A REGULATION TO FOSTER BULK ELECTRICITY GENERATION FROM RENEWABLE ENERGIES IN SOUTH AFRICA

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Abstract – Regulations to promote the application of renewable energy in the electricity sector are crucial to achieve the government's target of increasing the share of renewable energy to 10 TWh within 10 years. Feed-In Tariffs are best feasible to accomplish a significant growth of renewable energy since it provide high certainty to investors and is easy to implement. For the design of a Feed-In Tariff for South Africa it is recommended that operators of the distribution grid (i.e the regional electricity distributors) are obligated to purchase electricity from renewable energy sources at a fixed price. The price should be set according to the generic generation costs. Remuneration levels should differ according to different costs of renewable energy technologies. Off-grid energy systems, solar water heating systems, and demand side management programmes should be considered to be promoted with regulation, too. Promotion of renewable energy can thus form an integral part of the National Electrification Fund.
Keywords: renewable energy, regulation, feed-in tariffs, set asides,

1. INTRODUCTION

The South African government states in its White Paper "On the Promotion of Renewable Energy and Clean Energy Development" that "government support for renewable energy to help establish an initial market share and non-discriminatory open access to the national electricity grid" is needed (White Paper 2002). A regulation to foster electricity generation from renewable energy (RE) is a central building block to achieve the government's target of increasing the share of RE on final energy consumption by 10 TWh within 10 years from now on.[1] This article intends to provide input to the discussion for such a regulation. It focuses on design issues of a Feed-In Tariffs since this type of regulation is easiest to implement. Moreover, Feed-In Tariffs have been most successful to trigger deployment of RE in countries around the world. Experiences with the German Renewable Energy Act[2] and its predecessor, the Electricity Feed-In Law serves as a guideline for design recommendations.

There are some aspects, which make energy policy in South African rather different from other countries. Achieving equity in all areas of society and thus also the energy sector is a central driver for any policy in South Africa. An RE regulation for South Africa needs thus to be supportive for black economic empowerment. Electricity supply to remote rural areas has been another key issue of South African energy policy. RE do contribute to supply electricity to these areas already today. So it is reasonable to combine policies to promote the deployment of RE with policies to foster the electricity supply to remote areas. Finally, South African power generation is based on inexpensive domestic energy resources i.e. mainly coal and hydropower. This makes it harder to the newcomer RE to compete in costs. Using RE will also not save foreign currency or decrease the security of energy supply, a strong motive for promoting RE in many other countries. However, South Africa's low electricity rates allow some financial leeway for promoting RE in the electricity sector.

The first section summarises pro and cons of different regulations to foster RE electricity. I then recall why a regulation to foster generation from RE is needed. A very simple scenario on how RE can be incorporated in the electricity generation is presented allowing to estimate the costs of meeting the targets. Then specific design issues of a Feed-In regulation are discussed considering findings of a workshop held in the framework of the SEPCo-project in South Africa in November 2002.[3]

2. FEED-IN TARIFFS VS. RENEWABLE SET-ASIDES

Feed-In Tariffs (also referred to as Fixed Price Standards or Minimum Price Standards) require grid-operators respectively default electricity suppliers to purchase electricity form RE generators at fixed premium prices. Feed-In Tariffs lead to a kind of regulated power purchase agreements for RE. Feed-In Tariffs regulate also grid access of RE power plants and power purchase of RE electricity. With RE set-asides (also referred to as quota based systems, tradable RE certificates or Renewable Portfolio Standards), electricity suppliers (alternatively electricity customers or electricity generators) are obligated to cover a certain share of their electricity supply (respective electricity demand or generation) with RE. The obligated parties comply with the obligation by presenting tradable 'green certificates' certifying the generation of a certain amount of

[1] As it is expressed in the draft of the White Paper.
[2] Downloadable under http://www.bmu.de/english/download/renewable /files/res-act.pdf
[3] SEPCo – Sustainable Energy Policy Concepts. For more information see http://sepco.ises.org

electricity. Thus these certificates have an economic value generating an extra income to RE electricity producers.

