respondents' views on the future of the industry, their expectations vis-à-vis the new regulations, steps to be taken in order to meet 2020 targets and their views on the reality of reaching the 14.65% target.

The questionnaire also included questions specific to two groups of respondents (investors and bankers); I did not include these questions when interviewing others. Not all interview subjects responded to all the questions. At the outset of each interview, we agreed that if the subject does not believe him- or herself to be competent in a particular area, or does not feel their response would be well-founded, they would not answer the question. Bankers tended to skip questions related to green potential and how to utilize it, as well as on future avenues of growth; some of the experts did not profess to have in-depth knowledge about the operative side of the licensing process. In general, it was investors who agreed to answer most of the questions.

I took notes during the interviews, and recorded most of the actual conversations. I re-read my transcripts and listened to the recordings several times when analyzing the results. I collated the answers and the results, quantifying responses when possible. In the next section, I will present what I found to be the most significant findings and conclusions.

6.4.4. Key Reasons for Increasing Green Energy Production (Validation of Hypothesis H3)

In the theoretical overview I have already mentioned that, according to the literature, increasing the share of renewable energies serves three main goals: improving the security of supply; reducing the burden on the environment; and stimulating the economy. I formulated the hypothesis below in view of data on Hungary's import dependence:

> ***H3: The primary reason why Hungary needs to increase its use of renewable energies is to enhance security of supply, while environmental protection and economic growth are less important goals.***

I was able to confirm the hypothesis based on respondents' answers in the in-depth interviews. I asked respondents to rank-order the reasons in support of green energy according to what they see as the most pressing need in Hungary that green energy should support. If respondents found two goals to be equally important, I used half-points when processing their answers, in order to differentiate between those who actually determined a specific rank-order. If a respondent placed security of supply at the top of their list, and found the other two aspects to be equally important, I used the following score: 1, 2.5 and 2.5. Twenty-three individuals answered the question. Their answers are summarized in the chart below:

	security of supply	environmental protection	economic stimulus
Average	**1.5**	**2.1**	**2.3**
Minimum	1.0	1.0	1.0
Maximum	**2.0**	3.0	3.0
Median	1.5	2.0	3.0
Mode	2.0	3.0	3.0

Table 23: Rank-order of the reasons for the utilization of renewable energies in Hungary

Source: in-depth interviews

The table shows that security of supply was placed at the top of the list, with an average score of 1.5. Because this goal did not receive a score of 3 from any respondent (the maximum was 2), and because the most frequently assigned value –

the mode – was lower than in the case of the other two goals, we may conclude that respondents found this goal to be the most important one.

Environmental considerations placed second, with an average score of 2.1. Answers included all three values; it most often was placed third on the list however. The goal of economic stimulus was not far behind, with respondents finding it least important and assigning it an average score of 2.3. In this case, it was not just the mode, but the median as well, that was 3. This, therefore, should be placed last on the list. The difference, however, between environmental considerations (second on the list) and economic stimulus is not as great as the difference between the first and second place reasons, where the difference between averages is greater. Environmental protection and economic stimulus as goals both appeared in all places in the rank order; security of supply, however, was never mentioned in third place.

Based on the above, my conclusion is to accept the hypothesis.

A significant number of respondents wished to emphasize that the current share, 6-7%, of renewables is too low to achieve a remarkable reduction in fossil fuel imports (around 80%). I encountered a similar logic when discussing environmental goals: that the degree of the shift towards renewables in Hungary is too low to be able to have any real impact on the environment. Several individuals mentioned that, in terms of meeting set goals, Hungary is doing reasonably well in the fight against global warming. It was also mentioned that because this is a global issue, with no particular impact on Hungary, it is actually better to emphasize other aspects of environmental protection when it comes to renewables.

An additional interesting conclusion for me was that over half of the respondents, thirteen individuals, placed economic stimulus and job creation goals last (featured prominently in the NMCST), and that on the whole, this ended up placing third. In terms of wind power plants and solar power plants, respondents did not see a great potential for Hungary in terms of value added, as their manufacturing capacities have already been established and they are characterized by fierce competition. Some of them saw a possible potential for the establishment of a solar module assembly plant. Some of the biomass plants (e.g. straw-fired ones) are not especially labor-intensive, either, as the collection of the raw material has been mechanized. Other uses of biomass (including forestry waste and energy plantations) may require Hungarian workforce, although those would be unskilled, seasonal workers, for the most part. Several respondents mentioned, however, the potential that biomass plants have for the countryside to retain the population: it may constitute a credible vision for farmers if they see a long-term market for their produce.

6.4.5. Ten Years of KÁT – An Evaluation (Validation of Hypotheses H4, H5 and H6)

In order to formulate proposals for the METÁR system, I found it most useful to start out with an assessment of the current situation. A review of the characteristics of the KÁT system, and an examination of its strengths and weaknesses also provides insight into how the system may be improved; these are factors to consider when establishing the METÁR system.

The current price-based support system (called KÁP at the time) was launched in 2003; 2012 was thus the tenth year of its operation. I posed several questions related to this, in an attempt to assess how satisfied participants are with the performance of the scheme to date and with the capacity that was put in place over these ten years as a result of the KÁT system. I asked interview subjects to describe their opinions as far as various energy sources are concerned. I also asked about the strengths and weaknesses of the KÁT system, which in a way may be considered a first step in terms of guidance toward METÁR.

The most comprehensive indication on the operation, mechanisms and ten-year performance of the system was a single score, between 1 and 10, from each respondent. The lower the score provided by the respondent, the less satisfied they were with the KÁT system.

Seventeen respondents answered this second question, the table below shows their scores:

	Count	Average	Minimum	Maximum	Median	Mode
Total	**17**	**5.6**	**2.0**	**8.0**	**7.0**	**7.0**
experts	7	**6.8**	3.5	8.0	7.0	7.0
investors	7	**4.2**	2.0	8.0	3.0	2.0
banks	3	**6.2**	5.0	7.5	6.0	n/a

Table 24: Evaluation of the KÁT system's performance

Source: in-depth interviews

The ten years of operation of the KÁT system and its performance may be described as satisfactory, with an average score of 5.6. Scores are distributed on a relatively broad scale, with KÁT receiving both 2s and 8s, and 7 being the most common value assigned.

I also broke down the answers by respondent group (experts, banks, investors). As can be seen, investors thought the system performed worse than the average, with 4.2 being the average score in this group (compared to 6.8 and 6.2 in the other two groups). In several cases, investors used the lowest value; in the other groups, the minimum score was 3-4 and 5. In terms of maximums, I did not encounter significant differences; maximum values were close to 8 in all cases.

Investors' responses may have been greatly influenced by the regulatory uncertainty of the past two years. For many, this was the reason they mentioned for the low score they assigned, adding that given the country's potential, significantly more green power plants could have been constructed in ten years. This hypothesis led to the next set of questions, assessing how Hungary has done in terms of making the most of its potential in renewable resources, broken down by type of energy source. I asked specific questions pertaining to the utilization of wind energy, biomass and solar energy:

	Total	wind	biomass	solar
Average	**4.1**	**5.3**	**4.9**	**2.4**
Minimum	**2.0**	3.0	2.0	1.0
Maximum	**6.5**	10.0	8.0	10.0
Median	**4.0**	5.0	5.0	1.0
Mode	**3.0**	3.0	5.0	1.0

Table 25: Utilization of Hungary's renewable energy potential

Source: in-depth interviews

On the whole, respondents thought Hungary did a satisfactory job making use of its renewable energy potential, with an average score of 4.1. The scores were not distributed especially broadly, with all sixteen respondents assigning values between 2 and 6. It is worth emphasizing that no-one gave a score higher than 6.5; i.e. no interview subject thought the country managed to use over 70% of its potential. The most frequently assigned score was 3.

In terms of wind power plants, respondents may be divided into two broad categories. The first group accepted that the electricity network and its flexibility places a limit on the construction of wind power plants; the system operator set this value at 330 MW in 2005. Because nearly all of this capacity has been built already (the figure provided in the 2011 KÁT report is 328 MW in wind power plants in operation), this received a high score. Another group of respondents, however, refused to accept the fact the electric grid will only take 330 MW in wind power plant capacity, considering the wind power tender announced in 2009 (and withdrawn in 2010) as further evidence of this. Due to the withdrawal of the tender and the fact that no other wind quotas were announced in the past six years, this group gave lower scores. The range of scores was wider, too, as there were both 3s and 10s behind the average of 5.3.

Respondents also gave intermediate scores for the **utilization of biomass potential**: the average score of 4.9 is close to both the mode and the median, with both values being 5. A score of 5 was also the most commonly given score. No respondent gave a score higher than 8, because interview subjects were critical about the fact that the majority of biomass utilizing capacities constructed are multi-fuel plants created through the transformation of old coal-fired plants; these old and outdated units have a rate of efficiency typically around 20%, which is rather low. The overwhelming majority of interview subjects saw the reason for this in the fact that the construction of small-capacity, new and modern biomass power plants would only have been possible with a higher feed-in tariff than what was stipulated in KÁT. One of the interview subjects also emphasized that a modern power plant would be able to produce twice as much energy from the same amount of biomass.

It was also interesting for me to see that the majority of the respondents who either failed in their intention to construct a biomass power plant or operate or finance one, went out of their way to emphasize that this type of power plant is especially vulnerable to fuel supply. In terms of supplying fuel for these plants, many have had bad experiences in their cooperation with agricultural producers. In several cases, fuel was not supplied despite having long-term contracts in place, because producers were simply unwilling to abide by the contract because they were seeking either a higher price or greater agricultural subsidies. The statement below was typical especially of banker respondents:

"*The greatest risk with biomass is that neither energy nor agriculture are part of the business culture: contracts are not adhered to, and the sector is generally characterized by unpredictable behavior*."

As a result, the most time-consuming and most important task when preparing biomass projects was securing supply by seeking out dependable partners. Hungary is far from using its full potential in terms of biomass utilization. "Hungary's biomass reserves are somewhere between 350 and 360 million tons, of which 105-110 tons are primary – plant-based – biomass, replenished annually (and which could be utilized); yet the energy sector only uses some three percent of this amount."[61]

In terms of **solar energy,** Hungary does not yet have significant capacity to speak of: the 2011 KÁT report does not include any solar power plants in operation. At the same time, the NMCST has set a goal for the construction of 63 MW of capacity by 2020. The overwhelming majority of respondents therefore assigned the score of 1 to Hungary's solar performance, and indicated low feed-in tariffs as the reason for this situation. Some respondents estimated that for the construction of solar power plants to take off, the current feed-in tariff would need to be 45-60 HUF/kWh, as opposed to the 31 HUF/kWh currently in place. Rapid and significant reductions in price are to be expected, however, in this technology, as the technology is presently still in a rather active and intensive stage of its learning curve. One of my interview subjects also shared with me that they are already receiving offers from manufacturers promising a guaranteed discount of 12%, compared to the current price, if they wait until March to place their order for solar modules.

