

ELECTRICITY GENERATION: REGULATORY MECHANISMS TO INCENTIVE RENEWABLE ALTERNATIVE ENERGY SOURCES IN BRAZIL

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ABSTRACT

The dissemination of renewable alternative energy sources for electricity generation has always been done through regulatory mechanisms, created and managed by the government of each country. Since these sources are more costly to generate, they have received incentives in response to worldwide environmental concerns, above all with regard to the reduction of CO₂ emissions. In Brazil, the electricity generation from renewable alternative sources is experiencing a new phase of growth. Until a short time ago, environmental appeal was the strongest incentive to these sources in Brazil but it was insufficient to attain its objective. With the electricity crisis and the rationing imposed in 2001, another important factor gained awareness: the need to diversify energy sources. Within this context, this work has the objective of analyzing the regulatory mechanisms recently developed to stimulate electricity generation from renewable alternative energy sources in Brazil by following the experience of other countries such as the United States, United Kingdom, Germany.

1. INTRODUCTION

A large part of the experiences with renewable alternative sources in the world was developed in function of the application of specific mechanisms to stimulate their use. For our purposes in this work, renewable alternative energy sources should be understood as wind energy, solar photovoltaic and some forms of biomass, such as vegetable oils and residues of lumbering activities, among others. Unfortunately, one of the barriers to the dissemination of these sources is their elevated cost when compared to conventional sources. Due to the incipient development stage of some renewable alternative technologies and their production on a non-industrial scale, they are not yet attractive from a strictly economic point of view. However, if the traditional form of evaluation of energy costs considered the environmental costs of conventional sources and the advantages of renewable alternative sources to the environment, certainly this picture would be modified (Cavaliero & Silva, 2002).

One of the environmental advantages of renewable alternative sources is the potential reduction of the gas emissions responsible for the greenhouse effect in the atmosphere, especially CO₂. This fact, in association with the intensive growth of the electricity market and the difficulties in meeting its needs satisfactorily through large power plants, has motivated the support of decentralized energy generation (also known as distributed

generation). In this case, the renewable alternative energy sources again constitute an important option to attend growing needs.

Several countries are working along these lines to define policies to foment the renewable alternative sources of electricity generation in an effort to make them more competitive with conventional generation sources. For this reason, the objective of this work is to analyze the regulatory mechanisms in development in Brazil by following the experience of the United States, United Kingdom and Germany.

2. THE EXPERIENCE OF THE UNITED STATES, UNITED KINGDOM AND GERMANY

A large part of the initiatives being taken to promote alternative renewable energy sources is concentrated on regulatory activity, which is the responsibility of the government, a tendency that has also been observed in Brazil through actions of the National Legislative Power and the National Electric Energy Agency - ANEEL ¹. However, it is important to mention that these activities were being carried out in an inefficient manner, partially justifying the timid response of this agency in conceding incentives to the alternative renewable energy sources up until now.

Therefore, countries such as the United States, United Kingdom and Germany are advancing in the application of special programs and in the introduction of specific laws to stimulate the use of these sources in the generation of electrical energy. In both cases, an important factor is obvious in the interest of these countries: the predominance of thermoelectric generation using combustible fossils and the negative environmental impact associated to this type of generation. Aside from this fact, the electrical sector in both the United Kingdom and the United States underwent a process of restructuring in an attempt to introduce a competitive market in some activities. Faced with this scenario, it became necessary to adopt specific measures to protect generation through the use of alternative sources of energy.

In a summarized form, Table 1 shows the main programs introduced in these countries, as well as the policies adopted at the moment, to increase the participation of renewable alternative sources in the respective electrical sectors.

Table 1: Some programs and policies adopted in United States, United Kingdom and Germany.

