Organization for Security and Co-operation in Europe
Office in Baku

Framework Conditions and International Best Practices for Renewable Energy Support Mechanisms

---

Paper drafted within the framework of the seminar on "International Best Practices for the Legal and Regulatory Framework of Renewable Energy", Baku, Azerbaijan, 14-18 December 2009

Author:
Mr. David Jacobs
Free University of Berlin
Environmental Policy Research Centre
Email: david.jacobs@gmx.de
http://www.fu-berlin.de/ffu

Point of Contact at the OSCE Office in Baku:
Mr. Robert Zahn
Economic and Environmental Officer
Email: robert.zahn@osce.org

Table of contents

I. Abstract

This report is intended as background information for the seminar on International Best-Practice for the Legal and Regulatory Framework of Renewable Energy on behalf of the OECD in Baku, Azerbaijan. In line with the agenda of the seminar, the paper gives an overview of support mechanisms for electricity from renewable energy sources. It is intended to inform policy makers and civil servants about the necessity to support renewable electricity and to offer information about the most frequently used support mechanisms based on international best practice. Furthermore, this report gives an overview of non-economic barriers that concern renewable energy deployment (administrative, grid-related and social barriers) and concludes with detailed recommendations for the Azerbaijani legislator.

II. Why support renewable electricity?

Support mechanisms for renewable energy sources are needed to "levelize the playing field" in an often distorted energy market. The major sources of distortion are subsidies for conventional energy sources (fossil fuels and nuclear power) and the lack of internalisation for the negative external costs of conventional energy generation technologies. On this matter, the different investment structures for fossil fuel plants and renewable power plants have to be taken into account.

Subsidies for conventional power

In the latest World Energy Outlook the IEA confirmed that subsidies for the consumption of fossil fuels still exist in many non-OECD countries. In 2007, the accumulated energy subsidies of 20 non-OECD countries (accounting for more than 80 percent of all non-OECD energy demand) amounted to approximately $310 billion [IEA 2008b]. In these countries the full cost is often not passed on to the final consumer, thus reducing the sensitivity of consumers to price increases. As a result, energy efficiency measures and alternative renewable energy sources have difficulties entering the market. Even though the reduction of energy subsidies is often politically challenging, it can help to set free budgetary resources which can tackle certain social problems more directly [IEA 2009]. Instead of removing subsidies for conventionally produced electricity, governments sometimes prefer to establish an attractive support framework for renewables in order to "levelize the playing field".

Internalisation of external costs

The use of fossil fuels and nuclear power often has an environmental impact which creates costs for the society as a whole, such as, human health, climate change, and others. Not internalising the external costs of fossil fuels means that the full societal costs of electricity generation are not reflected in the electricity price. The negative external costs are generally covered by taxpayers and society as a whole in the form of increased health costs, etc. Some countries have tried to internalise the external costs via taxes or emissions trading schemes, e.g. the Kyoto Protocol or the European Emissions Trading Scheme.

High initial capital costs

To a certain extent, specific framework conditions for renewable energy sources are not only necessary because of the higher costs per unit but also because of the different investment structure. For gas or coal fired power plants, most of the financial resources will cover the provision of fuel for the lifetime of the power plant. However, in the case of wind power plants and other renewable energy technologies, almost all financial resources are need at the start of the project in order to purchase the equipment. Due to this high initial capital cost, long-term security and predictable returns on investment are essential for renewable electricity producers. Support mechanisms, as described below, often manage to create such conditions by significantly reducing investment risks.

III. Support mechanisms for renewable electricity

The promotion of renewable energy sources has become a priority for a large number of governments around the world. As of 2009, more than 70 countries have adopted targets for the development of renewable energy sources. Medium or long-term targets are needed to increase investment security for power producers. In order to reach these targets, governments around the world have employed a wide range of policies for the promotion of renewable energy sources. As of 2009, at least 64 countries have implemented specific policies for renewables. Most jurisdictions make use of either feed-in tariffs or quota based mechanisms [REN21 2009].

As described above, support schemes are necessary to compensate for market failure in the conventional energy sector. The most frequently used support mechanisms for renewable electricity are tax and investment incentives, feed-in tariffs, net metering, quota based mechanisms (based on certificate trading) and tender systems. These mechanisms can be grouped into price based and quantity based support. Furthermore, one can differentiate between capacity focussed and production focussed incentives [IEA 2008a].

SUPPORT MECHANISMS	**Price based support**	**Quantity based support**
Investment focussed	Investment subsidies Tax incentives Soft loans	Tender mechanism
Generation focussed	Feed-in tariffs Net metering	Tender mechanism Quota obligations (TGC / RPS)

In the recent years, more and more researchers have pointed at the fact that the actual design of support mechanisms is more important for effective and efficient support than the mere choice of support schemes. Therefore, it is important to take international best practice into account when designing a national support instrument for the first time. Well designed support mechanisms guaranteeing a maximum of investment security can reduce costs for renewable energies by 10 to 30 percent [de Jager & Rathmann 2008]. If the investor is able to foresee the income revenue of a project, financial institutions will provide capital at lower cost, thus lowering the costs for renewable electricity.

In the following section, the most widely used support mechanisms for renewable electricity will be presented. After a more general introduction the analysis will focus on international best practice as well as the advantages and disadvantages of support instruments. All mechanisms will be compared at the end (see "Effectiveness and efficiency of support mechanisms").

A. Quota based support (TGC and RPS)

Under quota based mechanisms the legislator obliges a certain market actor (consumers, producers or suppliers) to provide a certain share of electricity from renewable energy sources. The choice of the obliged party (consumer, producer or supplier) usually depends on the national market design. The obliged party can either produce electricity itself or buy it from other green electricity producers. In order to increase the flexibility of the system, in many countries the obliged party is also allowed to reach the share by trading certificates which serve as proof for compliance [EU Commission 2008]. Therefore, these mechanisms are often called Tradable Green Certificate schemes (TGC). In the US and other parts of the world they are often called Renewable Portfolio Standards (RPS), as supply companies are obliged to provide a certain share of the electricity portfolio from renewable energy sources.

RPS mechanisms sometimes operate without certificate trading and can also be combined with tender mechanisms or feed-in tariffs.

In the case of certificate trading, renewable electricity producers have two income sources. Firstly, they sell their electricity on the spot market for electricity at the given market price. Secondly, they can sell their certificates on the national green certificate market. In theory, the certificate sales should compensate for "greenness" of the electricity, i.e. the positive attribute of renewable electricity compared to conventionally produced "grey electricity". The obliged party can either obtain certificates by producing renewable electricity itself or by buying them on the certificate market. The certificates allow the obliged party to prove that they have "produced" a certain share of their electricity from renewable energy sources. If they cannot prove this, i.e. they do not have a sufficient number of certificates, they have to pay a penalty.