In the case of solar panels, it was precisely this rapid technological development and the resulting price drops that led several respondents to assign a rather high score for Hungary not yet having implemented the technology – after all, that could only have happened at a much higher cost.

> *"A-plus for not having jumped on the 'PV bandwagon', but waiting for the cost of the technology to drop."*
>
> *"As a result of these somewhat undifferentiated tariffs we were able to avoid the 'bubbles' that other countries, primarily the Czechs, encountered."*

[61] http://www.alternativenergia.hu/a-biomassza-lehet-a-megoldas/54016

As a result, this couple of near-10 scores raised the average, which ultimately came to 2.4.

Based on the responses of interview subjects, I may draw the following conclusion:

H4: It was only wind power stations and large-scale, mainly multi-fuel biomass power plants where the insufficiently differentiated system of feed-in tariffs currently in place managed to achieve the installation of substantial capacities. For the time being, tariffs are too low for establishing smaller, new biomass power plants and solar power stations.

I included a question dedicated to the strengths and weaknesses of the KÁT system utilized to date. Let us first examine responses to the question exploring the strengths of the KÁT system:

		No. of mentions	Percent of all responses
S	became more differentiated	2	8%
T	good mechanism	7	29%
R	that it exists	5	21%
E	**ensured predictability**	**13**	54%
N	good prices	2	8%
G	has achieved good results	2	8%
T	no retroactive regulations yet	1	4%
H	prevented bubbles	2	8%

Table 26: Strengths of the KÁT system

Source: in-depth interviews

Of the twenty-four respondents, thirteen mentioned among the strengths of the system that it creates a predictable environment and predictable conditions for Hungarian renewable energy investment. Several mentioned that one of the major strengths of FIT systems is predictability, which was especially necessary initially, when the first projects were being launched in this industry. Seven responded that its strength lies in the right mechanism, i.e. that a price-based motivator was selected. Because we were discussing the “first” ten years of the operation of the system, five individuals emphasized that Hungary having a system encouraging renewables is a strength in itself. When analyzing the answers and listening to interview recordings, it occurred to me that these three responses actually stem from the same notion: that it is beneficial that a price-based feed-in tariff system supporting electric energy production is in place and operating in Hungary. If I look at these three categories of responses as a whole, and correct the results for any responses mentioning more than one of the three options (counting each individual only once), then I end up with twenty-one (of the twenty-four) subjects mentioning this as a strength. Thus, instead of the narrower interpretation of thirteen individuals and 54%, the result becomes 87.5%.

Another set of responses had to do with the prices employed. The reason for citing "good prices" was, in part, that the KÁT price allowed for a fair return on investment in the case of wind power plants (this may also be the reason why the total capacity investors wished to deploy was five times the 330 MW quota that was actually distributed), as well as the fact that it helped the entire industry take off. Two mentioned the successful prevention of "PV bubbles," i.e. that Hungary managed to avoid excessive tariffs that might have led to an excessive growth of this technology.

Respondents also spoke highly of results achieved as far as Hungary's success is concerned in meeting EU requirements at a relatively low cost and without implementing price hikes for consumers. One respondent also mentioned that, so far at least, green energy has not been affected by retroactive legislation, unlike some other industries (including the energy industry, as well, by way of special taxes).

According to the subjects of the in-depth interviews:

H5:	***The greatest strength of the Hungarian KÁT system is that it created a predictable environment for green power stations.***

I received the following answers in connection with the weaknesses of the Hungarian KÁT system:

		No. of mentions	Percent of all responses
WEAKNESSES	**suspense about METÁR**	**8**	**33%**
	not differentiated enough	**11**	**46%**
	did not reach sufficient capacity	5	21%
	opportunity for profit hunting	2	8%
	underwent many changes	4	17%
	influenced by political priorities	5	21%
	mixed up with cogeneration	4	17%
	not the greenest results	2	8%
	how the agreement's term is determined	2	8%

Table 27: Weaknesses of the KÁT system
Source: in-depth interviews

Most votes went to the notion that prices are not sufficiently differentiated. Interview subjects believed this was connected primarily to a lack of new, smaller capacity biomass and solar power plants. Several emphasized that, given the differences in their maturity, it is impossible to motivate the construction of solar power stations with the same tariff as wind turbines.

Although the question pertained to the KÁT system, one could not ignore the fact that the announcement, in late 2010, that the METÁR system would soon be implemented undermined almost completely the functioning of the KÁT system. Because it was not known when the new system would be introduced, and how that might affect projects in the licensing phase of their launch, project development has essentially come to a standstill. Thus, in the last two years, the KÁT system both was and was not in operation. From this perspective, interview subjects found it particularly disadvantageous that the date of implementation of the new system kept getting postponed. Some interview subjects suggested that if it had already been known in 2010 that no new regulations would enter into force prior to 2013, they would have implemented power plant investments under the conditions of the KÁT system, as two years would have been sufficient to see the project to completion. Because, however, they believed at several points in time that the KÁT system only has six more months of operation, they did not launch any new projects, fearing these would have been caught by changing regulations precisely in their preparatory phases. One interview subject suggested, however, that if they had known in 2010 that no new regulations would be introduced prior to 2013, their business would already have shut down.

The notion that the KÁT system, in the ten years of its existence, did not lead to a sufficient expansion of capacities, received 21%; this is related to the satisfactory score seen in the case of the question related to utilization of potential. A similar number of responses mentioned the impact of politics as a weakness.

Additionally, a comparable percentage (17%) mentioned that the KÁT system (or, rather, the regulations governing it) changed several times, both as far as feed-in tariffs as well as (or primarily) conditions are concerned; they added that mixing the system with cogeneration production was also unfortunate. Of the member states of the European Union, Hungary was the only country where cogeneration and renewable energy production received subsidies under the same scheme. It was primarily banking representatives who emphasized the difficulty this causes for them. According to banking representatives, retroactive lawmaking in early 2011, as well as the changes and ideas implemented almost daily in the conclusion of subsidies for cogeneration, have shaken their confidence in the KÁT system and in the belief that new regulations would only affect newly built power plants. It is difficult to make these – oftentimes foreign – decision makers understand that what has already happened in the KÁT system (albeit "only" as far as cogeneration production is concerned) will not happen to green power plants, the operation of which is encouraged by the very same system.

H6:	***The greatest weakness of the KÁT is its insufficiently differentiated tariff system, while the second greatest weakness is the regulatory uncertainty caused by the government announcing but never actually providing any useful detail about the METÁR system.***

Following this examination of the past of the KÁT system, let us move to the questions and hypotheses related to the current situation. To do so, I will also rely on the hypotheses laid out in connection with the KÁT system.

6.4.6. Preconditions for the Stability of the New METÁR System (Validation of Hypothesis H7)

A regulatory system is only able to fulfill its goal if it is sufficiently stable and if stakeholders have trust in its predictability. A review of the literature and an overview of industry regulations currently in force have led me to the following hypothesis:

H7:	***At the moment, the most significant obstacle to the promotion of renewable electricity production in Hungary is regulatory uncertainty.***

In my research I found it important to map out the barriers that currently hinder the spread of renewable energy power plants. Several studies (e.g. IEA, 2011) have described the important impacts such obstacles may have, including potential effects on support systems that would otherwise be viable. I therefore believe that the policymaker must understand the barriers perceived by market players: these must be eliminated if the goal is to achieve significant progress and investment levels in the field of green energy.

When finalizing my dissertation proposal in February 2012, there was still hope that the METÁR system – in keeping with government communication – would go live in early 2013. Therefore, in early 2012, when formulating my draft hypotheses, I believed a complicated and cumbersome licensing process would prove to be the greatest obstacle. By now, when finalizing my dissertation in November, it has become clear that the deadline set for next year is no longer tenable, and that the increasing regulatory uncertainty has also shifted the focus away from the problems related to licensing procedures. Primarily because few green projects have received licenses in the last two years, the question I had thought would be most significant has ended up pushed to the background.

In the last nine months, the silence surrounding the METÁR system, and the statements advocating nuclear power have further quashed any faith the industry may have had in the future. The state has expressed its commitment to keeping prices for end consumers unchanged, or maybe even lowering them, which is a particularly sensitive area against the backdrop of the global economic crisis, and which may also constitute a barrier to the spread of green energy. Furthermore, also as a result of the crisis, final electricity consumption may also decrease, that is, an unchanged amount of renewable capacity may appear to represent a greater share. Renewable energy is also not at the top of the EU's list of problems: emphasis and attention is much more directed at fiscal and basic macroeconomic processes. Against this backdrop, it is no longer certain that increasing the share of renewables is a key priority for the leaders of the country.

When beginning the in-depth interviews, I already believed – having seen the increasing uncertainty of the regulatory environment during the last six months – that shortcomings of the licensing process would not be mentioned as the single greatest impediment to the proliferation of renewables. Twenty-three respondents answered the relevant question during the in-depth interviews. When processing their answers listing the various barriers, I first collated the number of times a particular obstacle was mentioned. I also prepared a list showing the placement of the various obstacles in respondents' answers, supposing that they would mention them in the order of importance as they saw it. The summary table below, then, shows not just how many mentioned a specific obstacle, but also where each obstacle was placed in their lists.

	No.	Average rank	Minimum	Maximum	Median	Mode
uncertainty or lack of regulation	**21**	**1.2**	1.0	2.0	1.0	1.0
macro environment/risk premia/financing	**11**	**2.7**	1.0	5.0	3.0	3.0
licensing	4	2.5	2.0	3.0	2.5	2.0
lack of legal certainty	**11**	**2.5**	1.0	6.0	2.0	2.0
authority-approved prices	1	3.0	3.0	3.0	3.0	3.0
lack of differentiation/wrong pricing	3	2.0	1.0	3.0	2.5	1.0
corruption	1	3.0	3.0	3.0	3.0	3.0
increasing role of the state	1	3.0	3.0	3.0	3.0	3.0
lobbying	1	2.0	2.0	2.0	2.0	2.0
network issues	3	2.3	2.0	3.0	2.5	2.0
fear of price increases	4	2.8	2.0	3.0	3.0	3.0
lack of commitment	4	1.0	1.0	1.0	1.0	1.0
negative publicity	1	3.0	3.0	3.0	3.0	3.0

Table 28: Barriers to the growth of renewable energies in Hungary

Source: in-depth interviews

Based on the results – and hardly surprisingly – the uncertainty or the lack of regulation emerged as the single most important obstacle to increasing the share of green energy production. Investors described how it takes a minimum of one year (but more likely two years) to move from initiating the licensing process to opening a green power plant. As a result, since initial communication on METÁR began, they did not launch any new projects, because there was a chance that the regulations would change while they were still in the preparatory phase. There was a real possibility that under new regulations and changing subsidies, their project could fall under a different category, leading to different feed-in tariffs. As a result, the parameters would need to be modified, and the process would need to be started over almost from scratch. Because market players always assumed that they were but six months away from the launch of the METÁR system, they never initiated new investments. Communication, then, by the policymaker announcing a delay of six months every six months, was more harmful than if they had announced in late 2010 that the METÁR system would eventually be implemented, but certainly not before 2013.