There is long and ongoing discussion both on the theoretical level as well as in practical politics whether Feed-In Tariffs or RE set-asides are the best suitable means to foster the market dissemination.[4] Neoclassical economic theory predicts, that both systems lead to an optimal and efficient solution. In a Feed-In Tariff the price is fixed and the amount of generated RE electricity is adapted. An individual generator will produce until his marginal costs equals the regulated price. With set-asides, the total amount of RE electricity is fixed and the price is flexible. In the order of their generation costs, RE electricity will be generated until the targeted amount is reached.

Although theoretical arguments have considerably influenced political discussion and decisions, the assessment of realised instruments is naturally of much bigger importance for the choice of an effective policy. Countries with Feed-In Tariffs (e.g. Denmark until 2000, France since 2001, Germany and Spain) have seen the largest growth of RE electricity. This applies particularly to wind power. At the same time, a viable RE manufacturing industry has been established in these countries. For reasons of organizing political support and creating local acceptance it has been proven successfully to spread ownership among many, preferable also local people. Albeit it is not appropriate to attribute the success in RE deployment solely to the influence of a single policy instrument it gets clear that a well designed Feed-In Tariff together with supplementing policies like simplified building-permission procedures is an effective means to support the deployment of RE electricity.

RE set-asides have been widely discussed recently and have been introduced in Austria (only small hydropower), Australia, Belgium (only the Flemish part) Italy, Sweden (May 2003), the United Kingdom and some states in the US. Such a mechanism is promising in theory, since it allows for the least expensive renewable energy technologies to be implemented first and equalises. At the same time, marginal costs of all obliged parties are the same. However, practical experience has been limited and rather mixed (Langniss and Wiser 2003). It is clear, that such a scheme creates higher uncertainty to investors then a well-designed Feed-In Tariff. Larger entities are more ready to take over these risks of selling electricity and certificates under uncertain conditions. Moreover, instead of a wide range of different RE technologies only the presently very most cost effective technology will be supported. Long-term contracts rather than spot markets will govern transactions between RE generators and the obligated parties undermining competition. The different design of the national renewable portfolio standards hinders rather than enables the free trade of certificates between different countries.

In bidding schemes RE capacity is periodically publicly tendered and power purchase contracts are awarded to the winning bids. Bidding schemes may be regarded as a special form of set-asides. Actual, obligated parties in RE set-asides have issued public call for tenders (Langniss and Wiser 2003). Thus the same lock-in to fixed prices occurs with RE set-asides as with power purchase agreements. In this respect RE set-asides have no advantages against Feed-In Tariffs.[5] England and Wales introduced a bidding scheme called Non-Fossil-Fuel obligation in 1990. In five rounds between 1990 and 1998, developers of RE plants could bid in different technology slots (e.g. wind power, waste to power, hydro power). The winners with the lowest bided generation costs were awarded with a 15-year power purchase agreement. The bid prices sank between 45 % (hydro power) and 70 % (wind power) between the first and the last round. Yet, due to different conditions in the procedure and the awarded power purchase agreements as well, the bid prices are not directly comparable to each other (Langniss 2003). More over, up to now (September 2002) none large wind project of the last bid round in 1998 has been commissioned at the low average bid price of 0.045 €/kWh. Supposedly, these bided prices are economically not feasible. Although the UK has the largest wind power potential in Europe, the NFFO failed to foster wind power and RE technologies in the expected way due to design weaknesses of the NFFO itself but also a lack of appropriate building-permission procedures. The NFFO was therefore abandoned.

Considering the large investments needed to establish RE in the energy system it will be crucial that RE power plants get a magnet for private capital. Long-term stability of income is a pre-condition to attract investors in long-term investments like RE power plants (Langniss and Wiser 2003, Langniss 2002). Thus long-term power purchase agreements either directly issued or guaranteed by a Feed-In-regulation are a suitable means. The long term stability allows access to low-interest credits. In contrast, set-aside regimes create uncertain income streams both for electricity and certificates leading to high costs for capital.