Best practice

Quota based mechanisms have been applied in a number of European countries (e.g. the UK, Italy, Poland), in more than 30 US states and in other parts of the world too. When using Tradable Green Certificate schemes for renewable electricity support, certain design options should be taken into account by the legislator.

Firstly, liquidity on the certificate market has to be guaranteed in order to assure the functioning of the artificial market, i.e. by avoiding volatility of the certificate price. The larger the market for renewable electricity, the larger the certificate trading volume and the potential for cost reductions based on certificate trading. Therefore, it is recommended to enlarge the market for green electricity in order to increase the number of market players [EU Commission 2008; Ragwitz et al. 2007]. Experience in Poland and Sweden also shows that the legislator needs to set a sufficiently high penalty payment to enforce compliance with the quota obligation. Generally speaking, the penalty should be considerably higher than the marginal generation costs for renewable electricity.

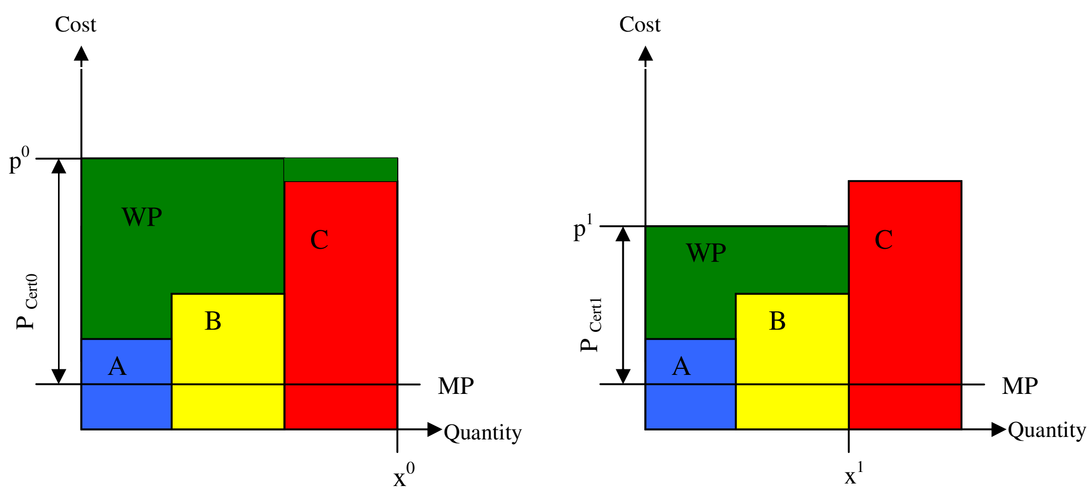
Additional support mechanisms are also necessary for less mature technologies, e.g. solar PV and geothermal, as quota based mechanisms are generally technology neutral. Therefore, all renewable energy technologies receive the same support which is determined by the certificate price. In reality, the least costly technologies primarily benefit from such a support scheme. In order to tackle this problem, Italy, for instance, has implemented an additional feed-in tariff scheme for solar PV. To promote a large range of renewable energy technologies the UK has recently implemented "certificate banding", a scheme in which renewable electricity producers receive a different number of certificates per unit of renewable electricity. In the UK, solar PV producers receive two certificates per unit of renewable electricity while wind power onshore producers only receive one certificate and landfill gas producers only 0.25 of a certificate. Several RPS programs in the United States have also tried to overcome this gridlock of less cost efficient renewable energy technologies by obliging utilities to purchase renewable electricity from different sources according to predefined ratios. Moreover, long term quota targets should be applied in order to increase investment security.

Advantages and disadvantages

In theory, quota based mechanisms have the advantage of being cost-efficient as they focus on the least cost technologies and spur competition between green power producers. Producers will install only the cheapest renewable energy technologies as this support mechanism does not take into account the differences in generation costs for different renewable energy technologies.

Theoretically, quota obligations are also thought to be the most effective way to reach a certain target, without exceeding or not reaching the set quota. In addition, certificate trading gives the obliged party the flexibility to reach a certain target; They can produce "green" electricity themselves, buy certificates on the certificate market and they can freely decide upon which technology to chose for meeting those targets. Unlike tax exemptions, public financed research and development and other support mechanisms, quota based mechanisms do not carry any additional costs for the legislator since the additional costs are passed on to the final consumer.

However, in practice quota based mechanisms have some disadvantages. In the case of certificate trading, they convey a high risk for renewable electricity producers as both revenue sources (the electricity spot price and the certificate price) are volatile. Due to fluctuations in electricity and certificate prices, long-term rates of return are difficult to predict, thus making the financing of renewable energy projects more expansive. In practice, the increased investors' risk can offset the theoretical benefits from competition between renewable electricity producers [Butler & Neuhoff 2004]. As quota based mechanisms are generally technology neutral, they only support the least costly renewable energy sources. Therefore, less mature technologies, such as solar power, geothermal and certain types of biomass are not being developed. This is shown in the following graphs. While the first graph assumes a very high certificate price (p cert0) the second graph shows that in the case of a lower certificate price more costly technologies (technology C) will no longer be profitable to operate and therefore de facto not be supported. The graph also shows that the least costly technology (technology A) always receives large wind fall profits (WP).



Non-technology specific certificate trading creates large excess profits for producers of relatively mature technologies, thus making the support of renewable electricity unnecessarily expensive [Jacobsson et al. 2009]. By focusing on the least costly technologies and not promoting other, less mature technologies, technological innovation is de facto penalised.

Moreover, empiric findings suggest that European Tradable Green Certificate schemes favour large players and especially incumbent industries. Thus, small-scale, independent power producers have difficulties entering the market. Finally, renewable electricity producers will always try not to achieve the targets fixed by the quota obligation as this would mean that the certificate price will drop to zero. Therefore, quota based mechanisms can even limit the expansion of renewable energy sources.

B. Tender systems

Tender or bidding systems are a quantity based support instrument in which the legislator issues a call for tender, i.e. an auctioning mechanism, for a certain renewable energy project of a specific size. The financial support can either be based on the total investment cost or the power generation cost per electricity unit. Instead of offering upfront support (investment cost), tender mechanisms are usually based on the power generation costs per unit of electricity, i.e. bidders provide renewable electricity at a predefined price per kilowatt-hour over a certain number of years. The bidder with the lowest necessary financial support wins the tender and has the exclusive right to profit from the support granted.

Best practice

Tender systems have been used in a number of countries by independent power producers of conventional power. Some European countries, including France and Denmark (wind energy offshore), have also used these support mechanisms for renewable electricity promotion. The UK was the first country to establish a tender mechanism under the Non-Fossil Fuel Obligation (NFFO) in 1991. In order to promote renewable electricity successfully, tender mechanisms should include specific design options. As a lack of continuous support can offset the establishment of a national industry, the legislator should ensure continuity and issue calls for tender periodically. Additionally, a tender should be technology specific and the policy maker should implement penalties for non-compliance, i.e. if a bidder wins a public tender it will have a strong “incentive” to actually realize the power project.