The uncertainty of the regulatory environment, in a sense, took the edge off the KÁT system: although it continues to exist in theory, it is no longer able to fulfill its role as a promotion scheme. When interviewing bank representatives, I asked them specifically whether they would decide today in favor of financing a renewables project that has all of its licenses, proof of KÁT-eligibility and an Energy Office permit. Of the seven respondents, five (!) answered with a definite no; as long as regulations are not in order, they would refuse to finance any project under the KÁT. Two respondents said they would examine the loan application, but added that they would only take on a project if it were truly convincing.

As shown, twenty-one respondents (91%) out of twenty-three mentioned this obstacle, all of them placing it in first or second place. Sixteen of the twenty-three placed it first; five placed it second.

The second greatest obstacle is the lack or insufficient degree of legal certainty, with eleven votes and a rank of 2.5. In connection with this, respondents mentioned the possibility of retroactive legislation, which could shake the foundations of trust in the sector. In the case of several industries – and with the termination of the cogeneration tariff in the KÁT system – it was seen that legislators introduced radical changes to a law passed just a few weeks earlier, significantly altering operating conditions. The majority of the investors and banks were also affected by the cogeneration issue. Because this method of production is also financed under the KÁT, interview subjects were concerned that even if a new METÁR system is announced for renewables, it is uncertain just how long it will last and whether it will be changed within a matter of months.

The palpable lack of legal certainty is rather important and is worthy of attention: it indicates that the performance of green energy in Hungary during the next eight years is not just a matter of how METÁR will turn out professionally, but also of how much confidence market players will have that regulations will not change in the long run.

> *"No business in their right mind would be willing to invest more than a single forint in this sector right now."*

> *"You have to do more than just write the new regulations: you have to believe that they will remain unchanged; this latter will be more difficult."*

> *"When making financing and loan decisions, there is an important step before you go on to analyze the specifics of the regulations: you have to examine your trust in the state and in the notion that the regulations will remain in force and will continue to work in the long run."*

Investors representing foreign-owned companies, with a presence outside Hungary, stated that Hungary is not currently on the map of renewable investments when they are looking to optimize their investments in the region. As a result of a combination of regulatory uncertainty and the lack legal certainty, they have temporarily suspended their projects in Hungary, and are instead active in other countries where the environment is more favorable and predictable.

Eleven respondents also mentioned the macroeconomic situation resulting from the economic crisis and Hungary's approach to crisis management and the consequences of increased risk premiums, which have above all made project financing more cumbersome and expensive. The costs of bank resources have also increased and investors' own share of projects is higher: there is stronger selection in place from the project idea to the realization. This point of view is not specific to the renewables sector: it is typical for almost the entire economy, but it also makes the financing of green projects more expensive, which is something feed-in tariffs should also reflect.

Four respondents mentioned licensing difficulties and the complicated and lengthy nature of the process. This question would likely have received more emphasis if the regulatory environment were more transparent, calm and characterized by a number of new investments. Today, however, there are more important concerns than this. Additionally, I posed several questions relating specifically to licensing; these also did not justify a particularly negative perception. On a scale of 1 to 10, respondents gave an average score of 5, indicating that the process currently in place is satisfactory; yet the values assigned differed widely (between 1 and 8), indicating different positions. Based on the above, I concluded that the complicated nature of the licensing process is not currently the greatest barrier to the growth of renewable energy production.

In terms of what was shared about the licensing process, it is worth noting that the greatest problems stem from the significant regional differences. Several individuals mentioned that offices in different regions operate with different deadlines, protocols and even fees. Learning about new technologies and establishing a new licensing practice is always difficult. This was the case when the first wind quotas were distributed, when the authorities had neither sufficient experience nor protocols in place for these power plants. It took some wind farms four years to obtain their environmental license. To summarize the opinions described: licensing is cumbersome and lengthy, which does not make investing any easier; but it is a manageable process. It is a fact, however, that it slows down the project and makes it more expensive. Increasing the transparency of the licensing process would be a solution, as would the nationwide standardization and the publication of protocols, and training relevant officials or providing them with nationwide opportunities to share their experiences.

Similarly, the lack of commitment was mentioned in four instances as an obstacle. What respondents meant by this is that politics appears to show that anything enjoying the backing of the government can be accomplished in a matter of days, even if legislative action is required (e.g. shutting down gambling operations). Thus, the fact that METÁR has not been implemented in the last two years is a result of the lack of commitment on the part of the government. Because there are more serious problems on the level of the EU, and because people's tolerance for additional burdens has decreased as a result of the crisis, the government is placing less emphasis on a desire to see the share of green energy increased. The four votes cast for the "fear of raising end consumer prices" may also be somewhat related.

The insufficient differentiation of feed-in tariffs received three votes. As we have seen, this consideration was much more important in respondents' assessment of the KÁT system. At the same time, if investment projects are cancelled as a result of difficulties and uncertainty regarding the regulations, we cannot even begin to examine the prices.

It is also worthwhile to examine the percentage of respondents who cited the most commonly mentioned responses:

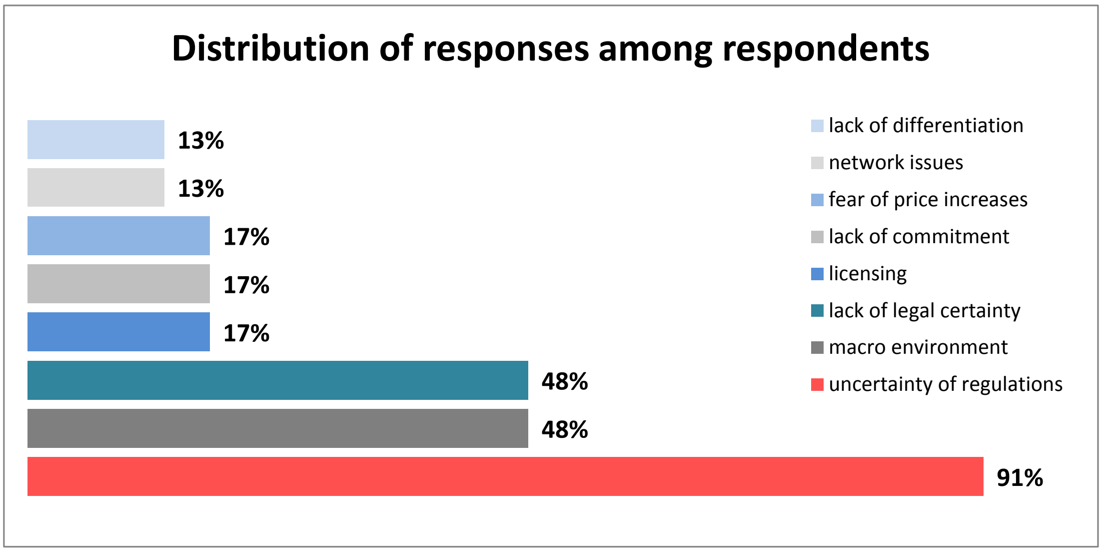


Figure 32: Barriers by the proportion of responses mentioning them

Source: in-depth interviews

Based on the results of the in-depth interviews, and the hypotheses formulated in connection with the KÁT system, I consider hypothesis H7 validated.

In addition to accepting the hypothesis related to the greatest barrier, the following conclusion may also be drawn:

> ***The proliferation of renewable power plants is hindered by two factors. On the one hand, the lack of legal certainty shakes stakeholders' confidence in the regulatory environment; on the other hand, the current macro environment makes the financing of green projects more difficult and expensive.***

If the desire of the policymaker is to reach twice the current capacity of renewables, as stipulated in the NMCST, by 2020, the factors above must be paid attention to, in addition to resolving the regulatory vacuum. Neither the question of confidence, nor the rising financing costs resulting from the macroeconomic situation are simple to resolve, and both present real challenges for Hungarian policymakers in the next eight years.

6.4.7. Requirements of the METÁR System

Based on the examination of the strengths and weaknesses of the KÁT system, as well as on the assessment of the barriers to the proliferation of renewable energy production, one may obtain an impression about what challenges the METÁR system would be facing. The extent to which new regulations are able to break down existing barriers and to avoid potential obstacles will be important factors as Hungary works toward reaching the renewables goals set for 2020 – and in how that is achieved.

Respondents' opinions of the challenges faced by the METÁR system are summarized in the table below:

	Votes
integrate heat production	1
"keep up" with solar technology	1
smart grid-smart metering	2
straying from target	2
not keeping 2020 targets in mind	1
introduce it, implement it finally	2
appropriately motivating	3
restore credibility and predictability	**17**
transparency	1
simplify licensing	**4**
issue of biomass raw material prices	2
introduction of new taxes/fees	1
ability to regulate the system	3
financing	2
right pricing	**11**
fear of affecting end consumer prices	**8**

Table 29: Challenges of the METÁR system

Source: in-depth interviews

Of the twenty-four respondents, the majority (seventeen) mentioned the restoration of credibility, confidence and predictability.

> *"As long as the environment for the industry is not predictable, there will be no real changes or developments."*

> *"It would be good to exclude as much of the regulatory risk from the system as possible, so that the only type of risk left is business-related. Investors know how to deal with that: they are used to it."*

"We don't need anything else – just METÁR. Or even if it's not METÁR, but is something stable and predictable: a public and transparent regulation, even if it includes restrictions or annual quotas."

During the interviews, the majority of respondents were of the opinion that the METÁR system will only be able to resolve this if it is guaranteed that the new regulation, and any future changes to it later, will only apply to newly built power plants. Any retroactive measures would only further decrease confidence in regulations, which is already at a critically low level. This is all the more true because this has been known to happen recently in the Czech Republic and Bulgaria, as a result of the excessive growth of solar power plants. Any retroactive measures would seriously and adversely affect the activities of both banks and investors, who would only consider investing in the sector if the policymaker ensured that conditions in place when making their decisions would remain unchanged and guaranteed for the long term.

Their desire to see prices determined appropriately, mentioned in second place, was also connected to this.

"This industry is full of investors who are only in it for the profit, trying to make their own fortune. This could be weeded out by ensuring that prices are not too high."

"It would be necessary to avoid a gold rush: that is just as dangerous and just as damaging as if there were nothing."