UNITED STATES

Program/Policy	Characteristics	Comments
Renewable Portfolio Standard - RPS	Establishes a certain percentage of alternative energy sources. The legislation permits that, instead of generating or buying electricity generated by renewable alternative sources, a given company meet its goals by purchasing "credits" on the market. These credits (Renewable Energy Credits – REC) are trade certificates that attest the guarantee of the generation by	In principle, in 1997, the federal government proposed that the goals be 3% in 2005 and 4% in 2010. However, in 1999, the proposed goal for 2010 increased to 7.5%. In 1998, eight states had already included the RPS in the directives of their plans for restructuring the electricity industry. According to some studies, if the goal for 2010 were 56 TWh of additional generation by these sources, the cost to the consumer

renewable alternative sources in a determined location and quantity. would be only 0.03 cents/kWh. Wind energy (56%) and geothermal energy (36%) would be the principal contributors to meeting the goals.

Funds for Renewable Alternative Sources

Funds collected from consumers by means of a tax on the tariff of the three largest Investor-Owned Utilities – IOU.

Adopted by the Californian Legislature (AB1890) in 1996. In application since January of 1998, it finances already existing renewable alternative source projects, projects with new technologies, projects based on emerging technologies, and the direct energy sale generated by renewable sources to the final consumers. Its resources are distributed through bids at auctions among projects for the development of new plants with renewable alternative sources. Estimates indicate collection of approximately 540 million US\$ in four years.

Green Marketing

Voluntary purchase of electricity generated by renewable alternative energy sources, even if this service should require an increase in the tariff.

In 1998, there were almost 40 utility companies in the country offering green power programs, but the total commercialized capacity and the number of consumers were still quite small in relation to the dimensions of the American market. By May of the same year, approximately 45 thousand residential consumers were participating in these programs.

UNITED KINGDOM

Program/Policy	Characteristics	Comments
Non-Fossil Fuel Obligation - NFFO	Electricity supply companies were obliged to guarantee a market, during a determined period of time, for pre-established amounts of generation capacity originated from pre-selected renewable sources. Payment was made through the application of different prices, called premium prices. The difference between the market price and the premium price was paid by a tax collected from all final electricity consumers in the UK, known as the Fossil Fuel Levy. The choice of the projects was made through a bidding process (cheapest scheme) and the auction occurred among similar technologies. The winning scheme was contracted for a period of not more than fifteen years.	Five rounds of bids were realized in England and Wales, two in Scotland and two in Northern Ireland, adding up to 331 projects (approximately 830 MW DNC). As NFFO rounds advanced, there was a gradual reduction of electricity prices by renewable energy sources. The reasons for this could be the amortization of capital costs over longer periods, the familiarity of the technologies and the knowledge of the risks involved. As a result, some technologies, such as sewage gas projects, were taken off the NFFO orders as they became more competitive on the open market. Even with the good results of the NFFO (3% of the total generation in the UK in 1997 was from renewable sources), the British government decided to adopt a new regulatory mechanism: the Renewables Obligation.
Renewables Obligation	All licensed electricity suppliers in England and Wales are obliged to supply a specific proportion of their market with electricity generated from renewable alternative energy sources. To	It was programmed to begin in October of 2001 and terminate in March of 2026. The emission of ROCs, monitoring of information and regulation of this new trade market will be the responsibility of

confirm the fulfillment of the goals, a certificate denominated Renewable Obligation Certificate – ROC – will be created to attest the origin, quality and quantity of energy acquired to supply the respective markets of each electricity supplier. The electricity suppliers have three options to fulfill their goals: supply part of their market with energy bought from these sources; negotiate the purchase of ROCs on the trade market; or still, pay something similar to a fine to OFGEM, called buy out price.

the Office of Gas and Electric Markets – OFGEM - that must annually present a report on the achievement of the goals. Some sources, such as large scale hydro (exceeding 10 MW) and energy from municipal, industrial and commercial waste, already present well-developed technologies, competitive on an equal basis with fossil sources in the UK. For this reason, the government decided to call these sources non-eligible renewables and exclude them from the Renewables Obligation.

