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List of Acronyms and Abbreviations

CEPAL	Comisión Económica para América Latina (Latin American Economic Commission)
EJSEDSA	Empresa Jujeña de sistemas Energéticos Dispersos Sociedad Anónima (Dispersed Energy Systems Company of Jujuy)
EPEN	Ente Provincial de Energía de Neuquén (Neuquen Provincial Energy Body)
EPH	Encuesta Permanente de Hogares (Household Survey)
EPRE	Ente Provincial Regulatorio de Energía (Energy Provincial Regulatory Body)
FEDEI	Fondo para el Desarrollo Eléctrico del Interior (Inland Electricity Development Fund)
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
INDEC	Instituto Nacional de Estadísticas y Censos (Nacional Institute of Statistics and Censuses)
IRAM	Argentine Material Nationalization Institute
ITC	Impuesto a la Transferencia de Combustibles (Fuels Transfer tax)
IVA	Impuesto al Valor Agregado (Value added Tax)
LPG	Liquid Petroleum Gas
OLADE	Organización Latinoamericana de Energía (Latin American Energy Organisation)
PERMER	Proyectos de Energías Renovables en Mercados Rurales (Renewable Energies Project in Rural Markets)
PV	Photovoltaic System
SECyT	Secretaría de Ciencia y Técnica (Science and Technology Secretariat)
SEE	Secretaría de Energía de la Nación (Argentine Energy Secretariat)
SEGEMAR	Servicio Geológico Minero Argentino (Argentine Geological and Mining Service)
SHS	Solar Home Systems
SIEMPRO	Sistema de Información, Monitoreo y Evaluación de Programas (Information, Monitoring and Asessment System)

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SUMMARY

Argentina has a relatively long tradition in the study and development of renewable energies and application projects, with a variable degree of success. The experience accumulated along the years has allowed the identification of the important role that RE could play in relation to the lack of satisfaction of basic needs of an important segment of the population, often linked to the lack of adequate energy sources. At the same time, when one observes the historical evolution of RE activities and projects it can be seen the sluggishness in the development of this sector and in some cases the stagnation or vanishing of some areas and stakeholders.

Motivated by the knowledge that only the implementation of adequate policies will untangle this situation, this study aims at identifying the causes of the behaviour mentioned above, through a systematization of the existing knowledge in the various dimensions of the RE issue, which constitutes the base for an adequate policy formulation process. Both aspects have been tackled in this study, in the Initial Assessment (Chapter 3) and the Policy Outlines section (Chapter 4) respectively. The Initial Assessment is conformed by sections on population characterization (section 3.1), energy requirements (section 3.2), technologies (section 3.3), resources (section 3.4), case studies (section 3.5), capacities (section 3.6), niches (section 3.7), assessment of other RE experiences (section 3.8), and a general diagnosis and identification of main problems affecting the RE sector (section 3.9).

From the assessment of energy requirements (section 3.2) we can conclude that the almost 20 million poor and indigent people existing in Argentina in year 2001 were not consuming in average the energy needed to cover their minimum energy requirements. The energy requirements of this population (including minimum residential uses, productive uses and basic health and education services) represents less than 8% of the total energy consumption of Argentina during year 2001 (table 19). It is important to note that a part of these requirements is already being satisfied and consequently the two figures are not strictly additive. Most of the poor population energy requirements correspond to residential uses since productive uses and community services would demand an extremely low amount of energy compared to the national total.

Poor residential power and electricity requirements represent a significant portion of national figures and a very significant portion of residential sector power and electricity demand (table 21), though these figures are not strictly additive because some of the poor population requirements are already included in the residential sector figures. As for the productive and community services requirements of power and electricity, they are extremely low compared to national totals. Thus, we conclude that it would be very difficult to meet poor sector power and electricity requirements exclusively with RE and that meeting these requirements, though not unfeasible, would require a significant effort from the existing EE sector infrastructure.

Another very important fact is that, opposite to what happens in other Latin American countries, the poverty problem is mainly an urban issue in Argentina. 89% of the poor population corresponds to urban and peri-urban areas, 9% is rural dispersed population and the remaining 2% inhabits rural communities of less than 2000 inhabitants. This will strongly condition the kind of solution to be formulated for the lack of energization of this sector of the population.

In relation to minimum residential energy requirements, the assessment by climatic zones indicates that caloric uses (cooking, water heating, heating) correspond in average to 69% of the minimum poor household requirements of Argentina in terms of useful energy (table 4), stressing the importance of focusing the policies towards energization and not only electrification of households.

In the case of productive requirements the structure varies according to the urban and rural areas, reflecting the different characteristics of the productive activities in the rural and the urban environment. For urban and rural grouped population caloric requirements are predominant (table 13), while for rural dispersed population mechanic power is the main requirement (table 17).

The assessment that was performed allows estimating the contribution that RE could make towards the satisfaction of poor population energy requirements (Appendix 3.5), making clear their important role but also the need of complementing in the short and mid term with conventional energy sources such as LPG, gas-oil and natural gas, particularly in urban and peri-urban areas where access to conventional energy networks should be part of the energization solution.

In relation to the availability of data to perform the study on requirements by climatic zones, it must be mentioned the lack of adequate detailed spatial information on the distribution of poor population (urban, rural dispersed and rural communities) and their energy consumption levels.