"The most important thing is that when it comes out, the prices be set correctly. In other words, the prices implemented need to allow for a return on investment in a reasonable amount of time."

In connection with the need to have appropriately determined prices, respondents also emphasized that prices that are too low or too high are not helpful, either: the former will not encourage new projects, whereas the latter might lead the sector astray from an ideal course.

In third place on the list was a fear of price effects on end consumers. The primary reason for this was that at a time of recession, both the public as well as the business sector are only able to bear lesser burdens, making them particularly vulnerable to a rise in the price of electricity. And because it is, ultimately, end consumers of electricity who subsidize green power plants, increasing the capacity of renewables automatically raises the burden on the public and on businesses. Several respondents mentioned that the government's communication appears to show a commitment to freezing utility costs at an unchanged level.

Four respondents also pointed out that the slow and cumbersome licensing process may also decrease the effectiveness of the METÁR system as well as the chances for the successful realization of a growth path; it would, therefore, be desirable to respond to, and streamline, this through the new regulations.

The chart below shows the shares of the four goals mentioned above as cited by respondents:

	Votes	Percentage of responses
restore credibility and predictability	**17**	**71%**
right pricing	11	46%
fear of affecting end consumer prices	8	33%
simplify licensing	4	17%

Table 30: Key challenges of the METÁR system

Source: in-depth interviews

71% of respondents mentioned the restoration of credibility; determining the appropriate prices was cited by 46%. 33% mentioned challenges related to managing the effects of the price; 17% mentioned managing and simplifying the licensing process. Based on the above, we may draw the following conclusions:

> ***The greatest challenge of the METÁR system is whether it will be able to restore the credibility and predictability of the regulation.***
>
> ***Setting prices at the right level in the METÁR system will be of critical importance as far as the success of the regulation and the future of the industry are concerned.***
>
> ***Two further challenges of the METÁR system will be keeping end consumer costs in check and simplifying the licensing process for green projects***

Based on the theoretical overview and respondents' answers, it is of course possible to formulate recommendations on how to successfully overcome the challenges. As respondents emphasized, communicating that there is no chance of retroactive regulations being introduced, and abiding by this notion, is critical to restoring confidence. International benchmarks may be used to set prices at the appropriate level; adjusting the tariffs used in other countries to meet Hungary's specific features could serve as a good guideline. One of the preliminary studies for the NMCST is the calculation produced by Pylon Kft., which put forward feed-in tariff proposals for 2011-2012 based on figures from other countries and according to the costs of the various technologies (Pylon, 2011). Should the policymaker still remain concerned about setting the prices at the wrong level, quantity quotas may also be used to reduce the risk of bubbles being created – this may also keep the burden on end consumers under control.

I also asked respondents familiar with the METÁR concept to briefly outline their opinion of it. The majority had a favorable opinion of the plan, and thought that prices differentiated by capacity and technology, as well as regional restrictions, would be favorable changes. Several of them also emphasized that it would be a favorable departure from the KÁT system if the term of the guaranteed purchase agreement would be 15 years for all, as included in the plan. This would differ from current practices, which allow for the energy office to make case-by-case decisions on how long a particular project is entitled to sell electricity under the KÁT system. Because, however, the proposal does not contain prices, only blank charts for each feed-in price category, it is impossible to assess the essence of the new system.

Following the elaboration of their opinions, I also asked respondents to summarize their opinion in one single word, or two words, if possible.

I received the following responses:

"good concept; coming along; paternalistic; Lucia's chair[62]; sophisticated; more professional; overwrought; cloudy; nothing new; expansive; overcomplicated;

[62] It is part of old Hungarian folk tradition to start making a sort of stool/chair on Lucia's Day (December 13); a key element of the process is that people shall only do one tiny bit of work on the stool/chair each day (up until Christmas Day, when it is supposed function as an important accessory for witch-spotting). Thus the main point, as far as my interviewees' responses are concerned, is: it is a very, very slow process.

generality; boring; usable; incomplete; good concept; good foundations; structured; patched together; good logic."

Using a software[63] to generate a "word cloud," I was able to create a visual representation of the terms used by respondents in the in-depth interviews to describe the METÁR concept:

Figure 33: Brief opinions on the METÁR concept

Source: in-depth interviews

On the whole, respondents found the published document relating to the new scheme (albeit lacking prices) a good concept and thought it could serve as a solid foundation: what is known about the plan so far seems to point in the right direction. In order, however, to meet the 2020 targets, it is necessary to end the regulatory uncertainty and to add more content (prices) to, and then implement, the concept.

I also asked interview subjects when they expected the system to go live (originally planned for summer 2011, and currently promised for early 2013). It is worth listing their answers one by one, to see their uncertainty:

"it will not be implemented during the present government's term"
"possibly never; but maybe mid-2014"
"mid-2013"
"late spring, early fall of 2013"
"spring-fall 2013"
"there will not be new regulations during the term of the current government"
"January 2013; but I would only give that 60%"
"January 1, 2014"
"not before July 1, 2013"
"I'll pass; maybe if there is a group of entrepreneurs too impatient to wait"
"possibly not before the 2014 elections"

[63] The software is available at http://tagcrowd.com/. It selects the most frequently used terms in a text. When respondents mentioned phrases, instead of single words, I omitted the spaces to ensure the complete phrase is shown.

"September 2013"

"it will be one year behind schedule: they will announce it in late 2013, or possibly even later due to the elections"

"July 1, 2013"

"I don't know – whenever the government has the will, because there is no other obstacle"

"June 30, 2013"

"2014 at the earliest"

"certainly not before summer 2013"

"September 1, 2013"

"spring 2013"

"not in the current government's term; if we're lucky, perhaps at the beginning of the next one, in 2015"

"certainly not during the present government's term"

"I'll pass"

Interview subjects were not very optimistic regarding the date of entry into force of the system. Only one respondent thought it possible that it would be introduced early next year; but even that individual put the probability of that happening at 60%. An additional eleven individuals thought it may happen during the next year; other respondents put the expected date even later, some of them potentially only after the next elections.

Not only is the system then already two years behind schedule. In 2011, it was already delayed on the path to the 2020 goals for the NMCST. Respondents thought it may take an additional one or two years for the new regulation to be implemented. In other words, we are yet further behind in terms of the path to growth and towards the 2020 goals.

6.4.8. The Viability of NMCST 2020 Targets

As a last step in the analysis of the in-depth interviews, I will examine the feasibility of the goals spelled out in the National Renewable Action Plan with a deadline of 2020. This question is particularly interesting in light of the results discussed above, as the uncertainty surrounding the regulation is a significant barrier to the proliferation of renewable energies. As the presentation of Hungary's challenges has shown, in 2011 the country was already lagging behind in terms of the course spelled out in the NMCST. This was why I formulated the question whether the regulatory uncertainty, the two years lost and the resulting challenges of the METÁR system threaten the realization of the 14.65% goal by 2020. Based on the results discussed above, we may assume that interview subjects will represent several different positions in the matter.

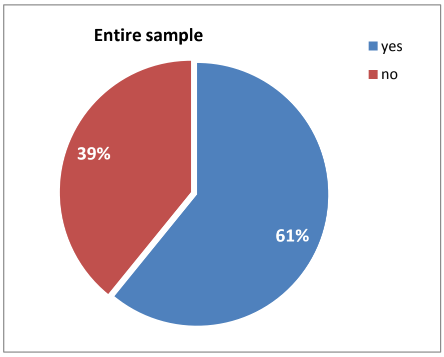
In response to the question **whether the respondent believed that the 14.65% renewable energy share determined in the NMCST would be feasible**, fourteen of the twenty-three respondents answered yes, and nine answered no. I examined the results within each group of respondents to determine any possible variations in the degree of optimism or pessimism among investors, bankers and experts. The table below summarizes the results:

	yes	no
experts	56%	44%
investors	88%	13%
bankers	33%	67%
Total	**61%**	**39%**

Table 31: Respondents' views on the viability of NMCST 2020 targets

Source: in-depth interviews

On the whole, the majority of respondents (61%) thought the 14.65% target is still realistic; a significant proportion (39%), however, no longer thought it feasible. Investors proved to be the most optimistic, with the highest share of yes responses (88%); experts were in the intermediate range, and bankers were the most pessimistic as far as the realization of 2020 goals was concerned (with only one-third of them responding yes). For ease of representation, I have plotted the results on the pie charts below:



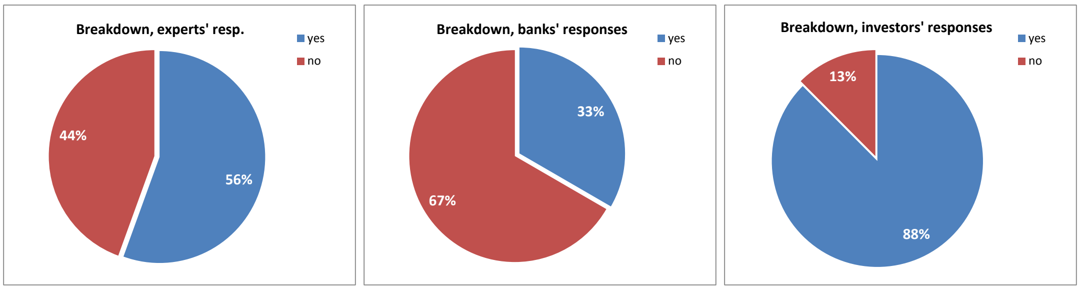


Figure 34: Distribution of respondents' views on the viability of NMCST 2020 targets

Source: in-depth interviews

I asked all respondents who answered in the negative whether they thought the target was realistic when the NMCST was adopted in 2010. All of them answered that they believed it was: in other words, all nine negative answers had to do with the lack of developments in the preceding two years and the regulatory uncertainty. Investors were still hopeful: they see that the necessary potential is there in terms of resources. Several of them mentioned that a significant increase in capacity could be achieved in just a matter of years through wind power plants and solar power plants. All that would require would be the announcement of a new wind tender and increasing the current solar power prices. The goal would be to nearly double the 755 MW green capacity listed in the late 2010 NMCST, bringing it to 1537 MW operating capacity by 2020. If this was realized exclusively through solar and wind power, that is more cumbersome in terms of the flexibility of the system and the ability to regulate it than if several, controllable (e.g. biomass) power plants were also included in the mix.

Bankers' responses were more reserved, in part due to the current difficulties of the banking sector and the increasing costs of resources. Additionally, it was bank representatives who most often emphasized that it is not sufficient to simply publish new regulations: it will take time for decision makers to believe that the new system will not change and that it can be relied upon and financed in the long term.

Experts represented the golden mean between hopeful investors and conservative bankers, with about half of them suggesting targets were still feasible, and half believing otherwise; the feasibility of goals was still in the majority however.