Advantages and disadvantages

In theory, tender schemes have a number of advantages. First and foremost, they are cost-effective, as the tender process initiates competition between producers. Since the bidder with the lowest proposed price wins the contract for power generation, the total additional cost for society can, in theory, be limited to a minimum. Furthermore, the government has direct control over the amount of renewable electricity that is produced under the support mechanism.

However, in practice tender schemes in the UK and France have revealed considerable problems; – this is the reason why the UK has switched from a tender scheme to a quota based mechanism in 2003 and France moved towards a feed-in tariff mechanism in 2000. The major disadvantage of tender schemes is the limited effectiveness of the support mechanisms. Due to a competitive bidding process, projects are often not put into practice as competitors issue bids which are actually too low to run power plants profitably. Consequently, these projects are frequently abandoned by developers. In the UK, not even one third of all projects have actually been installed [Butler & Neuhoff 2004]. Besides, in the UK the tender mechanism has been criticised for not promoting local renewable energy development as all necessary equipment has been imported from other countries [Mendonca et al. 2009a]. Moreover, tenders have created stop-and-go development cycles in the renewable energy industry as legislators have called for tenders irregularly.

C. Net metering

Net metering is a concept mostly applied in the promotion of decentralised solar electricity. Theoretically, other technologies can also be eligible under net metering mechanisms. Generally speaking, independent power producers have the right to be connected to the grid and should be able to rely on the local utility or grid operator to purchase all excess electricity. The name of the support instrument refers to the meter measuring the electricity consumption. In the case of most net metering schemes, the meter starts turning “backwards” once excess electricity is fed into the grid. If the consumer has produced more electricity than consumed the local utility or grid operator has to pay for the net production at the end of each month. Usually, the renewable electricity fed into the grid receives the standard wholesale rate for electricity.

Historically, consumers who intended to produce renewable electricity at home to sell the excess power to the grid had to use to separate meters. This “double metering”, however, has often created unfair conditions for consumers as utilities only wanted to pay very small rates for the electricity fed into the grid. With net metering, the consumer at least gets the retail electricity price (as the meter simply turns backwards).

International best practice
Net metering has been applied in a number of countries and regions, including a large number of states in the US, most Australian provinces, Japan, Mexico, Thailand and Denmark. Two of the most successful net metering schemes were implemented in California and New Jersey, which lead to the installation of more than 23,000 solar systems by early 2008 [Mendonca et al. 2009a]. The most successful net metering schemes did not limit the total installed capacity eligible under the system. Under most net metering mechanisms in the US, producers of renewable electricity cannot sell more electricity to the grid then they consume. This provision, however, should be avoided, since otherwise the support mechanism only targets small scale applications.

Advantages and disadvantages
Theoretically, net metering has a number of advantages. Solar PV is usually produced during the daytime when electricity demand is highest in many countries. Therefore, consumers can provide valuable electricity during peak demand periods. If feed-in tariffs were to be coupled with a price-model that features flexible electricity prices for consumers based on the time of the day (i.e. higher electricity tariffs during high demand periods such as early afternoons), net metering mechanisms could generate considerable incomes for consumers.

However, in most cases these incomes are not high enough to finance the solar modules. Therefore, using renewable electricity locally and not feeding it into the grid is inherently promoted by this support mechanism. Furthermore, net metering frequently focuses on small-scale solar PV systems, as only excess electricity is accepted. Thus, large scale renewable energy plants, which are necessary for transforming the global energy system, are not being supported. In contrast to other price based support mechanisms, namely feed-in tariffs, investment security is still rather low as the profitability of a plant largely depends on the long-term development of electricity prices for final consumers.

D. Feed-in tariffs

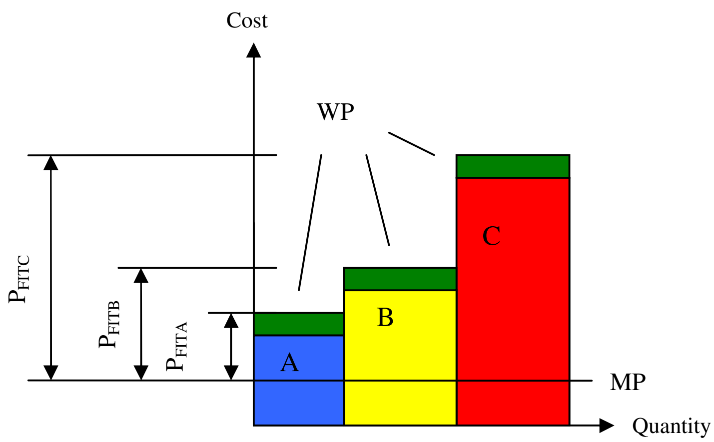
Feed-in tariffs set a fixed price for the purchase of one unit of renewable electricity. This rate is usually above the market price or above the cost of conventionally produced power and guaranteed for a long period of time (e.g. 15 to 20 years). Feed-in tariffs normally require grid operators to purchase all renewable electricity, regardless of total electricity demand. They are generally financed via a small top-up on the electricity price for final consumers, i.e. additional costs are distributed between all rate payers via national burden sharing mechanisms. When designing feed-in tariffs, legislators are looking for a balance between investment security for producers and reduced costs for the final consumer.

International best practice

A good feed-in tariff mechanism starts with a clear definition of the eligible technologies and plants. In order to choose the eligible technologies the policy maker should have a good idea about the resource potential in a given country or region. Thus, mapping the regional or national potential is an important first step. The first feed-in tariff schemes were implemented in the US (1978), Portugal (1988), Germany (1991) and Denmark (1992). However, these early feed-in tariffs had a number of shortcomings in comparison to present international best practice. This included insufficient tariff differentiation (for different technologies and plant sizes) due to the fact that tariff levels were usually based on the avoided external costs for conventionally produced electricity.

Nowadays, feed-in tariff schemes are almost exclusively calculated based on the generation cost for each renewable energy technology. Therefore, all feed-in tariff mechanisms are technology specific. The responsible ministry should develop a clear and transparent tariff calculation methodology which should include investment costs, grid connection costs, operation and maintenance costs, and fuel costs in the case of biomass and biogas. Good feed-in tariffs normally provide an internal rate of return of 5 to 10 percent.

Providing specific support for each renewable energy technology is a major advantage of feed-in tariffs over other support mechanisms, such as quota based systems. The German renewable energy law of 2000 was the first feed-in tariff mechanism that calculated the remuneration for all technologies, including solar power, based on the technology specific generation costs. In this way, windfall profits for producers can be reduced without damaging the high level of investment security (see graph below).