A general regulation will thereby create more reliable conditions for investors than the present South African case-by-case approach. This is of special importance if one does not only want to attract investment in RE electricity generation but also targets on creating a viable industry basis to manufacture RE plants. For the latter, the long-term perspective for a demand for RE power plants is an essential pre-condition. Moreover, a certain minimum size of the market for different technologies needs to be created to make investment in RE manufacturing feasible. Taking the case of wind power, it has been proven that the most viable manufacturing

[4] See e.g. Espey (2001), Haas et al. (2003), Meyer (2003) and more comprehensive Hveplund (2001).

[5] For a discussion of prices lock-in see Winkler and Mavhungu (2002).

industry can be found in these countries, which have established a Feed-In-type of regulation[6] whereas countries with bidding systems[7] or quotas[8] failed to establish a comparable manufacturing industry. Considering the significance of SA for entire Southern Africa, a South African RE manufacturing industry can gain a large importance for the entire region. Practise has proven that Feed-In regulations create far better conditions for small and medium size enterprises as operators. Thus, they give better grounds for economic development and black empowerment. In contrast, quotas tend to support larger enterprises.

Although economic support lasts to be the major driver for market dissemination of RE appropriate framework conditions like a fair access to electricity and gas grids, adapted building-codes, good access to capital or a vivid research environment are of high importance playing the role of 'hygienic factors' which need to be addressed for a successful market development.

3. THE NEED FOR REGULATION

According to neoclassical economics the state should only intervene in markets if markets fail to provide a beneficial good otherwise. This is especially true for so called public goods, which are beneficial for many but for which individuals will not pay for. RE comes with a set of public benefits thus public support for RE is reasonable.

RE have usually a lower environmental impact than conventional energy carriers. They do not emit poisonous gases[9] – as fossil power plans usually do – nor do they release CO_2. Environmental benefits from the use of RE arise therefore on the local, regional and global level. RE plants do not produce poisonous waste either – like nuclear power plants do. Based on calculations of the EXTERNE project the European Commission is assuming external costs of electricity generation of 5 cents€/kWh electricity (European Commission 2001). For South Africa, external costs of coal-fired electricity generation is calculated to be between 0.15 and 1.0 cent€/kWh (Spalding-Fecher and Matibe 2003) thus an order of magnitude lower than calculated for Europe. Using RE is also more labour intensive then fossil fuels thus jobs are created by the deployment of RE. Jobs are created with manufacturing of the plants, but also with erection and maintenance. Since RE are applied locally and dispersedly the jobs are often created in remote areas leading to some economic development desperately needed in these areas. As far as foreign energy sources are displaced the use of the domestic RE also saves on foreign currency.

Unfortunately, markets do not appreciate these public benefits today. Thus, RE technologies are still not economically competitive with conventional energy carriers in many applications. Thus, a cost gap between RE and conventional energy carriers still exists. This is especially true for the case of South Africa where inexpensive and abundant domestic coal reserves exist. But the use of these reserves is combined with high external costs. Thus, public regulation needs to correct this miss-control of the energy markets.

However, such kind of regulation is not meant as a permanent subsidisation of RE. Instead, dissemination of RE is targeted on bringing down generation costs of RE and making them competitive with the full costs of conventional electricity generation. Thereby, the head start of conventional energy carriers that has led to a technological lock-up will be compensated to a certain extent. It is worth to note that also other energy technologies namely nuclear power generation would not have seen commercialisation without public support in the early phases of their market introduction. At the same time, other national or international policies like emission trading or pollution control regulation will consider the external costs of conventional energy use thus increasing the generation costs of such technologies. A regulation to foster RE electricity generation should be thus regarded as a temporary means until the cost gap is balanced due to lower generation costs and an appropriate recognition of the external costs of conventional energy supply. In other words, such a regulation acknowledges the public benefits of RE.