At the same time, I must also point out that several positive answers came with the caveat that while the target is still currently feasible, we are running out of time. One of the respondents provided the following explanation for his negative response:

"It is already 2012, and the regulations cannot come out before summer 2013. Then the market will wait at least six months before actually believing the new regulations and before developments are initiated – and that is already early 2014. It takes 1.5-2 years to prepare a project, meaning that the first plants could begin production only in 2016 at the earliest. More complicated projects (e.g. biomass plants) take even longer to prepare."

That respondents hold a variety of positions was also made clear when I asked each of them to provide a single-word answer to describe the 2020 targets. I used the same software as described earlier to obtain a visual summary of their responses according to number of mentions:

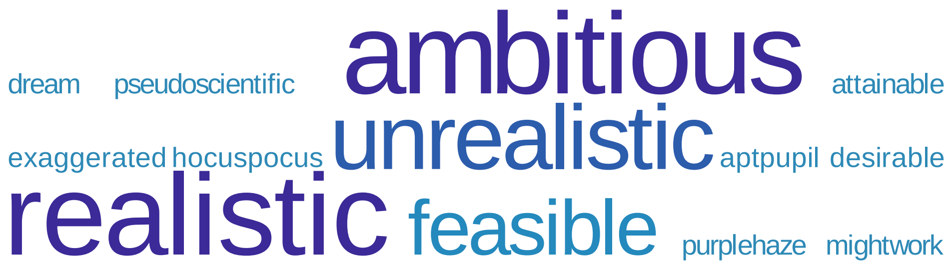


Figure 35: Brief opinions on the NMCST 2020 targets

Source: in-depth interviews

The words "ambitious" and "realistic" were cited the most often (by four respondents each). While both words imply feasibility, the word "ambitious" also has the connotation that there are still challenges to overcome. Three individuals used the word "unrealistic," and two said "feasible." That realistic and unrealistic are diametrically opposite is clear; and there is also perhaps some contradiction between "ambitious" and "feasible." Several answers which were only mentioned once each (dream, exaggerated, purple haze, hocus pocus) alluded to the untenability of the targets, while several had to do with its feasibility (might work, attainable).

Having seen the differences between attitudes within each group, I believe I cannot formulate a definitive answer to the question whether respondents thought the 2020 targets were feasible or not.

The subjects of the in-depth interviews were divided over whether Hungary will be successful in reaching the target of 14.65% renewables by 2020.

Continuing along the same logic, I will move on to a presentation of which actors interview subjects believed would have the greatest impact on progress through 2020. I asked respondents to rank-order stakeholder groups (investors, banks, policymaker) according to their role in moving towards the realization of NMCST targets. I received the following answers:

	investors	banks	policymaker
Average	**2,4**	**2,5**	**1,1**
Minimum	1,0	2,0	1,0
Maximum	3,0	3,0	2,0

Table 32: Key actors in achieving NMCST 2020 targets

Source: in-depth interviews

Respondents clearly pointed to the key role of the policymaker, with twenty out of twenty-three placing the policymaker at the top of their lists. No interview subjects placed the policymaker at the bottom of the list. Several took the position that "if good regulations are in place, then the rest (investors, banks) will come, too." Respondents did not especially differentiate between the importance of the role of investors and the scarcity of their resources. In terms of averages, investors placed slightly behind bankers; it is important to note, however, that no one placed bankers in first place, whereas some did put investors at the top of their list.

I was also interested in seeing whether the perception of the various roles is different when examined by respondent group: primarily, I was looking to see if banking and investor representatives have a different view of their own importance. The table below shows average ranks broken down by group:

	investors	banks	regulator
investors	**2,5**	**2,5**	**1,0**
banks	**2,1**	**2,6**	**1,3**
experts	**2,6**	**2,3**	**1,1**

Table 33: Key actors in achieving NMCST targets by group

Source: in-depth interviews

There was no significant difference between the various respondent groups. Investors primarily emphasized the key role of the policymaker, placing them at the top of their list, with themselves and bankers tied for second place. The policymaker also ended up first in bankers' responses as the primary guarantors of meeting the 2020 target, but investors were deemed more important by this group than banks. The reason for this was that banks' general attitude was characterized by the notion that good projects will continue to receive funding, but that – as a result of the macroeconomic situation and the situation of industry regulations – only a smaller share of projects will be able to meet higher expectations. Requirements for own resources have also become stricter, as have conditions for providing assurances; the role of project hosts and investors is also more important. Developers will only obtain bank financing if they possess the appropriate expertise and experiences. Experts also mentioned the policymaker in first place; they felt banks were somewhat more of a bottleneck than developers.

Based on the responses of all three groups, and on responses provided by all in-depth interview subjects, we can draw the following conclusion:

> ***It will be the policymaker that will play the most critical role in determining the pace of increasing Hungary's renewable electricity production capacity in the next eight years.***
>
> ***Lacking appropriate regulations, investors and banks will not assume an active role in the increase of green capacities.***

The primacy of the role of the policymaker is connected to the current exlex state of regulations and uncertain conditions. Responses also confirmed that when new regulations are implemented, investors and banks will be ready to support investments. In the words of one interview subject:

"The knowledge, the energy sources and the financing are all there – it's just a matter of making use of them."

7. Conclusion; Recommendations for the Hungarian Policymaker

In my dissertation, I have examined promotion mechanisms encouraging renewable electric energy production. Both the literature, as well as the general practices and experiences of European Union member states, support the primacy and success of price-based motivators. Accordingly, Hungarian regulators' decision in favor of a feed-in tariff system appears to be well-founded and is to be supported.

The significance of renewable energy sources, both in terms of community goals and as far as Hungary's own action plan is concerned, is set to increase in the future. Compared to traditional energy production methods, green energy is more closely in line with the requirements of sustainable development. The factors above suggest that special attention is to be paid to this area and to related regulatory issues.

The feed-in tariff system that has been in place in Hungary for ten years may not be considered a typical implementation of the scheme, for a number of reasons. First, the term of the guaranteed purchase agreement is not fixed, but is subject to case-by-case decisions of the energy office. Secondly, the feed-in tariffs themselves are not differentiated by technology: this leads to results similar to those encountered in a green certificate system, which also offer the same premia to all actors. A third, uniquely Hungarian, feature is that wind power plants may only be constructed up to the capacities approved in the quota established by the regulator: there is no automatic eligibility for participation in the KÁT.

These factors clearly played a role in the process that allowed Hungary to meet its renewables targets for 2010 relatively cheaply, and that subsidy amounts have not yet presented a significant burden to the end consumers of electric energy, who ultimately are the ones financing renewables. At the same time, this has also meant that it was primarily wind power plants and multi-fuel biomass capacities (larger in capacity, but lower in efficiency) that have seen a rise in numbers; the ones that are considered more mature and less expensive among renewable technologies.

In the ten years that the KÁT system has been in place, Hungary has reached a 6-7% share of renewables in electric energy production. The relatively undifferentiated nature of the system means that this was accomplished at a reasonably low cost and without encountering the types of regulatory failure experienced by other European nations.

Hungary’s own regulatory problems have come to light in the last two years. Meeting the EU requirements for 2020, and meeting even higher commitments agreed to for Hungary’s renewables sector amount to doubling, with base year 2010, the country’s green capacities. If we also figure into this the substitution of multi-fuel power plants which are gradually being excluded from the renewables category, then the goal becomes nearly tripling the capacities by 2020. Through the KÁT system, Hungary has already made full use of cheaper energy production modes, which are also easier to implement. The tariffs currently in place are not high enough to lead to the construction of new biomass power plants and solar power plants; and additional wind capacities cannot be constructed, either, without distributing additional quotas. Thus, if Hungary is to meet the 2020 targets, the KÁT system must be transformed.

The process was launched, with great momentum, in 2010; Hungary’s national renewables action plan was published, followed by the regulatory concept paper, which suggested a new regulatory system, METÁR, would be implemented as soon as possible. With a view towards the anticipated new promotion scheme, and in light of published tariff proposals, investments in the renewables sector were halted, and developers waited for the new regulations to be published. Two years later, they are still waiting. By 2011, Hungary’s share of renewables dropped by nearly 1%, to 6.3%, meaning the country is already behind schedule towards meeting 2020 targets.

My research has focused on challenges faced by the renewables sector in the future and has formulated related recommendations for regulators. My first hypothesis has shown that in the case of technologies characterized by a flatter marginal cost curve, an incorrectly determined feed-in tariff could result in a significant plan vs. actual variance in terms of newly installed capacities. Per my recommendation, risks associated with erroneous decisions could be avoided by introducing quantity quotas, monitoring the market, using international benchmarks and through an active dialogue with the industry. Countries which have experienced so-called PV bubbles also have several lessons to offer: their experiences show when a tariff is considered too high and also show how related problems can be overcome. Because the 2020 targets include 63 MW of solar power capacity – significantly higher than the 0 MW today – it is worthwhile to consider the following recommendation:

Solar power plants represent a technology demonstrating rapid development and require little time to construct. Should Hungarian regulators be planning to raise current feed-in tariffs – which are currently too low to encourage the proliferation of this technology – it would be important to ensure their understanding of the market is up-to-date. It would also be important to determine yearly quotas, as far as newly built capacities are concerned, to avoid a potential PV bubble. This may be done either by announcing tenders or by distributing quotas, as it was done with wind power.

Concurrently with the increasing share of renewable energy, the subsidy volume for green power plants is also increasing, as is their need for such support – the price of which is ultimately borne by consumers. Presently, the Hungarian government appears committed to keeping household utility costs unchanged; one possible reason for this may be the general public's lower tolerance for financial burdens in light of the economic crisis. Nonetheless, this presents an obstacle to the further proliferation of renewable energy. That was why I found it important, through the validation of my second hypothesis, to demonstrate that the current Hungarian practice provides less support for green energy and spends more on other generation methods based on fossil fuels.

KÁT support for green power plants has only increased to 23.3 billion HUF in 2011 from 18.4 billion HUF in 2008, an increase of 27%, while the amount of green energy produced went up from 1,771 GWh to 2,236 GWh, an increase of 26%. In other words, renewable energy production did not get significantly more expensive (thanks to feed-in prices being index-linked to inflation). As the results of my calculations show, subsidizing green energy, for the time being, does not place a significant additional burden on end consumers; it is also clear that, both individually and on a government level, almost twice that much is spent on supporting cogeneration and coal-fired power generation. This is what my second recommendation pertains to:

By gradually phasing out, or doing away with "coal cents" and with cogeneration structural reform fees, and by regrouping funding to encourage renewables, the

current amount of green energy subsidies could be tripled without placing any additional burden on end consumers.

For similar reasons, it would be a prudent measure to terminate support for providing electricity at preferential rates and regroup those resources, as well.