GERMANY

Program/Policy	Characteristics	Comments
Renewable Energy Sources Act	All utility companies that operate grids for public power supply (called grid operators) would be obliged to buy electricity generated from renewable energy sources. This electricity would be paid for at special new tariffs that would be charged for 20 years, after the year of commissioning, except for installations using hydraulic energy.	The norms are valid for new installations, also being applicable to reactivated or modernized installations, as long as their renovation costs be superior to 50% of the investment costs required to build a completely new installation. An important fact defined in the law refers to the gradual reduction of tariffs. As of January 01, 2002, the compensations to be paid for electricity generated from two renewable sources will be reduced annually: biomass will suffer a reduction of 1% in the minimum compensation amounts and wind energy a reduction of 1.5%.
250 MW Wind Energy Programme	Donations of a maximum of 25% of the investment cost are made, with a limit of 90,000 DM (approximately 43.5 thousand US\$) and operational subsidies of up to 6 pfenning/kWh (29.07 US\$/MWh) are given for energy delivered to the public grid.	It was introduced in February of 1991 as an extension of the 100 MW Wind Energy Programme that began in June of 1989. The last donations were approved in 1996 for turbines to be connected to the grid during the second semester of 1998.
100,000 Photovoltaic Roof Programme	Regards the installation and expansion of photovoltaic systems with a nominal potential of at least 1 kWp. It is administrated by the German Credit Institution for Reconstruction that grants financing, respecting the limit of 500,000 Euro (approximately 473 thousand US\$), at zero percent interest to be paid in 10 years, the first payment being due only after the second year.	It began in January of 1999 and terminates in 2004. This program is the successor of the 1,000 Roof Programme introduced in 1991.

Source: Cavaliero, 2003.

The measures taken by the countries mentioned show that, despite the different mechanisms existing to stimulate the use of renewable alternative sources, there is a tendency to adopt the obligatory purchase of electrical energy produced from these sources by applying a higher tariff to be paid by all consumers. In Brazil, this tendency can also be verified by the

recently created Program for Incentive of the Renewable Alternative Energy Sources – PROINFA.

3. BRAZIL

The Brazilian electrical sector presents a peculiarity that distinguishes it from the majority of countries: the predominance of hydraulic energy in electricity generation. In worldwide terms, the primary energy sources most explored are fossil fuels, like oil, coal and gas, followed by hydroelectric and nuclear sources, in a distinct context from the Brazilian situation, in which fossil fuels occupy a secondary position. In 2001, the hydroelectric participation was 61 GW, corresponding to 82% of the national installed capacity, while conventional thermal and nuclear generation was responsible for the other 18% (MME, 2002). In spite of this significant participation, the installed hydroelectric generation capacity represents only 23% of the total hydraulic potential in Brazil, showing that there is much more to be explored (CCPE, 2002),

The Brazilian electrical system is divided into two segments: the interconnected system and the isolated systems. The interconnected system presented an installed capacity of 66,694 MW in 2001, representing about 96% of the total, the largest portion of the Brazilian electrical system. The rest corresponds to the isolated systems, predominantly thermoelectric, and is located principally in the Northern Region of the country. While in the interconnected system and in the capitals of the Northern Region the electricity service is satisfactory, in the isolated systems of the inland areas of this region the service is precarious, due to the inefficient functioning of the motors (low load) and their advanced ages. All of these conditions increase the operation and maintenance costs that, together with fuel transportation costs to the localities, elevates the total electricity generation cost in the isolated systems, currently the highest in the Brazilian system. Besides that, the great majority of the inland communities has a very low family income, completely incompatible with electricity generation costs in the region (Silva & Cavaliero, 2001).

In Brazil, in spite of the environmental appeal used to stimulate renewable alternative energy sources, it was never decisive to its increment in the electrical sector, especially due to the low cost of hydraulic-based energy (which, we might add, is also renewable) and the incorporation of natural gas to the thermal base at relatively interesting costs in relation to alternative energies.

This scenario took a new route in 2001. The crisis in electricity supply experienced that year brought to the surface not only the discussions on the restructuring model adopted by the electrical sector but especially the importance of diversification of energy sources, so emphasized in the National Energetic Policy and in the Energetic Planning of the sector, but effectively ignored until now (Cavaliero et al, 2001).