4. A SIMPLE SCENARIO ON RE IN THE ELECTRICITY SECTOR

In the following, some rough calculations give an indication, what order of magnitude the financial burden from supporting RE electricity may reach. This calculation is based on some very simple assumptions.

The potentials of different RE technologies as given in the White Paper[10] are taken as a basis. I assume different realisation rates of the potentials according to the different costs of the technologies (the lower the costs the higher the realisation rate) and short term feasibility both in technical and organisational sense (refer Table 1). 80 % of the potential biomass residues are used as well as 80 % of the wind power potential. The potential hydro power is assumed to be exploited only half due to the more lengthy commission terms. Five solar thermal power plants each of 100 MW are assessed to be feasible to be commissioned by 2012. Since the scenario describes exclusively grid connected power generation PV is not

[6] Denmark until recently, Germany and Spain.
[7] The UK and France until recently.
[8] Austria (until recently), Italy and the UK.
[9] With the exemption of biomass burning as it is very obvious when applied in traditional open fires. However, modern technologies can omit most poisonous emissions.

[10] However, it is believed that some of the potential figures given in the White Paper are largely underestimating the real potential. Take the case of wind power. With more than 4000 km of coastline and 1.2 million km² area, SA is estimated to have only 3 GW of wind potential, whereas Germany with only 1000 km coast line and 350,000 km² has already realised 12 GW of wind power by end of 2002.

considered for cost reasons. In sum, such a RE generation portfolio would contribute to 14.6 % of the present electricity supply which translates to 26.5 TWh[11]. Please note, that this amount is much more as the target stated in the White Paper and relates much more to targets expressed in earlier drafts of the White Paper. The average costs of electricity generation for different RE technologies are estimated on the basis of generic data with some South African input (Synergy 2001, Kreher 2002). The average generation costs over all RE technologies amount to 0.032 €/kWh resulting in total additional annual costs of 380 Million €/yr by 2012. This translates to an increase of the present average electricity sales price of 0.0021 €/kWh sold or a relative price increase of 12 % over ten years compared to the present average electricity tariff of 1.75 €cents/kWh for electricity.

	Potential		Generation Costs	Scenario		
						Additional Costs
	GW	GWh	EUROct/ kWh	%	GWh	MEURO/yr
Wind	3	6000	4.5	80%	4800	132.00
Biomass					15120	189
Bagasse	0.30	1200	3	80%	960	12.00
saw mills		7600	3	80%	6080	76.00
pulp mills		4500	3	80%	3600	45.00
energy crops						0.00
grass						0.00
manure		5600	3	80%	4480	56.00
Hydro		11000	2	50%	5500	13.75
Solarthermal		36000	6		1100	46.75
PV			80		0	0.00
Total		71900			26520	381.5

Table 1: A simple scenario for bulk RE generation in SA by 2012.

There are certain short falls of this scenario approach. First, due to a lack of transparent generation and transmission costs, RE generation costs are related to the entire average electricity price. The pure generation costs are reportedly only 50 % of total electricity tariffs but are not determined on open markets, yet. A further price increase of conventional electricity generation (as projected with installations of new conventional power plants) is not taken into account. No growth of the electricity demand is considered. No cost reductions due to e.g. technical progress with RE technologies are considered. Mitigated external costs are not taken into account either. Still, this scenario may give an indication of the order of magnitude of the additional costs related to the introduction of renewable energies for electricity generation

[11] The RE generation is compared to the electricity supply instead of the net electricity generation since distributed RE generation close to consumption is assumed.