In order to avoid windfall profits and anticipate technological learning over time, many feed-in tariff schemes automatically reduce tariff payment on an annual basis. The German feed-in tariff mechanism was the first to implement this concept of tariff degression, i.e. the automatic, annual reduction of tariffs based on the expected learning curve of each technology. Accordingly, the tariff payment for each technology is reduced by a certain percentage. This tariff decrease, however, only affects new installations. In Germany, the tariff for wind energy, for instance, is reduced by 1 percent per annum. In the case of solar PV, the degression rate can reach 11 percent due to the higher potential for technological learning.

At a later stage in renewable market development, some countries have opted to implement location specific tariffs. So far this approach has only been used in the case of wind energy. Location specific tariffs for wind energy will lead to a more even distribution of wind power plants in a given territory, since producers will not be controlled solely by the windiest locations. This could reduce local opposition to wind farms, as the windiest spots are normally located in touristy areas on the coast line or the top of mountains, where they are most visible. If this approach is chosen, all wind power producers would receive a flat-rate tariff for the first years of operation. In this time period, the average full load hours are measured and the remuneration for the following years is fixed accordingly. Through this approach, windfall profits for producers at very good locations can be avoided. Even though location specific tariffs allow for wind power generation at second-best locations, the tariff scheme should nonetheless grant higher profitability rates at the most windy locations otherwise, the overall efficiency of the feed-in tariff scheme could be undermined.

With an increasing share of renewable electricity, policy makers will be looking for the implementation of design options to better integrate green power into the grey electricity market. Wind energy producers are sometimes obliged to forecast their production but at the same time they can receive additional tariff payments for auxiliary grid services, such as the capacity to support voltage dips and the provision of reactive power for grid stability. Furthermore, producers that can control the timing of power output are sometimes paid higher tariffs during peak demand and lower tariffs in off-peak periods. Legislators can also grant an additional tariff payment for the combination of several fluctuating and non-fluctuating technologies (e.g. the combination of electricity produced from wind power, biomass and solar power).

The most prominent design option for better market integration is the premium feed-in tariff. The renewable power producer sells electricity on the conventional power market and receives an additional premium on top of the guaranteed feed-in tariff. Together, both remuneration components should provide enough income for sufficient profitability. Logically, this premium feed-in tariff is lower than the normal, fixed feed-in tariff. Thus, the renewable electricity producer can no longer rely on the above mentioned purchase obligation. Premium feed-in tariffs are in use in a number of European countries, including Spain, the Netherlands, Czech Republic, Denmark and Slovenia.

Premium feed-in tariffs should be an optional choice for RE producers parallel to the more traditional fixed feed-in tariff schemes since premium feed-in tariffs normally favour large power producers such as utilities who have already gathered experience in selling electricity on the market. For small producers, such as households with solar PV panels on the roof, selling the electricity on the market is no option as the transaction costs are too high. In order to avoid windfall profits, the legislator must anticipate the market price of electricity as this becomes one component of the overall remuneration. Since predicting electricity prices has become increasingly difficult in times of volatile fuel prices, it is recommended to implement a "cap" and a "floor". The cap prevents the overall remuneration exceeding a certain limit thus avoiding windfall profits. The floor impedes the remuneration from falling below a certain threshold, thus guaranteeing a minimum amount of revenue.

Many developing countries and emerging economies, including Argentina, China, Ghana, Malaysia, Kenya, Nigeria, Pakistan, Ukraine and South Africa, have recently chosen feed-in tariffs to support renewable electricity. When implementing feed-in tariffs in developing countries, some specific design options have to be taken into consideration. Firstly, the financing mechanism might have to be modified as electricity consumers in these countries are usually more vulnerable to electricity price increases. The tariff payment is normally financed by distributing all cost amongst final electricity consumers. In developing countries, the additional costs or parts of it, might have to be covered by a national fund for renewable energy deployment. This approach, however, could undermine the stability of the support mechanism as governmental money would be included. Secondly, developing countries may need to limit the installed renewable capacity in order to control costs. Even though these "caps" had disruptive effects in the case of many industrialised countries, developing countries often still have national plans for the future investment of new power generation capacity.

Advantages and disadvantages

The success of feed-in tariffs largely relies on a high degree of investment security. Investors' risks (volume and price risk) can be significantly reduced by providing fixed tariff payment over a long period of time. Furthermore, renewable electricity producers are generally not subject to balancing risk (providing pre-negotiated amounts of electricity at a given moment in time), as feed-in tariffs include a purchasing obligation. The biggest advantage of feed-in tariffs over other support mechanisms is the technology specific approach. By being able to promote all renewable energy technologies according to their stage of technological development, the policy maker also has the chance to promote technologies which are still rather costly but have a large mid- or long-term potential (e.g. solar PV). In addition, mature technologies such as wind energy can be promoted in a cost-efficient manner.

Nonetheless, feed-in tariffs also have some disadvantages. In countries with liberalised energy markets, feed-in tariffs have sometimes been criticised for not being in line with the principles of a free market economy since the idea of "fixing" tariffs is associated with state-dominated, monopolistic energy markets. Tariff fixing has also been criticised for hindering technological learning. However, tariff degression and frequent assessments of tariff levels can help to address this problem. Additionally, the purchase obligation, i.e. the purchase of all renewable electricity regardless of electricity demand patterns, might lead to network balancing problems and increased grid operation costs. Moreover, it might be difficult to predict the number of market players and consequently renewable electricity projects which are attracted by a certain tariff level. Therefore, emerging economies and developing countries have often chosen to operate with capacity caps.

E. Supplementary tax and investment incentives

Investment incentives, i.e. capital grants, tax incentives, tax credits and soft loans, were the major support mechanisms for renewable energies in the 1980s and at the start of the 1990s [Resch et al. 2005]. They were mostly used for the realisation of demonstration projects. The previously mentioned support schemes, especially feed-in tariffs, quota based mechanisms and tender schemes, are generally supplemented by additional tax and investment incentives at an early stage of market development. Investment incentives are normally capacity-based incentives and investment focused, i.e. the State grants a certain financial incentive based on the size, i.e. the installed capacity, of the power plant.

Best practice
Capital grants are often given in form of contributions towards the total investment costs. In Turkey, for instance, renewable energy projects can now get capital grants of up to 20 percent of total investment costs. In Japan, the Sunshine Program provided capital grants for roof-top solar PV plants. Between 1994 and 2000, the government spent 86 billion yen (US$725 million). This led to the installation of 58,000 solar PV systems amounting to 220 MW installed capacity. The subsidies consisted of payment for each installed kilowatt hour peak that was installed [Beck & Martinot 2004]. Similarly, Germany started a "1000 solar roof" program in 1991. This program provided capital grants of up to 60 percent of total equipment costs. The program was succeeded by a "100,000 solar roof" program in 1999 which primarily consisted of soft loans as an additional feed-in tariff was guaranteed. In Germany, soft loans for renewable energy (and energy efficiency) projects are provided by the state-owned KfW bank group. The bank also grants soft loans for renewable energy projects in other countries. The loans are subsidised so that the bank can offer interest rates below market rates (in the range of 1 to 7 percent for German costumers).