During the crisis the Chamber for Electricity Crisis Management (GCE) was created to act in an immediate way, establishing goals for the reduction of electricity consumption laid out in the Rationing Plan, and also looking for short and medium-term solutions to stimulate investments in generation and diversify the sector's energy resources (CSPE, 2001).

In order to correct some dysfunctions detected in the restructuring model during the period of rationing, the Plan for Revitalization of the Electrical Sector Model was introduced

in January of 2002. In its Progress Report n° 1, various measures were listed, some for immediate implementation, such as the incentive to alternative energy sources, and others to be submitted to public consultation. The Plan suggests the modification of the financing system for programs based on these sources with the objective of stimulating the development of technologies whose present state impedes them from being competitive. Aside from this, this measure attempts to make clear the subsidies granted to these sources and divide the costs among all of the country's consumers, avoiding that the entire cost of renewable alternative technologies fall upon only one group of consumers (Energia Brasil, 2002).

In an effort to regulate the Revitalization Plan measures and other points, such as the compensation of the utilities revenue losses during the rationing, the Provisory Measure n° 14 was elaborated. After some changes, this measure was transformed into Law 10.438/02 that regulates various points, among them the creation of the Program for the Stimulation of Renewable Alternative Energy Sources, called PROINFA (Canal Energia, 2002).

3.1. PROINFA

The objective of this program is to increase the participation of Autonomous Independent Producers¹ in electricity generation using wind energy, small hydroelectric plants and biomass in the interconnected national system (Presidency of the Federal Republic of Brazil, 2002). To achieve this objective, PROINFA is divided into two stages. In the first, Centrais Elétricas Brasileiras S.A. – ELETROBRÁS, the major electricity state-utility in the country, will contract, in a period of up to 24 months after the publication of the law, 3,300 MW of capacity generated by installations that will become operational by December 30, 2006. The purchase of electricity will be guaranteed for 15 years after the beginning of operation, at an economic value corresponding to the specific technology of each source, to be defined by the Executive Power. However, this value needs to respect a minimum, defined as 80% of the average national tariff of supply to the final consumer.

The costs will be divided proportionally among all consumer groups belonging to the interconnected system by the individual consumption verified. The total capacity, mentioned before, will be distributed equally among the three alternative sources: wind energy, small hydroelectric plants and biomass and will be contracted by public bidding. Priority will be given to installations that possess the Environmental License for Installation and then to installations possessing the Preliminary Environmental License. Aside from this, manufacturers of generation equipment can participate as Autonomous Independent Producers as long as the percentage of national equipment used is at least 50% of their value (Presidency of the Federative Republic of Brazil, 2002).

Once the goal of 3,300 MW of capacity is reached, the second stage of the program determines that, in 20 years, these alternative sources should attend 10% of the annual national consumption of electricity. The contract will continue to be signed with ELETROBRÁS for 15 years, but there will be an annual program of energy acquisition, so that these sources attend a minimum of 15% of the annual electricity increase to be supplied to the national consumer market. The purchase price will correspond to the economic value of competitive energy generation, defined by law as the average generation costs of new hydraulic improvements, superior to 30 MW, and natural gas power plants. Since this value will certainly be insufficient to cover the generation costs, the supplier will be given an credit,

¹ Companies whose stock control does not belong to any generation, transmission or distribution company.

calculated by the difference between the specific economic value of each source (but always respecting the minimum value) and the value received from ELETROBRÁS (competitive generation). The resources for these credit come from the Energy Development Account, also created by Law 10.438/02. This stage foresees the implementation of a Renewable Energy Certificate - CER, on which the supplier's juridical information, primary energy source and quantity of energy commercialized will be given. This certificate will be presented to ANEEL so that goals can be accompanied and controlled annually (Presidency of the Federative Republic of Brazil, 2002).

Electricity will continue to be contracted through public bidding and ordering will maintain the priority degrees defined in the first stage. A minimum term of 24 months will be stipulated, however, between the signature of the contract and the actual functioning of the installations. The equal distribution among the sources will be maintained, with the possibility of the Executive Power, after each 5 years of implantation of the second stage, to transfer to other sources the surplus capacity not contracted for lack of interested parties. Aside from this, the Executive Power will be able to authorize ELETROBRÁS to contract independent suppliers that are not Autonomous Independent Producers, as long as this does not result in their neglect and does not exceed 25% of the annual contracting program (in the case of wind energy, this value should not exceed 50% of the first stage of the program). And, finally, all of the costs will continue to be divided proportionally among all final consumers of the interconnected system (Presidency of the Federative Republic of Brazil, 2002).