5. WHO SHOULD BE OBLIGATED TO PURCHASE THE ELECTRICITY?

The first question to be answered when designing a Feed-In regulation is who should be obligated to purchase the electricity from RE power plants. If one assumes a fully liberalised and disintegrated electricity market

- power generators
- transportation-grid-operators
- distribution-grid-operators
- electricity suppliers
- electricity consumers or
- an independent (state) agency

could be potentially obligated. Certain principles should be considered with the choice:

- There should be exactly one but only one obligated party for any RE plant. Otherwise it might lead to confusion if several different entities are obligated with a certain power plant. More over, obligated parties might shift off their obligation to each other.
- The parties to be obligated should be able to market the RE electricity. At least they should be able to forward it to entities that are able to do so.
- The additional financial burden from the purchase of RE power should be distributed equally since it is a national target to deploy RE electricity. For instance, the additional costs electricity consumers are charged in a region with a lot of obligated RE electricity purchase should not be higher than in areas with only a few RE power plants.
- The obligated purchase of power should not lead to a distortion of competition. This has to be considered only if the parties who finally bear the burden are in competition to each other.
- It must be feasible to enforce the obligation.

The first two principles point very much to the sectors of the electricity industry that are (still) monopolies. A monopoly means that there is only one service supplier for a given purchaser. In an regulated environment integrated electricity suppliers are organised as monopolies. In a liberalised market it is the transmission and distribution grid which remains usually a regulated monopoly. Thus, obligating grid-operators seems to be the natural choice to establish a future-proofed regulation. An important and desirable side-effect of obligating the grid-operator is that the access to the grid is regulated simultaneously. Thus, access to the grid often rated as the biggest obstacle for independent RE generators will be ensured at the same time.

One might argue that obliging the grid-operator to purchase electricity would counteract against a clear distinction between generation, distribution and trade, as it is seen as an indispensable condition for liberalising electricity markets. According to this argument, grid-operators should have exclusively the task to transport

and distribute electricity from the generation to the consumption but they should not own or market electricity. In practise however, a grid-operator needs also to purchase and market electricity in a entirely liberalised market to balance generation and demand in the electricity system. Thus, the marketing of the RE electricity would require no other skills then those located with grid-operators anyway. Grid-operator may even use some of the RE power to balance the system.[12]

With one national operator running a grid all over the country a surcharge on the grid-fees may be imposed on any electricity to be transported through the grid. By this, the financial burden will be distributed equally among all customers. Certain customer groups like electricity intensive industry (for reasons of international competition) or low-income households (for reasons of affordability) may be excepted from this surcharge. However, since electricity prices in SA are already among the lowest world-wide and the specific financial burden is very low[13] it seems reasonable to abstain from such exemptions as far as possible.

In case of several different grid-operating companies operating the grid in different regions one has to establish a balancing mechanism to keep the burden equal for all customers all over the country. This is not only desirable according to the third principle but also because commercial customers in competition may be affected differently in different grid-areas otherwise. A possible option for a balancing system would be to include the additional costs of the RE in the surcharge to be raised for the purpose of the planned National Electrification Fund anyway.

Alternatively to imposing an obligation, the state itself might purchase and marketed the RE electricity. Either an own state agency is established for this purpose or this task is handed over via a public request for proposals to a private entity. The costs could be covered via a grid surcharge. Such an approach would have the advantage that the purchase of RE electricity did not interfere with any other business of the purchasing party. RE generators would clearly know to whom to address to. However, such an attempt would require additional regulations on grid-access which would be included with an obligation of grid-operators automatically. Moreover, it would contradict against privatisation of the power sector since the state would need to play a more active role on the market again.

The participants of the SEPCO workshop in Pretoria on November 2002 agreed that the operators of the electricity distribution grid (i.e. up to a current of 132 kV) are the most appropriate parties to obligate since they will stay regional monopolies and thus also remain subject to regulatory supervision.[14] Moreover, operation of the grid does not underlie competition thus the additional burden from RE remuneration does distort markets. The distribution grid stretch across the entire country[15] RE operators can address to a unique entity. Since RE power plant operators will usually not feed in beyond the level of 132 kV they need to deal with the distribution grid operator anyway.