For the third part of my research, I conducted in-depth interviews with key industry stakeholders and used these to draw further conclusions. All interview subjects had significant experience with Hungary's renewable regulations, and the majority of them had been active in the sector ever since it was launched. I have shown that the announcement of the METÁR system two years ago and that it has still not been implemented have shaken confidence in regulations to the core. I was surprised to see the popularity of the notion that the introduction of the METÁR system might affect projects already realized under the KÁT system. This may have been due to the removal of cogeneration production from the KÁT system and to various pieces of retroactive legislation in other areas. Accordingly, banks would be either unwilling to finance projects under the KÁT, or would only be willing to do so in extremely special cases. Investors, moreover, were also unwilling to launch new projects because of the repeated postponement of the implementation deadline. In order to maintain confidence in and a vision for the industry, it would be crucial to follow the following recommendation:

The METÁR system must not be retroactive, i.e. it must not affect power plants already operating under the KÁT system, and must only apply to projects that are approved after it has come into force.

In light of this current atmosphere of uncertainty, it would be useful for the government to come out with reliable and realistic information on the actual implementation of the METÁR system, as soon as possible. This would contribute greatly to the predictability of the regulatory environment.

It would not necessarily present a problem if the date announced was not one in the near future. If this is known in advance, then at least the investments that suit the old KÁT system could go on. As I already pointed out earlier: the absence of credible communication will keep investors at bay, right until trust in the policymaker has been restored.

Certain recommendations may even be formulated for the hopefully soon-to-appear METÁR system, as well, in order to increase our chances of meeting the year 2020 goals.

In order to achieve the year 2020 targets, the METÁR system needs to employ a tariff system that is more differentiated than the current one, and an increase in the tariffs for PV and biomass power plants seems inevitable, as well.

Because the METÁR system, as a concept, places smaller and more decentralized units at an advantage, the expected pace of growth will only possible to achieve through the realization of a larger number of projects. This is a change compared to the current practice, which has concentrated primarily on large-capacity biomass power plants and wind power plants. It is to be expected that the greater number of projects will place a higher burden on licensing authorities, which will also have to deal with managing what is currently an overly lengthy process as well as with the challenges of licensing new types of power plans (e.g. solar plants).

It would be advisable to introduce a simplified, uniform licensing process, to improve transparency and to develop the practices of licensing the new types of power plants along with the implementation of the new regulatory system.

Respondents were divided about the feasibility of the year 2020 objectives. They all agreed that the targets had actually appeared realistic at the time when the NMCST was issued (the end of 2010), yet as a consequence of the period that has passed since then without any significant advancements, without any noteworthy investments, but with a decreasing share of renewables, more than one third of them have become extremely skeptical about achieving the targeted rate of 14.65%.

I do sincerely hope that this proportion will not continue to deteriorate and that the policy makers will very soon put the industry back on a path of stable growth, the first (and in fact a crucial) step of which would be to give a clear indication of what the regulatory reform should be expected to be like.

While preparing my dissertation, I also formulated **several potential future research avenues**. The renewable shares in the heating and cooling sector, and in transportation, would each be appropriate areas to examine in stand-alone dissertations, looking beyond electric energy. The NMCST includes specific targets in each of these areas, and because there is no promotion scheme in place yet for renewable heat generation, meeting heat-side targets presents a special challenge. The 2009 EU directive includes a target of 20% not just for the share of renewables, but also for increasing energy efficiency and reducing greenhouse gas emissions. Examining each of these targets separately would be worthwhile, as would exploring the synergies of potential links between the various targets.

Further, it would be possible to prepare separate analyses dealing with the various energy sources, following a similar approach; the in-depth analysis could examine the characteristics of each area, results achieved and motivators employed in various member states.

My survey, using in-depth interviews, was useful as a tool of exploratory analysis, but it would be worthwhile to add further structure to this method through the use of questionnaires. Relying on the findings of the in-depth interviews as far as attitudes concerning the KÁT and METÁR systems are concerned, a questionnaire-based survey could be conducted among KÁT-licensees and industry stakeholders. Although the small sample size would not allow for classical statistical analysis, it would nonetheless highlight differences between the representatives of the various sectors (wind power plant owners, biogas developers).

Following the implementation of the METÁR system, it would be worthwhile to examine which of the recommendations I formulated have been followed and, of course, what the introduction of the new scheme will mean for the future of the industry.

Appendices

Appendix 1: Power plants generating electricity from renewable sources, 2011

Source: Magyar Energia Hivatal, 2012a; Beszámoló a megújuló alapú és a kapcsolt villamosenergia-termelés, valamint a kötelező átvételi rendszer 2011. évi alakulásáról

Wind power/1

Operator	Location	Installed capacity (MW)	Commercial Start Date
Those selling within the KÁT framework:			
Mistral Energetika Villamosenergia-termelő Kft.	Ikervár	26.00	2011
Vento Energetika Villamosenergia-termelő Kft.	Tét	8.00	2011
RENERWIND Energetikai Kft.	Jánossomorja	2.00	2011
Vento Energetika Villamosenergia-termelő Kft.	Tét	38.00	2010
Mistral Energetika Villamosenergia-termelő Kft.	Nagyigmánd	36.00	2010
Euro Green Energy Kft.	Bőny	25.00	2010
Pannon Szélerőmű Villamosenergia Kft.	Bábolna	15.00	2010
Kaptár B Energetika Kft. (Greenergy)	Lövő	2.00	2010
Kaptár Szélerőmű Kereskedelmi és Szolgáltató Kft.	Kisigmánd	48.00	2009
CLEAN ENERGY Szolgáltató és Termelő Kft.	Pápakovácsi	2.00	2009
Kaptár Szélerőmű Kereskedelmi és Szolgáltató Kft.	Kisigmánd	2.00	2009
TRITOM Építőipari, Kereskedelmi és Szolgáltató Kft.	Vönöck	0.85	2009
Vienna Energy Természeti Erő Kft.	Levél	24.00	2008
Hungarowind Szélerőmű Üzemeltető Kft.	Sopronkövesd	23.00	2008
RENERWIND Energetikai Kft.	Jánossomorja	2.00	2008
RENERWIND Energetikai Kft.	Jánossomorja	2.00	2008
RENERWIND Energetikai Kft.	Jánossomorja	2.00	2008
RENERWIND Energetikai Kft.	Jánossomorja	2.00	2008
CLEAN ENERGY Szolgáltató és Termelő Kft.	Ács	2.00	2008
W.P.S.S. Energetikai Kft.	Jánossomorja	1.80	2008
VILL-KORR ENERGIA Energiatermelő és Befektető Kft.	Csorna	0.80	2007
VILL-KORR ENERGIA Energiatermelő és Befektető Kft.	Mosonszolnok	0.80	2007
MOV-R H1 Szélerőmű Kft.	Mosonszolnok-Levél	24.00	2007
"PRECIZ" Építőipari és Kereskedelmi Kft.	Bakonycsernye	1.80	2007
Energia Csoport Szolgáltató és Kereskedelmi Kft.	Mecsér	0.80	2007
Windpower Hungária Kft.	Ostffyasz-szonyfa	0.60	2006
Kavicsbánya Móvár Kft.	Mmóvár	10.00	2006
"PRECIZ" Építőipari és Kereskedelmi Kft.	Csetény	2.00	2006
"PRECIZ" Építőipari és Kereskedelmi Kft.	Csetény	2.00	2006
N-ZOLL TRANS Szállítási és Kereskedelmi Kft.	Felsőzsolca	1.80	2006
Mezőwind Kft.	Mezőtúr	1.50	2006
e-Wind Kft.	Törökszentmiklós	0.80	2006
"PRECIZ" Építőipari és Kereskedelmi Kft.	Szápár	2.00	2005

Wind power/2

Operator	Location	Installed capacity (MW)	Commercial Start Date
Harsányi 2004 Kft.	Mmagyaróvár	2.00	2005
Lenteam Erőmű Kft.	Mmagyaróvár	2.00	2005
NETPOINT Bt.	Mmagyaróvár	2.00	2005
HOFFER Kft.	Mmagyaróvár	2.00	2005
THÉRA Bt.	Mmagyaróvár	2.00	2005
Pacziga Kft.	Erk	0.80	2005
NETPOINT Bt.	Mmagyaróvár	0.60	2003
THÉRA Bt.	Mmagyaróvár	0.60	2003
E.ON Energiatermelő Kft.	Mosonszolnok	1.20	2002
Bakonyi Erőmű ZRt.	Inota	0.25	2001
Total KÁT capacity:		*326.00*	
Those exiting KÁT:			
EMSZET Első Magyar Szélerőmű Kft.	Kulcs	0.60	2001
Nagy-Ferenczi Kft.	Bükkaranyos	0.23	2005
Total capacity exiting KÁT:		*0.83*	
Those selling outside of the KÁT framework:			
EMSZET Első Magyar Szélerőmű Kft.	Kulcs	0.60	2002
Nagy-Ferenczi Kft.	Bükkaranyos	0.23	2005
LÉG-ÁRAM Alapítvány	Újrónafő	0.8	2005
Szélerő Vép Kht.	Vép	0.6	2005
Total non-KÁT capacity:		*2.23*	
Total wind power capacity:		***328.23***	

Hydropower

Operator	Location	Installed capacity (MW)	Commercial Start Date
Those selling within the KÁT framework			
Hydropower plants below 5 MW:			
Blue Stream Kft.	Öcsöd	0.16	2011
Blue Stream Kft.	Boldva	0.03	2010
Blue Stream Kft.	Bogyiszló	0.04	2009
KENYERI Vízerőmű Kft.	Kenyeri	1.52	2008
Villamos Energia Termelő és Szolgáltató Kft.	Chernelházadamonya	0.03	1998
Villamos Energia Termelő és Szolgáltató Kft.	Lukácsháza	0.03	1998
Hernádvíz Kft.	Kesznyéten	4.70	1945
Szombathelyi Vízerőmű Kft.	Csörötnek	0.49	2004
Szombathelyi Vízerőmű Kft.	Ikervár	2.44	1896
Szombathelyi Vízerőmű Kft.	Magyarlak	0.24	2004
Sinergy Kft.	Gibárt	0.49	2004
Rappold és Penz Vízerőművek Kft.	Pornóapáti	0.24	1951
Rappold és Penz Vízerőművek Kft.	Szentpéterfa	0.11	1951
Jank Magyarország Kft.	Több helység[64]	0.44	1960
Közép-Duna-völgyi Vízügyi Igazgatóság	Budapest	2.00	2005
Kapuvári Vízerőmű Kft.	Kapuvár	0.11	2001
KÁT capacity below 5 MW:		*13.06*	
Hydropower plants above 5 MW:			
Tiszavíz Vízerőmű Kft.	Kisköre	28.00	1975
Tiszavíz Vízerőmű Kft.	Tiszalök	12.90	1956
Capacity above 5 MW:		*40.90*	
Total KÁT capacity:		***53.96***	
Those exiting KÁT:			
Sinergy Kft.	Felsődobsza	0.49	2004
Hunag Kft.	Hegyeshalom-Máriáliget	0.12	before 2005
Szombathelyi Vízerőmű Kft.	Körmend	0.40	1930
Hernádvíz Kft.	Bőcs	0.02	before 2005
Total capacity exiting KÁT:		*1.03*	
Those selling outside of the KÁT framework:			
Blue Stream Kft.	Szolnok	0.03	2011
Sinergy Kft.	Felsődobsza	0.49	2004
Hunag Kft.	Hegyeshalom	0.12	before 2005
Hernádvíz Kft.	Bőcs	0.02	before 2005
Szombathelyi Vízerőmű Kft.	Körmend	0.40	1930
Total non-KÁT capacity:		***1.06***	
Total capacity below 5 MW:		*14.12*	
Total hydropower capacity:		***55.02***	