Since the Provisory Measure nº 14 was voted, the creation of PROINFA has been surrounded by positive and negative repercussions. In its objective, the program includes a new figure in the electrical sector: the Autonomous Independent Producer. According to the law, these new agents will have priority in contracting electricity, a fact that left many market segments discontent. On the other hand, it cannot be denied that the introduction of the Autonomous Independent Producer makes the generation segment more competitive, especially in the case of wind energy, considering that just two large companies together already detained approximately 80% of the projects authorized by ANEEL up to April of 2002. Aside from this, the law defines that, in the first stage, the independent producers (not autonomous) can participate with up to 50% of the total capacity of wind energy to be contracted, which restricts their participation, avoiding the formation of market power and permitting other companies to participate.

A favorable point in the program procedures was the determination to equally distribute the contracting of capacity among the three alternative sources: wind energy, small hydroelectric plants and biomass. This measure avoids investments in only the most competitive technology, as is the case of wind energy compared to the others. It is also understandable that this program be, at least initially, directed to these sources, since the cost of photovoltaic solar energy is still too high on the interconnected system when compared to the other alternative sources. In the case of Brazil, this situation is more serious, since there is no national photovoltaic industry.

There are doubts, however, regarding the capacity of this program to develop the technologies to a point of reducing their costs and making them competitive. This is due to the fact that the system adopted guarantees the energy economic value during the entire program. In the first stage, this system could be interesting to attract investors. In the second stage, however, which foresees the long-term expansion of these sources, this system could be ineffective and faulty, since the companies will lack motivation to improve their efficiency

and to reduce their costs. A fundamental characteristic of any incentive mechanism consists in the gradual reduction of these incentives within a stipulated period of time. Only in this way the companies would be obliged to invest in their technologies so that they can reduce their costs and gradually become competitive with traditional sources.

An interesting point in the program refers to the proportional division of the costs among all consumers. This is a tendency that is occurring in many countries. Although different lines of incentive for renewable alternative energy sources exist, what can be verified currently is the convergence to a specific system: the payment of a special and higher tariff by all electricity consumers. Something similar is already being done in Brazil: a share among all consumers to support the more costly thermoelectric generation of the isolated systems through the Combustibles Consumption Account – CCA. The problem is that, unfortunately, up to now, this resource has not been able to give support to generation using renewable alternative sources, as is foreseen in law for the isolated systems, but only to diesel oil and fuel oil power plants.

The program also foresees the issuance of CERs attesting the electricity generation from renewable energy. This is a point that causes some doubts because it is not clear if this refers only to the alternative sources or to renewable sources in general, including hydroelectric generation. In this case, practically all of the generation companies would issue certificates, due to the predominance of hydroelectric generation in the country. It would be more interesting if the certificates referred to alternative sources, leading in the future to a trade market of green alternative certificates, with the guarantee that the technology used causes the least environmental impact.

On the other hand, there are some points of extreme importance that are not part of the program. One of them refers to the development of technologies industry based on alternative sources. With all the energetic potential of biomass, solar and wind energy, the country still remains marginal in research and development of new utilizations of these sources. No mechanism implemented to stimulate renewable alternative sources in the electrical sector mentions any commitment to develop a national technology industry, knowing full well that the installation of any system based on these sources will depend on imported equipment, making its final cost higher.

It would, therefore, be interesting to include minimum nationalization indexes when giving incentive to electricity generation based on any renewable alternative energy source in Brazil, for example, an obligatory percentage of national equipment utilized. Aside from the legal mechanism, financial mechanisms should be created to foment research and development of this equipment, and fiscal mechanisms to stimulate the installation of manufacturers in the country. These mechanisms should gradually be removed as the renewable alternative technology market becomes consolidated.