6. WHICH ENTITIES SHOULD BE FAVOURED BY THE PREMIUM REMUNERATION?

In a liberalised market any market player should usually be eligible to receive the premium tariffs according to the regulation. This means that established utilities as well as Independent Power Producers (IPP) can operate a RE plant which receives the premium remuneration. However, in practise electricity markets are not so much liberalised as textbooks assumes. Thus, an exclusion of established utilities may be considered under certain aspects.

Regulations to foster RE electricity were specifically successful in these countries where new players in form of IPP could be established. IPPs focusing on RE create usually strong support for public policies to foster RE since their core business is effected by any changes in the regulation. If ownership on these IPPs is spread among the population[16] such support translates also in votes thus raising the importance of such lobbying in the view of the politicians. Supporting new generators also enhance competition, once electricity markets are liberalised. Established utilities want often to exploit their existing generation capacity as much as possible thus having not too much interest in establishing new technologies. Another problem with the eligibility of utilities occurs when these utilities are still vertically integrated thus operating also the grid. The grid-operating subsidiary of the utility could refuse grid-connection of a RE-IPP thus preparing ground for an own RE power plant of the utility's generation branch. Moreover, an internal business is created, if the grid-operating branch pays the generation branch of the utility. Such an internal business would require additional monitoring to avoid fraud. Due to the decentralised, small character of many RE technologies, namely wind and PV, IPPs ran as small entities are sometimes better suited to implement RE than large utilities[17].

[12] Biomass plants and geothermal power plants are the best controllable RE technologies thus best suitable for balancing the electricity grid.

[13] See previous section.

[14] Presumably, the Regional Electricity Distributors will run the distribution grid depending on the final design of the restructuring of the power sector.

[15] Although it is not accessible everywhere.

[16] There are some 60.000 people (out of a population of 5 million holding shares on wind power plants in Denmark (Langniss 1999). In Germany, ownership on wind power plants are comparable widespread.

[17] Much of the wind power development in Europe has been driven through small and mid-size enterprises. This applies to the manufacturing as well as project development and operation. It is only recently, that also large companies are active in this field. Indeed, many initiatives of large utilities to introduce RE failed in Germany in the eighties and nineties.

On the other hand, some large economies of scale can be realised with certain RE technologies. This is especially true for solar thermal power plants and biomass plants. Also large wind power plants can realise some economies of scale. Large companies are well suited to raise the necessary capital for such projects and manage their operation. Regarding the large total capital required to deploy RE one should not exclude entities which have the capital sources to invest in RE. There is also a political aspect: Excluding certain parties may intensify resistance against a regulation from those who are excluded.

7. WHICH RE TECHNOLOGIES SHOULD BE FAVOURED?

Generally, any technology using RE to generate electricity should be supported. All available RE sources need to be exploited to reach a higher share of RE on the total energy supply. Also from the perspective of technology policy it is reasonable not to restrict development to only a few technologies. RE technologies for bulk electricity generation which have good prospects in terms of potential and possible application are wind power, solar thermal power plants, biomass and some small hydro power plants in South Africa. Some on-grid bulk electricity generation will be economical feasible in a few niche applications on the short and medium run. Deviations from the general rule may be considered for different reasons:

- Certain RE technologies are already mature and economical viable thus they do not need any extra public support. This applies e.g. for large hydropower plants.
- Due to restrictions in budget, regulators may wish to focus the limited financial means to only some, most promising technologies.
- Likewise, certain technologies may be feasible only with large power plant sizes. Then, the absolute burden from these installations might be rather high although the specific generation costs are rather low. Even though a certain share of RE-electricity would be achieved quite inexpensive this way, a few installations may not lead to a general establishment of RE technologies in South Africa.
- Other national and international means may already support certain technologies. Therefore a regulation may not need to support these technologies additionally. However, these others means are only an alternative to a regulation if they have the same reliability and long-term horizon as a regulation which is covered here. This has to be considered especially regarding international funding.
- Certain technologies may be also sponsored for other reasons than deployment of RE. This applies especially for waste to power schemes which are built to solve waste deposition at a first place. If legal requirements for building such schemes already exist, there is no need to sponsor it additionally with an RE regulation.