Producers of renewable electricity are often exempt from certain taxes. This can be carbon taxes in the case of industrialised countries or taxes for imports of renewable energy equipment in developing countries. Tax exemptions are normally justified by the unfair competition with conventional energy sources which occurs when negative external costs are not internalised (see section "Why renewable energy support"). Many countries also operate with accelerated depreciation for renewable energy projects. This allows people investing in renewable energy projects to profit earlier from tax benefits. In India, an accelerated depreciation policy enables renewable energy investors 100 percent depreciation in the first five year of operation. The effect of accelerated depreciation is similar to the effects of investment tax credits [Beck and Martinot 2004].

In the United States, tax credit mechanisms have been used frequently to promote renewable energy sources. They can be separated into investment tax credits (ITC) and production tax credits (PTC). As implied by the name, ITCs guarantee favourable tax treatment to parties deciding to invest into renewable energy projects by providing a partial tax write-off. When buying renewable energy equipment, investors can receive a 5 to 50 percent tax credit [Mendonca et al. 2009a].

Advantages and disadvantages

Capital grants and tax incentives have the advantage of giving a very clear and predictable investment incentive to renewable energy investors. They can be applied to one specific or a whole range of technologies. In contrast to governmental research and development funding, private parties are usually targeted by capital grants and tax incentives. As mentioned above, these incentives have proven to be a successful supplementary instrument for renewable energy deployment. Like the previously mentioned support schemes, they socialize the costs from renewable electricity promotion by distributing them amongst all tax payers.

Yet these support mechanisms might also have certain drawbacks. Most obviously, investment incentives are (naturally) investment focuses and thus do not focus on the long-term operating performance of renewable energy power plants. This has sometimes led to a situation where investors have profited from governmental grants but never operated renewable energy power plants properly. This occurred in a wind energy plant in India, where the legislator now decided to move away from investment based support towards production based support instruments. Tax incentives such as accelerated depreciation and tax credit schemes also tend to favour large-scale power plants (due to economies of scale) and wealthy people since sufficient income is needed to utilize tax credits effectively. Therefore, capital grants and tax incentives implicitly exclude individuals and small businesses from participating in the renewable energy market [Mendonca et al. 2009a].

IV. Effectiveness and efficiency of support mechanisms

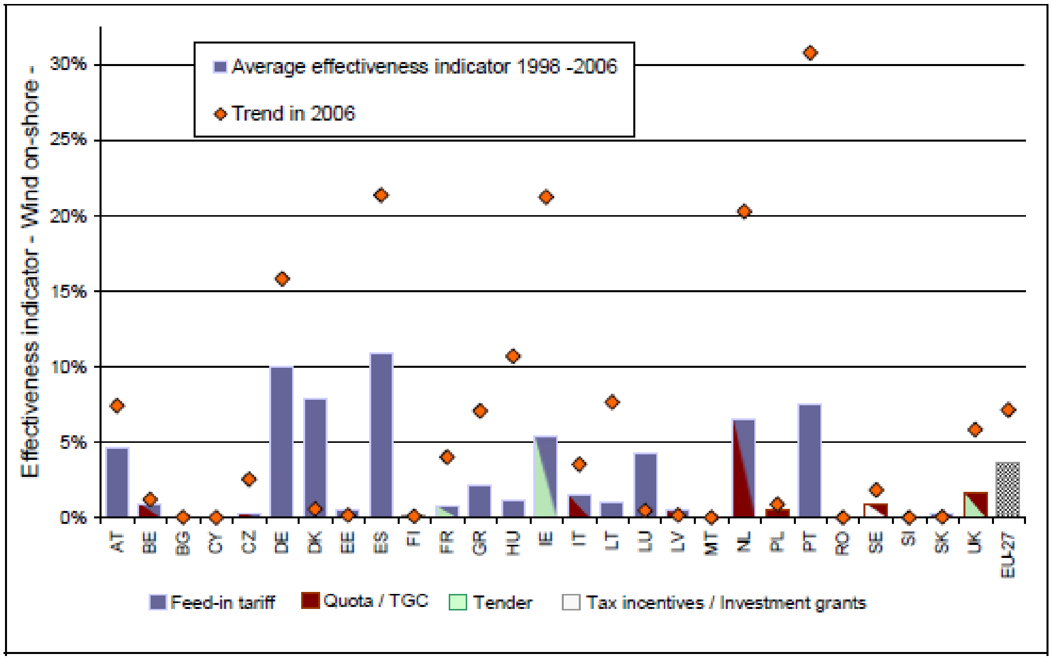
Support mechanisms for electricity from renewable energy sources have been frequently analysed. In economic theory, price and quantity based mechanisms ought to have the same impact. Both approached create an artificial market in order to stimulate renewable electricity deployment. In the case of price-based support the legislator fixes the "price" and the market decides the "quantity" of renewable energy projects. In the case of quantity based support the legislator fixes the amount of renewable electricity that shall be produced and the market decides the price [Hvelplund 2005]. However, in reality some support instruments have proven to be more successful than others.

Most recently, the European Commission and the International Energy Agency have evaluated the above mentioned support instruments for green electricity [EU Commission 2008; IEA 2008a]. Furthermore, a large European research project called "Assessment and optimisation of renewable support schemes in the European electricity market" (OPTRES) was co-financed by the European Commission [Ragwitz et al. 2007]. The success of support mechanisms has usually been evaluated my measuring the effectiveness and efficiency. Effectiveness refers to the ability of support mechanisms to increase the share of renewable electricity in the overall energy mix. Meanwhile, efficiency is related to cost-efficiency, i.e. a comparison of the total amount of support received and the generation cost. Only a small number of studies also took into account other non-economic factors such as stability, participation, transparency and ownership structure [c.f. Mendonca et al. 2009b; Jacobs 2005].

In the following section the most prominent renewable electricity support mechanisms will be compared, namely quota based mechanisms, tender schemes, net metering and feed-in tariffs. Investment and tax incentives are not being considered as they are generally applied as additional support mechanisms and their success significantly depends on the specific design in each country. This is, of course, also true for all other support instruments. In order to allow for a comparison, we are therefore going to assume standard design for the different mechanisms, e.g. quota based mechanisms being technology neutral while feed-in tariffs being technology specific.