With these measures, the program would be attacking the main barrier to the dissemination of these sources, that is, the higher costs when compared to traditional sources, and would be compensating society (that will be paying more for these sources) with other benefits, such as the creation of new jobs, domination of technology and less environmental impact.

Therefore, one of the great challenges of PROINFA will be to encounter its compatibility within the universalization of electricity services. Currently, the region that

possesses one of the lowest indexes of electricity non-service is the Northern Region, where the majority of isolated systems are located. Law 10.438/02 also disposes on universalization and, in its Art. 15, determines that the supplier of the electricity public service can make the grid expansion or simultaneously become associated with or contract companies that have authorization to implant installations based on solar, wind, biomass and small hydroelectric plant energy (Presidency of the Federative Republic of Brazil, 2002). However, in the case of isolated systems, the companies could not utilize the PROINFA benefits since they are destined only to the interconnected systems. This is a point that should be reevaluated, since the isolated systems are an important market for the alternative energy sources.

Due to the great distances, plus the difficult access and the low electricity demand, the generation of these systems is maintained in a decentralized form. Aside from this factor, one must take into consideration that these systems are inserted in the Brazilian Amazonian Region, occupied by the humid tropical forest, on which all of its hydrological cycle and fragile ecosystem depend. The majority of the indigenous communities and a great potential wealth of minerals, wood, biodiversity, etc. are also located in this region (Amaral, 1996). All of these characteristics confer an importance to the Amazonian Region as a continental climatic regulator, creating national and international interest in its preservation (although the current scenario includes increasing deforested areas, without reforestation). These peculiarities make renewable alternative energy sources an excellent option to guarantee the maintenance of sustainable development in the region (Silva & Cavaliero, 2001).

The law that created the PROINFA also defined the formation of the Energetic Development Account, whose resources will be provided by the annual payments made for use of public property, by fines applied by ANEEL and, as of 2003, by the annual quotas paid by all of the agents that commercialize electricity with the final consumer. The account will have a duration of 25 years and will be regulated by the Executive Power and administrated by ELETROBRÁS (Presidency of the Federative Republic of Brazil, 2002).

Aside from promoting the universalization of electricity services, this account will also be utilized to guarantee the competitiveness of the energy produced by wind, small hydroelectric plants, biomass, natural gas and mineral coal sources. An important point defined by the law states that none of these sources may receive yearly funds whose total value exceeds 30% of the Energetic Development Account's annual collection. The law does not define, however, the equal distribution to each source, which may cause investments in some specific sources, in detriment of others. This can already be conjectured by examining the Energetic Development Account's utilization procedures that incorporate the payment of the cost of combustibles for thermoelectric companies that use only mineral coal and the installation costs for natural gas transportation where the supply of piped natural gas does not exist.

At the end of 2002, the Ministry of Mines and Energy - MME published Decree n° 4.541, regulating some articles of the Law 10.438/02, including a few points concerning the PROINFA. In the decree, some procedures for public bidding and the elaboration of the Annual Plan for Energy Acquisition from Alternative Sources, among others, are regulated. However, the main point, which is the definition of the economic value of each source, is not yet present in the decree. Only the considerations to be included in the calculation methodology are listed and are to be published at a later time by MME. Until this is duly regulated, the projects based on these sources will be paralyzed. A surprise presented in the decree was the possibility of fitting PROINFA into the Clean Development Mechanism –

CDM of the Climate Changes Convention of the United Nations. If this actually happens, external financial resources can be obtained from the Global Environment Facility – GEF.

4. CONCLUSIONS

All of the countries mentioned above have been able to increase the participation of renewable alternative energy sources in the electricity generation, either by way of subsidies granted by the government, or by way of incentive mechanisms. Motivated by questions in common, such as the need to reduce energy dependence, emissions of greenhouse gases, etc., each country adopted different lines of incentive: the creation of a fund collected from a tax, the auctions of energy from renewable sources, etc. Meanwhile, what can be verified currently is the convergence to a specific system: the obligation to acquire the energy generated by renewable alternative energy sources at a special and higher tariff, paid by all electricity consumers.