[64] Alsószölnök,Felsőcsatár,Gencs-alsó,Gencs-felső, Gyöngyöshermán,Tanakajd

Biomass power plants

Operator	Location	Installed capacity (MW)	Commercial Start Date
Those selling within the KÁT framework:			
DBM Dél-Nyírségi Bioenergia Művek Energiatermelő Zrt.	Szakoly	19.80	2009
Vértesi Erőmű Zrt.	Oroszlány	67.4	2006
PANNONGREEN Megújuló Energia Termelő és Szolg. Kft.	Pécs	49.90	2004
Bakonyi Bioenergia Kft.	Ajka	30.00	1961
Mátrai Erőmű Zrt.	Visonta	11.9	1970-1973
Total KÁT capacity:		*179.0*	
Those exiting KÁT:			
HM Budapesti Erdőgazdaság Zrt.	Szentendre	1.30	2005
Bakonyi Erőmű Zrt.	Ajka	37.0	2004
AES Borsodi Energetikai Kft.	Kazincbarcika	85.4	2002
Total exiting KÁT:		*123.7*	
Those selling outside of the KÁT framework:			
Mátrai Erőmű Zrt.	Visonta	64.4	1970-1973
Bakonyi Erőmű Zrt.	Ajka	37.0	2004
Rossi Biofuel Zrt.	Komárom	0.60	2009
Total non-KÁT capacity:		*102.0*	
Total biomass capacity:		***280.9***	

Biogas / landfill gas / sewage gas power plants/1

Operator	Location	Installed capacity (MW)	Commercial Start Date
Biogas plants			
Those selling within the KÁT framework			
Aufwind Schmack Első Biogáz Szolgáltató Kft.	Szarvas	3.57	2011
MIL-POWER Kft.	Pusztahencse	1.20	2011
Zöldforrás Energia Kft.	Szeged	1.20	2011
Bakony Bio Zrt.	Kisbér	0.84	2011
AGROWATT Környezetvédelmi Szolgáltató Nonprofit Kft.	Kecskemét	0.64	2011
Béke Agrárszövetkezet Hajdúböszörmény	Hajdúböszörmény	0.64	2011
Bicsérdi Arany-Mező Zrt.	Bicsérd	0.64	2011
Inícia Mezőgazdasági, Termelő, Szolg. és Kereskedelmi Zrt.	Ikrény	0.64	2011
Jászapáti 2000. Mg. ZRt.	Jászapáti	0.64	2011
Kemenesmagasi Agrár Kft.	Kemenesmagasi	0.63	2011
Ostffyasszonyfai Petőfi MGSz	Ostffyasszonyfa	0.63	2011
„STF” Sertéshústermelő és Forgalmazó Kft.	Hajdúszovát	0.63	2011
Aufwind Schmack Első Biogáz Szolgáltató Kft.	Szarvas	0.60	2011
”Erdőhát” Mezőgazdasági Zrt.	Vámosoroszi	0.60	2011
Cosinus Gamma Kft.	Bugyi	0.50	2011
Körös-Maros Biofarm Szarvasmarha Tenyésztő Kft.	Gyula	0.49	2011
Merész Sándor mezőgazdasági vállalkozó	Csomád	0.25	2011
Pannónia Mezőgazdasági Zrt.	Bonyhád	1.36	2010
Kaposszekcsői Mg. Zrt.	Kaposszekcső	0.84	2010
AGRO-CITY Mezőgazdasági Zrt.	Nyírtelek	0.63	2010
„Dombka 2003” Zrt.	Dombrád	0.63	2010
Biharnagybajomi "Dózsa" Agrárgazdasági Zrt.	Biharnagybajom	0.63	2010
Kisalföldi Mezőgazdasági Zrt.	Kapuvár-Miklósmajor	0.52	2010
Kisalföldi Mezőgazdasági Zrt.	Nagyszentjános	0.50	2010
Green Balance Energetikai Kft.	Dömsöd	1.40	2010
Csenger-Tej Kft.	Csengersima	0.54	2009
Csanád Gazdaságfejlesztési Kht.	Klárafalva	0.53	2008
Pilze-Nagy Kft.	Kecskemét	0.33	2008
Pálhalmai Agrospeciál Kft.	Rácalmás	1.70	2007
Kenderes Biogáz Termelő Kft.	Kenderes-Bánhalma	1.05	2007
BÁTORTRADE Kft.	Nyírbátor	3.49	2003
Total biogas capacity:		*28.46*	

Biogas / landfill gas / sewage gas power plants/2

Operator	Location	Installed capacity (MW)	Commercial Start Date
Landfill gas plants			
Those selling within the KÁT framework			
ENER-G Natural Power Kft.	Tatabánya	1.03	2011
ENER-G Energia Technológia Zrt.	Kökény	0.50	2011
ENER-G Natural Power Kft.	Salgótarján	0.50	2011
Perkons Depo Kft.	Győr	0.50	2011
ZÖLD NRG-AGENT Kft.	Gyál	1.02	2010
ENER-G Energia Technológia Zrt.	Bicske	0.50	2010
MIHŐ Miskolci Hőszolgáltató Kft.	Miskolc	0.50	2010
ENER-G Energia Technológia Zrt.	Kecskemét	0.88	2009
ENER-G Energia Technológia Zrt.	Veszprém	0.88	2009
Perkons Kft.	Dunaújváros	0.33	2008
Civis-Biogáz Kft.	Debrecen	0.63	2007
Perkons Kft.	Sopron	0.33	2007
ZÖLD NRG-AGENT Kft.	Hmvhely	0.32	2006
EXIM-INVEST BIOGÁZ Kft.	Nyíregyháza	0.53	2005
Total landfill gas capacity:		*7.40*	
Sewage gas plants			
Those selling within the KÁT framework:			
Perkons Kft.	Sopron	0.33	2008
Those exiting KÁT:			
Vasivíz Zrt.	Szombathely	0.37	2008
Non-KÁT:			
BKSZT Budapesti Szennyvíztisztítási Kft.	Budapest	4.25	2010
Debreceni Vízmű Rt.	Debrecen	1.17	2004
Bácsvíz Rt.	Kecskemét	0.78	2006
FCSM Zrt. Észak-Pesti Szennyvíztisztító Telep	Budapest	3.04	2009
FCSM Zrt. Dél-Pesti Szennyvíztisztító Telep	Budapest	1.46	2006
Vasivíz Zrt.	Szombathely	0.37	2008
Non-KÁT sewage gas capacity:		*11.07*	
Total sewage gas capacity:		***11.40***	

Appendix 2: Additional Information on Subjects of the Structured In-Depth Interviews

1. Experts, regulators:

- ***Ada Ámon: Director, Energiaklub Climate Policy Institute***

  Has been working on energy issues at her present place of employment since 1993. Participated in the drafting of the first (2001) version of the electric energy act, which first laid the groundwork for the KÁT system. The Institute monitors regulations on a daily basis and several of their projects and studies are related to renewable energy. They have participated in the development of the National Renewable Action Plan and in bringing it in line with EU regulations. They have authored a study dedicated to the licensing procedures of green projects.

- ***Zsolt Bertalan: CEO, MAVIR ZRt.***

  Working for his current employer since 2002, where he held a variety of senior leadership positions (Deputy Section Head, Strategy; Section Head, Market Organization; Deputy Director, System Management; Director, Market Operations; Director, Market Operations and Deputy CEO, Business); appointed CEO in December 2011. In the eleven years spent with MAVIR, he has observed progress made by the renewables sector, including system-wide accounting, planning and the challenges of linking green power plants to the national grid.

- ***József Fucskó: Director, Hungarian Environmental Economics Center***

  The Center has prepared several studies on the efficient management of environmental economics problems; e.g. a 2003 study titled "Green Certificates for Trading and Alternatives".

- ***Péter Gordos: Director, Corporate Relations Hungary, MOL NyRt***

  Worked between 2000 and 2010 at the energy department of the Ministry of Economy and Transport (and successor ministries), holding a variety of senior positions responsible for regulations. Eventually appointed Department Head, he then served as State Secretary for Energy between 2008 and 2010.

- ***Péter Grábner: Former Vice President, Hungarian Energy Office***

  Worked at the Hungarian Energy Office between 2001 and October 2012. From 2003 was Section Head, Section for Electric Energy Licensing and Supervision; served as Vice President from summer 2011 until October 2012. Created the accounting system of the KÁT scheme; has also co-authored several pieces of legislation and model calculations.

- ***Péter Kaderják: Research Center Director, Regional Centre for Energy Policy Research***

  Director General since 2000 of the Hungarian Energy Office; President of the Office between 2002 and 2003. Participated in the establishment of the KÁT system. Founder and Director of the energy policy research centre at Corvinus University; two main areas of focus for the Centre are renewable energy and energy regulations.

– ***Zoltán Pápai: Managing Director, Infrapont Kft.***

As an economist, has been working on regulatory issues related to network industries; has worked on energy market price regulations for twelve years. In 2010, the company prepared a comprehensive study on renewable energy subsidies; in 2011, they authored a study on problems related to the linking of renewable energy plants to the grid.

– ***László Varró: Director, Gas and Electric Market, International Energy Agency (IEA)***

As Senior Economist of the Hungarian Energy Office between 2000 and 2005, he monitored the establishment and introduction of the KÁT system. Between 2005 and 2010 served as Senior Economist and Strategic Development Director of MOL Nyrt. Since 2010 serves as regional director for IEA, and has a considerable overview of EU member state practices and global trends.