Effectiveness

To date, technology specific support mechanisms, namely feed-in tariffs, have proven to be the most effective schemes. This is especially true in the case of wind energy, biogas, and solar PV. In the case of biomass, some quota based mechanisms have also been able to bring about renewable electricity deployment, due to the fact that these mechanisms generally promote the least costly technologies, e.g. landfill gas plants. The European Commission also stresses that production based support is far more important for the development of renewable energy projects than investment based support [EU Commission 2008]. This confirms that tax and investment incentives should be used as supplementary support instruments but not as the major policy for support. The graph below shows the effectiveness indicator for wind energy development within European countries. Clearly, feed-in tariff countries have made the biggest progress between 1996 and 2006:

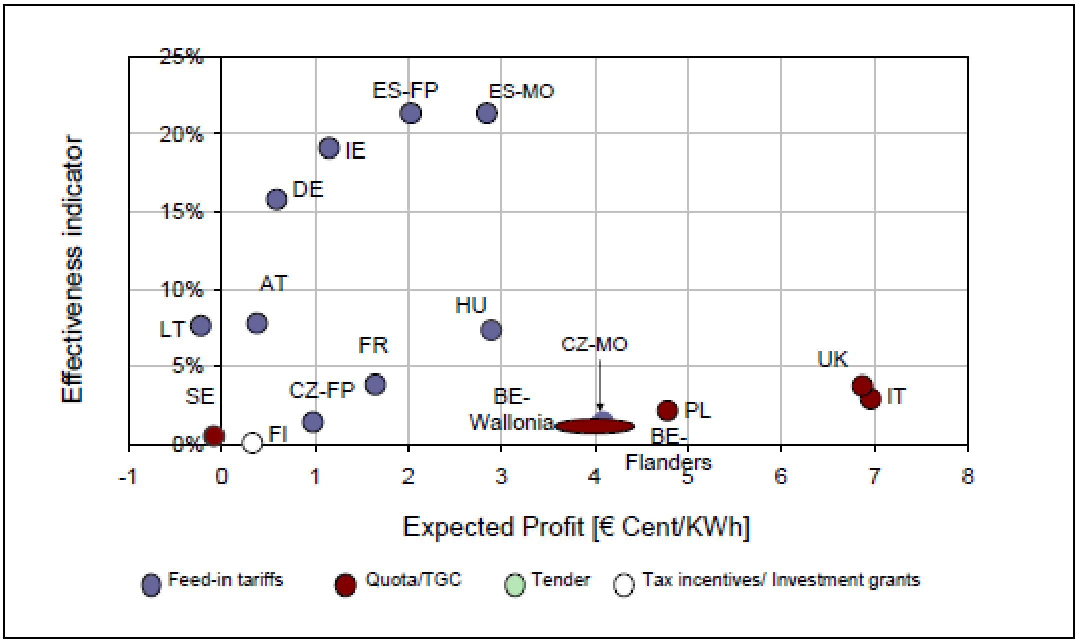


Source: Ragwitz 2007, EU Commission 2008

The dominance of feed-in tariffs over other support mechanisms is clearly related to the high degree of investment security, which is achieved by guaranteeing fixed tariff payment over a long period of time. In the case of quota based mechanisms, insecurity about the future rates of return slowed down investment while tender based mechanisms suffered from the fact that many projects had been abandoned because of low bids.

Efficiency

A similar picture appears when comparing the efficiency of support mechanisms. Generally speaker, feed-in tariff countries made better use of the money dedicated to renewable electricity support. The higher degree of efficiency of feed-in tariffs is also due to the high degree of investment security. By guaranteeing tariffs for a long period of time, project developers have fewer difficulties financing the renewable energy projects and financing conditions are generally better than with other support instruments. In the case of quota based support instruments, capital is generally more expansive as banks normally take a risk premium for the uncertain development of the certificate price and the electricity price. The graph below compares the effectiveness indicator for wind energy in the EU (see above) with the expected profit for the year 2006. It is evident that despite the fact that profits for renewable electricity producers under quota based support instruments are significantly higher, the effectiveness is still lower.



Source: Ragwitz et al. 2007; EU Commission 2008

The higher degree of efficiency of feed-in tariffs is also related to technology specific support. As shown above, well designed feed-in tariffs calculate the tariff payment based on the generation costs for each technology, normally assuming an internal rate of return between 5 and 9 percent. By doing this, windfall profits can be avoided. In contrast, technology neutral quota based mechanisms grant the same support to all technologies. Therefore, cost efficient technologies can normally count on very high internal rates of return while less mature technologies will not be developed at all. The following table summarises the effectiveness, efficiency and investment security for the different renewable electricity support mechanisms.

Summary of effectiveness, efficiency and investment security of support mechanisms for renewable electricity

	Effectiveness	**Efficiency**	**Investment security**
Feed-in tariff	High (due to fixed tariff payment over a long period of time)	High (due to cost-based tariff calculation and frequent adjustment of tariffs)	High (due to fixed tariff payment over a long period of time)
Net metering	Medium (due to focus on small-scale applications)	High (due to focus on auto-consumption of power)	Medium (due to volatility of purchase price for excess electricity)
Tender scheme	Low (due to high rate of unfinished projects)	High (due to acceptation of lowest bidder)	High (due to fixed remuneration based on tender process)
Quota obligations	Low (due to technology neutral design)	Low (due to lack of technology differentiation)	Low (due to volatility of electricity market price and certificate price)

V. Overcoming non-economic barriers

Economic incentives alone are often not enough to stimulate growth in the renewable energy sector. Therefore, in the following section we are going to present a number of non-economic barriers which have to be overcome. These can be grouped into administrative, grid-related and social barriers.

A. Administrative barriers

Effective administrative procedures can be achieved through the removal of frequent administrative barriers. They consist of long lead times for new renewable energy projects, complicated application procedures with a high number of involved authorities, and the lack of inclusion into spatial planning [Ragwitz et al. 2007].

Long lead times

The most frequently stated administrative barrier for the quick uptake of renewable energy technologies are long lead times. In the European Union, lead times for small hydro power plants vary from twelve months (Austria) to twelve years (Portugal and Spain). Long lead times have also influenced the development of other technologies. In the case of wind power in France, for instance, wind farm developers have to wait for up to five years to move from a project outline to the operation of the power plant. Legislators can eliminate this barrier by establishing a maximum time limit for the entire permitting process or single steps in the permitting process, thus exercising pressure on each institution involved to deal with applications in a timely manner. When setting deadlines the legislator has to make sure that the targeted organisations have the administrative potential to keep theses deadlines. At local or regional level, authorities often lack both experience in dealing with industrial size renewable energy projects and knowledge about the positive features of renewable energy sources in general.

Number of authorities and permitting

Legislators should also reduce the number of authorities involved in the permitting process. A large number of authorities involved often prolongs the process and makes it unnecessarily expensive for project developers. The number of involved authorities normally increases because of competences at different political levels, e.g. national, regional and local. In France, for example, a wind power plant developer has to get in touch with twenty seven different authorities. In some Italian regions, the permitting procedure for small-scale hydro power projects even requires the consent of up to 58 authorities. Therefore, the legislator should clarify the responsibilities of authorities at different political levels. The European Commission even suggested establishing a "one-stop-shop" organisation that could coordinate and simplify the entire administrative process. Developers would then only have to get in contact with this one organisation dealing with all other authorities. The European Commission also recommends quicker permitting procedures for micro generation projects as they differ fundamentally from large scale coal-fired power plants [EU Commission 2005]. Logically, small-scale, decentralised renewable energy installations should not have to go though the same permitting procedure as large-scale gas-fired power plants.