In spite of the impact on the tariff, the strategic advantages behind the international mechanisms cannot be ignored. The payment of a higher tariff may reflect on the consumer's income but, on the other hand, the government has a great interest in the development of a renewable source technology industry.

Proof of this is that many countries are attacking other barriers to the dissemination of these sources, such as the absence of specific lines of credit, the non-existence of foment mechanisms of fiscal nature (exemptions, discounts, etc.), the lack of diffusion of information, etc. In this way, the weight of the tariff is actually reverted in benefit of the population itself, with the creation of more employment and qualification of labor; and of the country, with the development of a new market niche: the renewable alternative energy sources. In this sense, the larger the investment in research and development of the technologies in energy generation from these sources, the smaller their respective costs will be and the greater the chances of introduction in the electrical sector.

But, aside from dominating the technology, it is also necessary to make the industrialization of this technology feasible in the country in order to obtain returns on the investment in research and development. It is, therefore, fundamental and urgent that mechanisms be created to stimulate the development of a national industry of renewable alternative source technologies since, in this sense, very little has been done in the country until now.

One suggestion is the inclusion of minimum nationalization indexes each time the electricity generation from renewable alternative sources receives incentives, for example, utilization of an obligatory minimum percentage of national equipment. Aside from the legal mechanisms, financial mechanisms should be created to foment research and development of this equipment and, later on, fiscal mechanisms to stimulate the installation of manufacturers in the country. These mechanisms should gradually be removed as the renewable alternative technology market becomes consolidated. In this way, the principal impediment to the dissemination of these sources would be resolved, which is their higher cost when compared to traditional sources. At the same time, the society, that would be paying more for these sources, would be compensated with other benefits, such as the generation of jobs, domination of technologies and less environmental impacts.

Another important characteristic of the international mechanisms presented consists in the gradual reduction of incentives within a stipulated period of time. This measure is totally coherent with the principal objective: stimulation of the use of these sources until they become competitive and no longer need incentives.

Regarding the reduction of environmental impacts, the creation of alternative green certificates could be used to differentiate and privilege the companies that utilize renewable alternative sources, as occurs with the ISO 9000 and ISO 14000 quality certificates, used even as company marketing. On the other hand, the possibility of trade alternative certificates on a market separated from the electricity one could help to stimulate investments in these sources, but would be useless if not effectively implanted and respected. In this sense, it is fundamental to change companies' mentality regarding the environmental question, leaving aside the image of an expensive activity (from the economic point of view) that has always been associated with the subject.

Brazil, after facing the electricity supply crisis and the reevaluation of the adopted restructuring model, introduced a series of measures to revitalize the sector. One of the measures for immediate implementation refers to the change in the form of financing the alternative sources of energy, regulated by Law 10.438/02 with the creation of PROINFA.

This program presents interesting points, such as the goal of expanding alternative energy sources in the electrical sector on a long-term basis and the proportional division of the costs of this generation among all consumers. There are, however, points that cause concern about the real incentive that would be given to these sources. In this sense, there is a lack of commitment to gradually reduce the incentive for alternative generation as the development of technology, the increase in productivity and the reduction of costs are sought. Another important point that also causes concern is the lack of incentive for the development of an alternative technology industry for electricity generation. The creation of this national industry is extremely relevant in the development of the technology and in the reduction of the costs of these sources, making them effectively competitive with conventional sources.

KEYWORDS:

Renewable Alternative Energy Sources, Regulatory Mechanisms, Electrical Sector, Isolated System, United States, United Kingdom, Germany, Brazil.

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REFERENCES

AMARAL, A. C. (1996) A Incorporação das Variáveis Sócio-Ambientais ao Processo de Planejamento do Setor Elétrico: o Caso da Amazônia. **Revista Brasileira de Energia**, Rio de Janeiro, v. 5, n.2, p.271-282, 1996.