At the SEPCo-workshop in November 2002 it was found that a positive list of RE technologies should be developed. Some RE technologies with debatable environmental impacts such as large hydropower, land fill gas and waste incineration should be subject to a more comprehensive assessment on a case by case basis as it is provided e.g. by the World Commission for Dams. The frame developed recently to certify green electricity may serve as a basis for further discussion. Off-grid electricity systems, solar water heating and demand side measures should be considered to be eligible for promotion through the regulation.

8. WHAT PRINCIPLES TO SET THE REMUNERATION LEVEL SHOULD BE APPLIED?

An appropriate level of remuneration is very crucial for the success of a Feed-In regulation. If the remuneration levels are set too low, then no or only insufficient deployment of RE will take place. If on the other hand the levels are set too high, more financial means than original targeted will be allocated to RE-E electricity generation. Yet, the latter situation is neither ‘inefficient’ nor is it an ‘excess-subsidisation‘. It only means that more RE electricity will be generated at the specific price then originally implicitly targeted. It is politics that has to decide on the level of remuneration in the end since there are value judgements involved in such a decision. Still, certain principles on scientific grounds can be followed. Principles to be considered are

- One can orientate the remuneration on the generation costs of the different technologies.
- The remuneration is set following the prices of electricity.
- The remuneration is fixed according the avoided cost of conventional electricity generation considering thereby also the external costs of conventional electricity generation.

With putting the RE generation costs into focus one remunerate according what RE generators need to survive or RE industry in general needs to flourish. Thereby, one can assess the real costs of each plant applying for premium tariffs. This would ensure that not more than necessary is paid. However, in practise it is difficult and time consuming to determine exactly the generation costs as the general practise of regulating the electricity supply industry shows. Moreover, such a case-by-case approach would undermine the certainty so important for investors. Thus, the remuneration should orientate itself on the general generation costs of RE power plants. Thereby, it is feasible to distinguish by different RE technologies so that power plants using less expensive technologies will get a lower remuneration than more expensive ones. One may distinguish between solar thermal power, wind power hydropower, biomass and PV. If generation costs

of a certain technology vary over a large range a further distinction is possible. This distinction should follow the factor determining the cost differences. For example, if there exist large economies of scale with a certain technology the remuneration can be differentiated according to the size of the power plants. As another example, generation costs of wind power plans vary largely with the average wind speed at the specific site thus an orientation of the remuneration of wind power plants on the wind speed is appropriate. The general costs of generation can be determined with calculating typical, standard applications of RE technologies under typical South African conditions. Experiences from realised projects should be considered, too. With more and more RE applications in SA, cost determination will ease more and more in the future.

Against that, remuneration oriented on the prices[18] of electricity follows an entirely different concept. The affordability[19] compared to the electricity prices or the generation costs of conventional power plants is put into focus. The burden of the parties obligated to purchase the RE electricity should be reasonable. Thus, political opposition from those who will be obligated can be limited. On the other hand, a remuneration determined this way may be insufficient to drive deployment of RE. Or it will come to a remuneration exceeding by far the cost of generation. Consequently, the costs of typical RE generation have to be calculated anyway to give an indication whether the remuneration levels are sufficient or not.

It was stressed earlier that a Feed-In-regulation should be regarded as a means to consider the external benefits of electricity generation from RE. So it is rationale to orientate the level of remuneration on the avoided external costs plus the avoided market costs of conventional electricity generation. As with taking the prices of conventional electricity production as guidance this concept confines the remuneration to some justified level. However, it fails to ascertain what level of remuneration is needed to see a certain deployment of RE generation. Thus, this concept may serve as a justification for the remuneration rather than for determination.