Spatial planning

The early inclusion of renewable energy projects in spatial planning is equally important for quick administrative procedures. Spatial planning provisions are generally implemented to organise the use of land in a given region, including space for roads, industrial areas, power plants etc. Therefore, spatial planning provisions have to anticipate the increased deployment of renewable energy projects. One successful example is the German building code of

1996. It obliged all municipalities and region authorities to designate special areas for wind power plants.

B. Grid-related barriers

In order to promote renewable electricity effectively, the legislator also has to tackle grid-related barriers. Primarily, these include grid access and connection rules, the lack of sufficient grid capacity and the cost sharing methodology for grid connection.

Priority access and connection

Grid access and connection rules are crucial for all independent power producers. Unfair and non-transparent grid access rules are frequently a barrier to renewable energy developments, especially in markets without “unbundling”, i.e. the grid operator is also engaged in power generation activities. This might lead to a situation where the grid operator prioritises its own power plants when considering whose power plant will be connected to the grid or whose power plant will be disconnected in times of of overcapacity. Therefore, good renewable energy legislation should include a provision that eligible power producers must be connected to the grid. In some countries, e.g. Germany, the legislator even imposes a “priority connection” obligation. Accordingly, the grid operator has to connect renewable energy plants prior to conventional energy plants, thus emphasising the political intention to support renewable energy sources and replace conventional power plants successively. In the case of electricity dispatch, i.e. choosing which power plants remain connected to the grid in the case of overcapacity, renewable energy plants usually remain connected as the short term power generation costs are close to zero. This is especially true in the case of solar and wind power as the “fuel cost” (wind and sunshine) is also zero. The situation is slightly different in the case of biomass where the short term cost for one unit of electricity highly depends on the price of biomass.

Grid connection charging

When designing a legal framework for renewable electricity generation, the cost sharing approach for grid connection has to be taken into consideration. In the past, most legislators around the world have followed a “deep” connection charging approach for power plants. In this situation, the power producer has to pay for grid connection costs but also for grid reinforcement of the existing grid infrastructure. In other words, if there is a lack in transmission capacity the renewable electricity producer has to pay for the necessary upgrading of the grid. The “deep” connection charging approach follows the logic of a power system based on large-scale, conventional power plants. Due to the high overall investment cost of coal or gas fired power plants the additional costs for grid connection and grid reinforcement are relatively small. In the case of renewable energy projects, however, grid connection and reinforcement costs can make up a significant share of the overall investment costs. The GreenNet-Europe study calculated that grid connection costs can account for up to 26.4 percent of the total cost of offshore wind installations [Auer et al. 2007]. Even though the share is lower in the case of all other renewable electricity technologies, the grid connection approach is still a decisive factor for the profitability and feasibility of a project.

For these reasons, more and more countries around the world are choosing a “shallow” connection charging approach for renewable energy projects. In this way, producers of renewable electricity only have to pay for the grid connection to the nearest connection point while the cost for grid reinforcement is covered by the national grid operator (or monopolist). The costs covered by the grid operator can be passed on to the final consumer in the shape of system charges. This approach allows renewable electricity producers to choose the best location for the power plant according to the availability of the resource (e.g. wind speed and solar radiation intensity) and not the availability of grid capacity. In the recent years, some countries, (e.g. Denmark and Germany) have even gone one step further, establishing a "super shallow" grid connection approach for wind offshore plants. Here, the renewable electricity producer does not even have to pay for the grid connection line to the next connection point. As the next connection point for offshore wind power plant is usually onshore, the long distance makes the new connection line very expensive. Under the "super shallow" approach even the costs for grid connection to the next connection point is paid by the grid operator, thus strictly separating the costs for power plants and the costs for grid infrastructure.

Grid extension plans

Finally, renewable energy development usually requires governments to plan substantial grid extensions. Therefore, grid extension plans should be prepared by the grid operator well ahead of time. In some cases, the best locations for renewable energy plants are located in regions with an underdeveloped grid infrastructure. In order to tap the full potential renewable energy potential in a given country, first of all the resource potential for the different renewable energy technologies has to be evaluated and later the grid has to be extended accordingly.

C. Social barriers

Renewable energy power plants are often small-scale and decentralised. Therefore, social acceptance is even more important than in the case of large-scale, centralised conventional power plants. Social barriers are often related to the NIMBY effect (Not In My BackYard) and the lack of inclusion with the local population in planning and ownership. Opposition from the local public has frequently been observed when deploying renewables. Even though the public is generally in favour of renewable energy promotion, resistance towards renewable energy technologies, especially wind energy, might occur at local level. TheNIMBY effect can be overcome by including the local public into the decision making process (e.g. spatial planning) at an early stage.

The local acceptance of renewable energy projects can also be increased by ownership participation of the local people. Examples in Denmark and Germany show that community wind energy projects, where local people were earning money from the wind power plants in their area, faced less opposition than utility owned and run wind power plants [Mendonca et al. 2009b]. The design of the national tax system can also contribute to local revenues and thus local acceptance. In Germany, for instance, owners of wind parks have to pay 50 percent of business tax to the community where the wind power plant is planned. This avoids situations where all tax benefits flow exclusively to the city where the company's headquarter is located.

VI. Summary and recommendations for Azerbaijan

Azerbaijan has already been successful in decoupling economic growth and energy consumption. As noted by the International Energy Agency, Azerbaijan experienced a GDP growth of 23 percent while electricity demand decreased by 15 percent in 2007. This improvement was largely due to more cost-reflective prices, better metering of electricity and more efficient improvements in electricity generation plants [IEA 2009]. A next step towards a more sustainable energy system is the establishment of a stable policy framework for the promotion of renewable energy sources. Azerbaijan has promising resources for wind energy, geothermal power, solar energy and biomass which are only waiting to be harnessed.

General recommendations

In order to promote renewable electricity, Azerbaijan needs to establish a long-term policy which grants a high degree of investment security. This policy should be supported by long-term, ambitious targets for renewable electricity generation (e.g. targets for 2020 or even 2030). Nowadays, all experts agree that support for renewable electricity should be technology specific in order to avoid windfall profits and at the same time promote a large range of renewable energy technologies.

Furthermore, administrative and grid related barriers should be tackled as soon as possible. Some legislators have made the mistake of primarily developing an attractive financial support framework and only dealing with non-economic barriers once they occur. This includes transparent and fair grid connection rules, the implementation of a "shallow" approach for sharing grid connection costs, and the streamlining of the permission process.