- ANEEL – AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (2003) **Resolução ANEEL**. 05/01/2003. Reference available on the Internet.
<http://www.aneel.gov.br>
- CANAL ENERGIA (2002) **Newsletter 30 04 2002:Presidente veta pontos aprovados pelo Congresso na Lei do Setor Elétrico**. 30/04/2002. Reference available on the Internet.
<http://www.canalenergia.com.br>
- CAVALIERO, C. K. N. (2003) Inserção de Mecanismos Regulatórios de Incentivo ao Uso de Fontes Renováveis Alternativas de Energia no Setor Elétrico Brasileiro e no Caso Específico da Região Amazônica. Campinas: FEM, UNICAMP, 2003. Tese (Doutorado) – Faculdade de Engenharia Mecânica, Universidade Estadual de Campinas, 2003. p. 285.
- CAVALIERO, C. K. N.; SILVA, E. P. (2000) Os Sistemas Isolados e o Uso e Fontes Renováveis Alternativas de Energia no Contexto de Regulação do Setor Elétrico Nacional In: CONGRESSO BRASILEIRO DE REGULAÇÃO DE SERVIÇOS PÚBLICOS CONCEDIDOS, 1, 2000, Salvador. **Anais...** Salvador, 2000.
- CAVALIERO, C. K. N.; SILVA, E. P. (2002) Geração de Energia Elétrica a partir de Fontes Renováveis Alternativas: Algumas Experiências na Região Amazônica. In: CONGRESSO BRASILEIRO DE ENERGIA, 9, 2002, Rio de Janeiro. **Anais...** Rio de Janeiro, Sociedade Brasileira de Planejamento Energético, 2002. v. 4, p.1553-1560.
- CAVALIERO, C. K. N. et al (2001) Sistemas Isolados: Política, Planejamento e Regulação. In: CONGRESSO BRASILEIRO DE REGULAÇÃO DE SERVIÇOS PÚBLICOS CONCEDIDOS, 2, 2001, São Paulo/SP. **Anais...** São Paulo: Associação Brasileira de Agências de Regulação, 2001. CD-ROM.
- CCPE – COMITÊ COORDENADOR DO PLANEJAMENTO DA EXPANSÃO DOS SISTEMAS ELÉTRICOS (2002) **Plano Decenal de Expansão: Ciclo 2001-2010**. 01/07/02. Reference available on the Internet.
www.ccpe.gov.br
- CSPE – COMISSÃO DE SERVIÇOS PÚBLICOS DE ENERGIA DO ESTADO DE SÃO PAULO (2001) **Racionamento: Legislação**. 17/07/2001. Reference available on the Internet.
<http://www.cspe.sp.gov.br/racionamento>
- ENERGIA BRASIL (2002) **Relatório de Progresso nº 1**. 09/01/2002. Reference available on the Internet.
<http://www.energiabrasil.gov.br>
- (2002 b) **Newsletter 30 04 2002: Presidente veta pontos aprovados pelo Congresso na Lei do Setor Elétrico**. 30/04/2002. Reference available on the Internet.
<http://www.canalenergia.com.br>
- MME – MINISTÉRIO DE MINAS E ENERGIA (2002) **Balanco Energético Nacional 2002**. Brasília, 2002. 183p.
- PRESIDÊNCIA DA REPÚBLICA FEDERATIVA DO BRASIL (2002) Legislação. 30/04/2002. Reference available on the Internet.
<http://www.planalto.gov.br>
- SILVA, E. P.; CAVALIERO, C. K. N. (2001) **Regulação Energética e Meio Ambiente: Propostas para a Região Amazônica Isolada**. Campinas: NIPE/UNICAMP, 2001.
- WALTER, A. C. S. et al (2000) Proposição de Eliminação de Barreiras e Formulação de Políticas de Fomento, com os Instrumentos Regulatórios Associados à Geração Distribuída de Energia Elétrica no Brasil, sobretudo com Fontes Renováveis e Plantas de Cogeração. In: **Projeto Integração entre as Regulações Técnico-Econômica e Ambiental do Setor Elétrico Brasileiro**. Convênio entre ANEEL e FUNCAMP. Cap. 5: Fomento às Fontes Renováveis de Energia na Geração Distribuída de Eletricidade. p. 31-44.