At the SEPCo-workshop a remuneration based on the average generation costs of a certain RE technology was regarded to be most feasible. Against that, remuneration on the basis of avoided generation costs of conventional power plants including external costs were rejected since numbers on external costs of electricity production in South Africa are regarded as weak. Moreover, it was felt that there is no further need to justify a higher remuneration to RE beyond that what is stated in the White Paper. Further investigations are needed to determine typical RE generation costs in SA. Remuneration levels should be differentiated according to different RE technologies. The local content of plant manufacturing and electricity generation in general should create a bonus. The same applies to RE power plants owned by members of disfavoured groups.

The level of remuneration is not the only factor influencing the income of the entities parties favoured by the regulation. Also the duration/term in which the premium tariffs are guaranteed has an influence. The shorter this term is the higher has to be the remuneration to achieve the same income in terms of net present value. Principally, the term of guaranteed payments should be as long as the typical economical lifetime of a certain RE technology thereby lowering the absolute level of remuneration. 15 to 20 years are reasonable plant lifetimes for most RE technologies. At the same time, a strong incentive is provided to operate conscientiously the RE power plant over its entire lifetime. To raise certainty with investors, the term of remuneration should be fixed in the regulation.

9. CONCLUSION

This article provided an overview on design issues of a Feed-In Tariff to promote renewable energy for electricity generation in South Africa. For certain aspects recommendations were drawn:

A Renewable Electricity regulation based on a fixed RE feed in tariff is the most appropriate and crucial policy element to achieve an immediate RE deployment in the electricity sector. The level of remuneration should be fixed based on the costs of RE generation. Different levels should be fixed for different RE technologies. The operator of the distribution grid (i.e. up to 132 kV) should be obligated to purchase the RE electricity at the fixed prices. Presumably, the distribution grid will be run by the Regional Electricity Distributors (REDs).

The National Electricity Regulator should be mandated to further develop recommendations for the details of a Renewable Electricity regulation based on fixed Feed-In Tariffs; and to implement this following input from stakeholders and to develop a framework for a Tradable Renewable Energy Certificate (TREC) system.

Set asides should be considered as an option for bringing down further costs in the future. Development and establishment of a functioning RE set-aside system will require more time and efforts.

Off-grid energy systems, solar water heating systems, and demand side management programmes should be considered to be promoted with RE regulation, too.

A scheme for certification of RE electricity generation should be developed, learning from previous South African experience, e.g. the certification scheme already developed for the purpose of green electricity supply to the WSSD. Furthermore, the TREC framework creates opportunities for regional Renewable Energy trades.

[18] The electricity price comprises the costs of generation, transport and distribution plus a profit.

[19] One has to be aware that the term 'affordability' has a different notion in different countries. In developing countries it has the notion of access of poor people to modern energy services whereas in a developed country context affordability is very much about the burden of means to state or private budgets.

Certification is helpful in a Feed-in Tariff for auditing RE generators. At the same time, certification opens the opportunity for voluntary marketing of green electricity.

A certification scheme is a crucial element of a RE set aside, too. A Feed-In Tariff can be adapted to the specific demands of South Africa concerning equity and rural electrification. The financial burden to the electricity customer is negligible with an estimated 0.21 cents€/kWh in the final stage. A system benefit charge as envisaged for funding electrification could be used to collect required funds for the Feed-In Tariff. Even though easy in design the implementation of such a regulation would need some more investigations concerning costs of RE electricity generation in South Africa and some other details. However, such investigations should be not used as an excuse for delaying further necessary steps to establish a promotional regulation in due time.

ACKNOWLEDGEMENT

This article benefited from input of the project Sustainable Energy Policy Concepts (SEPCo) commissioned by the International Solar Energy Society (ISES) on behalf of the German Ministry for the Environment. In the framework of this project two two-day work shops were held in Pretoria in November 2001, 2002 respectively. The 2002 workshop was targeted on developing cornerstones for a regulation to promote RE for electricity generation in South Africa. 35 people from ministries, business and NGOs attended the workshop.

The authors holds currently a Marie-Curie Grant of the European Union (Contract MCFI-2000-01067).

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