The Azerbaijani tariff regime – moving towards feed-in tariffs

International experiences with feed-in tariff schemes, as outlined in this paper, can provide guidance for Azerbaijani policy makers when designing the framework conditions for the promotion of renewable energy in Azerbaijan. Other support mechanisms, such as quota based instruments with certificate trading, require a well functioning liberalised energy market, which includes an electricity spot market (for electricity sales) and a large number of independent power producers (in order to create competition); – This is not the current situation in Azerbaijan.

To transform the existing tariff scheme in Azerbaijan into a well-designed feed-in tariff mechanism, the following design criteria should be taken into account:

- The tariff levels for all renewable energy technologies should be calculated based on the generation costs of each renewable energy technology. The increased tariff level for wind energy is already a step into the right direction but is not sufficient for sustainable and self-sufficient market development.
- Grid operators should be obliged to purchase all renewable electricity.
- Tariff payment should be guaranteed for a long period of time (e.g. 15 to 20 years) and should not be changed on an annual basis.
- Tariffs should be revised frequently. However, changes in the tariff regime should only produce new installations.
- A robust financing scheme for the feed-in tariff scheme has to be developed (e.g. financing via price increase for the final consumer, governmental budget or a fund option).
- In order to control costs of the feed-in tariff mechanism, capacity caps might have to be implemented at the start.
- Evaluate the development of renewable energy sources in frequently published progress reports.

VII. Further reading/bibliography

Auer, H.; Obersteiner, C.; Prüggler, C.; Weissensteiner, L.; Faber, T.; Resch, G. (2007) *Action Plan – Guiding a least cost grid integration of RES-electricity in an extended Europe*, GreenNet-Europe, May 2007.
Available online at: http://greennet.i-generation.at/

Baker, R.; Safarzade, E. (2009): A roadmap for renewable energy in Azerbaijan 2009 - Azerbaijan alternative energy sector analysis and roadmap, Report R-CDTA 7274, ADB, July-September 2009.

Beck, F.; Martinot, E. (2004): Renewable Energy Policies and Barriers, Encyclopedia of Energy 5 (2004), pp. 365 383.
Available online at: http://www.martinot.info/Beck_Martinot_AP.pdf

Butler, L.; Neuhoff, K. (2004): Comparison of feed-in tariff, quota and auction mechanisms to support wind power development, Cambridge Working Papers in Economics CWPE 0503, CMI Working Paper 70, 21 December 2004.
Available online at: http://www.econ.cam.ac.uk/electricity/publications/wp/ep70.pdf

Coenraads, R.; Reece, G.; Voogt, M.; Ragwitz, M.; Resch, G.; Faber, T.; Haas, R.; Konstantinaviciute, I.; Krivosik, J.; Chadim, T. (2008) *Progress: Promotion and Growth of Renewable Energy Sources and Systems, Final report*, Contract no.: TREN/D1/42-2005/S07.56988, Utrecht, Netherlands, 5 March 2008;
Available online at: http://publica.fraunhofer.de/eprints/urn:nbn:de:0011-n-815781.pdf
de Jager, D.; Rathmann, M. (2008): Policy instrument design to reduce financing costs in renewable energy technology projects, IEA Implementing Agreement on Renewable Energy Technology Deployment (RETD), October 2008.
Available online at: http://www.iea-retd.org/files/RETD_PID0810_Main.pdf

EU Commission (2005): *The support of electricity from renewable energy sources*, Communication from the Commission, COM(2005) 627 final, Brussels, 7.12.2005.
Available online at:
http://ec.europa.eu/energy/res/biomass_action_plan/doc/2005_12_07_comm_biomass_electricity_en.pdf

EU Commission (2008): The support of electricity from renewable energy sources, Commission staff working document, accompanying document to the proposal for directive of the European Parliament and of the Council on the promotion of the use energy from renewable sources, SEC(2008) 57, 23.01.2008, Brussels.
Available online at:
http://ec.europa.eu/energy/climate_actions/doc/2008_res_working_document_en.pdf

Haas, R.; Meyer, N.I.; Held, A.; Finon, D.; Lorenzoni, A.; Wiser, R.; Nishio, K.-I. (2008): Promoting electricity from renewable energy sources - lessons learned from the EU, United States, and Japan, in: Sioshansi F.(ed.), Comparative electricity markets - Design, Implementation, Performance, Amsterdam: Elsevier, 2008, pp.419-468.

Hvelplund, F. (2005): Renewable Energy: Political prices or political quantities, in: Volkmar Lauber (ed.): Switching to renewable power. A framework for the 21st century, London: Earthscan, pp. 228-245.

IEA (2008a): Deploying renewables: Principles for effective policies, Paris.

IEA (2008b): World Energy Outlook 2008, Paris.

IEA (2009): World Energy Outlook 2009, Paris.

Mendonca, M.; Jacobs, D.; Sovacool, B. (2009a): Powering the green economy – the feed-in tariff handbook, Earthscan: London.

Mendonça, M., Lacey, S. and Hvelplund, F. (2009b): Stability, participation and transparency in renewable energy policy: Lessons from Denmark and the United States, Policy and Society 27 (2009), pp. 379–398.

Morthorst, P. E.; Jørgensen, B. E.; Helby, P.; Twidell, J.; Hohmeyer, O.; Mora, D.; Auer, H.; Resch, G.; Huber, C. (2005): Support Schemes for Renewable Energy - A Comparative Analysis of Payment Mechanisms in the EU, RE-Xpansion project.
Available online at:
http://www.ewea.org/fileadmin/ewea_documents/documents/projects/rexpansion/050620_ewea_report.pdf

Ragwitz, M.; Held, A.; Resch, G.; Faber, T.; Huber, C.; Haas, R. (2006): Monitoring and evaluation of policy instruments to support renewable electricity in EU Member States, Final Report, Federal Environmental Agency (Umweltbundesamt).
Available online at: http://www.erneuerbare-energien.de/inhalt/36428/35605/

Ragwitz, M.; Held, A.; Resch, G.; Faber T., Haas, R.; Huber, C., Coenraads R., Voogt, M.; Reece, G.; Morthorst, P. E., Jensen, S. G., Konstantinaviciute, I., Heyder B. (2007): Assessment and optimisation of renewable energy support schemes in the European electricity market, OPTRES final report, Karlsruhe, February 2007.
Available online at http://www.optres.fhg.de/OPTRES_FINAL_REPORT.pdf

Resch G.; Lopez-Polo, M.-A.; Auer, H.; Haas, R.; Twidell, J.; Kjaer, C.; Chandler, H. (2005): Electricity from renewable energy sources in EU15 countries – A review of promotion strategies, Report of Work Phase 1 of the Altener project REXPANSION, supported by DG TREN, March 2005.

Stern, N. (2006): Stern Review: Report on the Economics of Climate Change, Cambridge University Press.