– ***András Vinkovits: Deputy CEO, Business, Budapest Power Plant***

Served as Department Head, Energy Department, in the Ministry of Economy and Transport during the drafting and implementation of the KÁT system; his responsibilities included preparing for the liberalization of the electric energy and natural gas market. Served as CEO of Mavir ZRt. between 2006 and 2008. Appointed Director, Business Development of EdF Hungary Kft., EdF's commercial enterprise in Hungary. Since July 2009 is Deputy CEO, Business, of the Budapest Power Plant.

2. Investors:

– ***Sándor Antal: Director, Energy Services Branch, Dalkia Energia Zrt.***

First came in contact with the KÁT system in 2007 with the purchase of the Pécs power plant. This is the largest (49.9 MW) biomass-fired power plant block in Central Europe. The power plant is currently being expanded, under his supervision, to include a 35 WM straw-fired plant.

– ***István Bakács: Director, Energy Resources Division, Accenture***

Has held senior positions in the Paks Nuclear Power Plant and in the Power Plant Investment Company. Served as CEO of Magyar Villamos Művek Zrt. from 1998. Served as Deputy CEO of E.ON Hungária Zrt. between 2001 and 2010, overseeing energy production, trading and sales. Joined Accenture in late 2011.

– ***Dr. István Borbíró: Attorney, Jutasi and Partners Law Office***

Has worked on the licensing of green power plants since the introduction of the KÁT system; has significant experience primarily in the licensing of wind power plants.

– ***Attila Chikán, Jr.: CEO, ALTEO Energy Services Plc.***

Has worked in the industry since the launch of the KÁT system, initially as Investment Director of EETEK Holding, responsible for 30 MW small power plant investment. His experiences primarily include wind power plants, biomass and alternative gas projects. Has been CEO of

ALTEO since 2008; the company currently owns three wind power plants, two landfill gas power plants and two thermal-methane power plants.

- ***Csaba Kiss: Director, Energy Production, E.ON Hungária Zrt.***

  As Director of AES's Borsod and Tiszapalkonya power plants, he played a role in the plants' switch to biomass fuel sources. Serves as E.ON's Director of Energy Production since 2006, with responsibilities for all power plant operations of the company. They own three wind power plants in Hungary; he has also participated in preparatory work for two wind farms.

- ***Dr. Tamás Kovács: Head, Lawyer's Office, Kovács Tamás Ügyvédi Iroda***

  Started his career in 2000 at the law office serving as the Energy Office's external legal counsel; has experience primarily in electric energy and licensing. The office has done work for investors in the field of licensing energy projects and on related contracts; wind power plants, biomass and biogas developments, licensing. Has been managing his own lawyer's office since 2006; one area of focus includes green energy projects and support for acquisitions.

- ***Csaba Nagylaki: Managing Director, Raiffeisen Energy Hungary***

  The company, founded in 2006, has constructed several wind farms with a total capacity over 50 MW. They have also dealt with licensing and developing biogas and biomass projects.

- ***István Szabó: Managing Director, IPS Power System Kft.***

  Has worked in the field since the launch of the KÁT system, initially dealing – as a member of the STS Group Kft. – with the licensing and construction of renewables projects (primarily wind power plants) and with implementing links to the electric grid. Following the end of the wind boom they turned to developing biogas, landfill gas and wind power plants. Currently, the architect's office focuses on solar energy and also manages the operations of some wind power plants located in Hungary.

- ***Csaba Varga: Financial Director, Saphire Sustainable Development Zrt.***

  Has worked on energy projects since 2002; the company has audited and licensed wind power plants, biogas and biomass projects in Hungary. Since 2006, the company owns two wind power plants in neighboring countries. They are currently active in Romania and Bulgaria, in terms of wind power plants and solar power.

3. Financiers, banks:

- ***Ákos Csobádi: Department Head, Project Financing and Syndication, Raiffeisen Bank Zrt.***

  Has worked in the industry since the introduction of the KÁT system, maintaining a constant overview of the energy sector. Has audited and financed several renewables projects, including wind farms, and biomass and biogas projects.

- ***Attila Erhardt: Department Head, Project, Structural and Corporate Finance, MKB Bank Zrt.***

  Has overseen the financing of energy projects for five years. They receive credit applications for all technology types; they have significant financing experience primarily with biomass and biogas projects.

- ***Péter Gombkötő: Department Head, Project Financing, KH Bank Zrt.***

  Has worked in the industry since the introduction of the KÁT system; has always been responsible for the energy sector. Has audited and financed several renewables projects, including wind farms, and biomass and biogas projects.

- ***Balázs Jávor: Department Head, Structured Financing, Unicredit Bank Hungary Zrt.***

  Has worked in the industry since the introduction of the KÁT system, maintaining a constant overview of the energy sector. Has audited and financed several renewables projects, including wind farms, and biomass and biogas projects.

- ***István Németh: Department Head, Structured Financing, ING Bank Zrt.***

  Has been dealing with the financing of renewable power plants since 2007. They do not deal with smaller projects: their approach is that of corporate financing, i.e. they focus primarily on financing wind farms.

- ***Éva Révész: Department Head, Energy and Infrastructural Projects; Project Financing and Acquisition Directorate, OTP Bank Nyrt.***

  Has been working on energy issues at the bank since 2001. They have been receiving applications for financing renewable power plants since 2004. They deal with almost all types of projects, financing hydro power plants located in Hungary, biomass power plants and a wind farm. They also coordinate the financing of renewable power plants in the region (Poland, Romania and Bulgaria); corporate financing.

- ***Zoltán Trombitás: Section Head, Infrastructure and Energy Financing, Erste Bank Hungary Zrt.***

  Has been in charge of this division, whose responsibilities include the financing of renewable power plants, since 2010. They receive credit applications for several technology types; specifically, they have significant financing experience primarily with biomass and biogas projects.

Appendix 3: Questions of the Structured In-Depth Interviews

1. How much contact do you have with the KÁT system, which serves to encourage the use of renewable electric energy in Hungary? How familiar are you with it? What impact does it have on your work? How long have you been working in a position which is affected by the KÁT?

2. Are you satisfied with the operating mechanisms of the system and with the results achieved over the last ten years? Assign a score between 1 and 10 (1 indicating complete dissatisfaction; 10 indicating complete satisfaction)
   a. What do you believe are its greatest strengths?
   b. And its weaknesses?

3. What do you believe is the greatest obstacle today to the proliferation of renewable electric energy production? (List the 5 factors you believe are most important.)

4. How would you go about changing these?

5. What do you think have been the best and worst outcomes of the current KÁT system to date? On a scale of 1 to 10, where would you place Hungary in terms of utilizing its renewable electric energy potential in light of its resources? Provide a brief justification of your score; then assign scores for each type of energy source, and justify the scores assigned.
   a. wind energy
   b. biomass
   c. solar energy

6. What would it take for these to achieve higher scores?

7. What do you think is the key reason for increasing the utilization of renewable energy in Hungary? Rank the following in order of importance:
   a. security of supply
   b. reducing environmental effects (global warming)
   c. economic stimulus
   d. other?

   What do you think Hungarian regulators believe is the most important factor?

8. Do you know the new METÁR concept? How familiar are you with it?

9. What is your opinion of it?
   Explain; then provide a brief, one word answer

10. What do you believe are the greatest challenges facing the METÁR scheme? What do you believe may become the greatest potential problem or risk to be avoided by Hungary's green energy sector? How should it be avoided?

11. What is your opinion of the licensing processes for green projects? Are they appropriate? How should they be changed?

12. Assign a score between 1 and 10 (1 – unsuitable; 10 – perfect).
    a. for investors: What was the lengthiest licensing process that you have been faced with? What was the cause of the delay?

13. What do you think of the 2020 targets in the NCST?
    a. in one word
    b. explain

14. What do you think is the reason for us committing to an excessive target?

15. In general, do you believe the 14.65% target is feasible?

16. What do you believe are the greatest obstacles and hindrances on the path to growth?

17. Of the groups below, which do you think will have a key role in realizing NCST targets? Why? Rank them in order of importance.
    a. investors, project managers
    b. financial institutions (banks)
    c. regulators

18. If you were a decision maker responsible for encouraging renewable electric energy, what would you change as compared to current practices? What do you think would be the most important goals?

19. In your opinion, what have been the most constructive and most destructive measures in renewable energy regulation in the last ten years?

20. When do you think METÁR will be implemented?

21. What else would you like to mention in connection with (the future of) Hungary's renewable energy promotion system? Is there anything we have not touched upon?

22. If you were going to relocate your energy-related activities or corporation to some other EU member state, which country would you choose? Why?

23. For investors:
    a. What are your expectations for return-on-capital?
    b. What type of credit and credit premium do you use in your calculations?
    c. Share of own resources and credit
    d. What obstacles hinder the implementation and financing of projects?
    e. What are the greatest risks in project development?
    f. How has your company been affected by the postponement of the new regulatory scheme? What steps did you take in response? Would you have done anything differently if you had known the new scheme would be postponed for so long?
    g. Are you only active in Hungary? What are your experiences in other countries?

24. For bankers:
    a. Would you be willing to finance a KÁT-project today? Why?
    b. Is the financing of renewable energy projects a priority area for your company? Why?
    c. What types of credit and credit premium are generally used for renewables projects in Hungary?
    d. Credit share?
    e. What do you believe is the greatest obstacle to such projects?
    f. What determines the risk rating of the various projects?
    g. If you are active as a financier in other countries, is it easier or more difficult there? Why?

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List of Abbreviations

AC	average cost
BAT	Best Available Technique
CO_2	carbon dioxide
EC	European Community
EU	European Union
FiT	feed-in tariff
TGC	tradable green certificate
GKI	Gazdaságkutató Intézet (GKI Economic Research Co.)
GWh	gigawatt hours
IEA	International Energy Agency
KÁP	feed-in tariff compensation
KÁT	feed-in tariff system (literally: guaranteed purchase)
kWh	kilowatt hours
MAVIR	Hungarian Independent Transmission Operator Company Ltd.
MC	marginal cost
MEC	external marginal cost
bn.	billion
MEH	Magyar Energia Hivatal (Hungarian Energy Office)
METÁR	Megújuló Energia Támogatási Rendszer (Renewable Energy Promotion System)
MW	megawatt
MWh	megawatt hours
NMCST	Nemzeti Megújuló Energia Hasznosítási Cselekvési Terv (National Renewable Energy Utilization Action Plan)
NFM	Nemzeti Fejlesztési Minisztérium (Ministry of National Development)
NIMBY	Not-In-My-Back-Yard
p	price
Q	quantity
REKK	Regionális Energiagazdasági Kutatóközpont (Regional Centre for Energy Policy Research)
TÁM	investment subsidy
TWh	terrawatt hours
VET	Act No. LXXXVII of 2007 on electric power (Electricity Act)
GPR	green premium

The Author's Own Publications on the Topic

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