Section 3.3 presents an assessment of RE technologies and their availability within Argentina. It is recognized that there is good experience and capacity for the local development of many RE technologies (mini-hydro, solar PV, solar thermal, wind for EE generation and water pumping, biomass and geothermal). The present R&D and industrial infrastructure would make feasible the development of a local high quality RE systems manufacturing industry if the proper conditions and incentives are put in place. As a prerequisite, proper quality standards should be applied for manufacturing and installation of the systems and the links between R&D institutions and industry must be strengthened. An important void and need for R&D in the modern biomass technologies has been detected.

When analyzing the technologies and resources available and the energy requirements of the poor population it is very important to note how some technologies are much better suited than others to meet the energy requirements of the poor. This is particularly true in the case of productive requirements, where mini hydro and advanced biomass are in a much better position to cope with them than, for example, photovoltaic energy (Appendix 3.2).

Section 3.4 presents an assessment of renewable energy resources of Argentina, a country very well endowed with solar, wind, hydro and biomass energy resources with a good geographical coverage (table 22). In this sense, some regions are better endowed than others since the availability of a diversity of resources allows a better coverage of the requirements with RE. Other regions that depend only on one RE resource will probably have to complement with conventional energies to cover all energy requirements adequately. A large part of these RE resources could be tapped in the short and mid term (technology and capacity available).

Sustainable wood seems to be underutilized in relation to the average theoretical potential of each bio-geographic zone (table 23), though a more detailed analysis is needed to account for local over-extraction and lack of accountability of non-commercial and informal firewood trade. Woody biomass has one of the highest potentials to meet many of the energy needs of the poor through improved combustion, gasification and boilers, though low and mid power systems still need further R&D and industrial development.

Livestock manure is highly underutilized (table 23) and represents one of the resources with highest availability and potential for energy production in large parts of the country (biogas). However, it seems to be underutilised due to cultural reasons and a lack of dissemination of the technology. On the other hand, the total energy content of agricultural and agro-industrial resources is also very high, but their availability is very low since they are already being used for competitive uses.

Solar resources could be very important to meet caloric uses in large areas of Argentina, even in urban areas where most of the poor population inhabits. Solar resources could significantly reduce conventional fuels consumption for caloric uses of a large portion of the population through the use of solar water heaters, heating systems and solar dryers). In many situations improvements in general housing infrastructure are needed to implement some of these technologies in compliance with quality standards.

Wind potential is excellent in Patagonia and could contribute significantly to the national grid when the ongoing interconnection of the Patagonian and national energy grids is completed (table 24). On the other hand, in many parts of the country the resources are good enough for water pumping activities.

Hydro resources for small and micro-hydro projects are also significant but sometimes difficult to match with existing population distribution.

Section 3.7 presents some RE niches identified as a promising combination of resources, capacities, technologies and energy requirements that could be developed in the short and mid term. These are listed in table 28, and stress the relevance of different technologies in different situations and parts of the country.

Section 3.9 presents the problems affecting the RE sector of Argentina, identified through the previous analysis. In order of priority, the main problems are:

1. Lack of a strong institutional entity that coordinates activities, formulates policies and objectives.
2. Lack of a comprehensive policy as proper framework for the role of RE within the context of the nation's social and energy needs. Lack of incentives to promote the development of renewable energies projects.
3. High investment cost and perceived risk. Market size; lack of subsidy policies; lack of payment capacity on the part of consumers.
4. Exclusion of the modernization processes of poor and indigent population. Lack of adequate perception of poor and indigent needs. Poor population sectors are not being given proper support in terms of health, education, housing and basic services. Thus, it is easy to understand that their energy requirements are not a priority in general
5. Lack of an adequate O&M infrastructure. Scarce local development of the equipment-production industry. Many projects have failed due to the lack of proper maintenance and capacity development of users, a problem that will be difficult to solve, particularly in low density rural areas. Up to some years ago, equipment imports prevented the growth of a strong national equipment industry, a situation which has reverted to some extend in recent years. Quality standards for equipment production and installation should be applied to national manufacturers and service providers

Chapter 4 presents objectives and policy outlines formulated in order to cope with these main problems. Stakeholders´ reactions are also analyzed.

Chapters 5 and 6 present the main recommendations arising from the previous analysis:

- To develop an adequate institutional framework that allows a coordinated functioning of stakeholders and the design of policies to integrate renewable energies into the national development strategy.
- To give coherence and stability to the legal and regulatory framework. To make it supportive of RE and eliminate bias against renewable energies.
- To establish alternative financing mechanisms and incentives that recognize non-economic benefits of RE, with stable rules over time that guarantee the effectiveness of the instruments.

Without an adequate institutional and regulatory framework, we will be dealing endlessly with scattered projects whose success or failure depends upon the particular framework of the project. Moreover, their sustainability will not be guaranteed by an adequate and coherent set of incentives at national level. Stability of playing rules is a key element for potential investors and users.

- To develop instruments for risk and uncertainty management in renewable energies projects.

Since RE projects are still regarded as risky and with high levels of uncertainty, this affects negatively the economic assessment of the projects. Alternative instruments are needed to manage these two issues properly (e.g. specific insurance funds)

- To improve the knowledge of renewable energies resources starting from the existing data for the preliminary identification of the highest potential areas.

Our knowledge of national RE resources is still quite general and we lack detailed information on the geographical distribution of resources and its match with demographic and energy requirements data.

- To support R&D in renewable energies technologies aimed at local industrial production and equipment cost reduction
- To develop quality standards for equipment production and installation and ensure compliance

Argentina is in position of manufacturing many RE equipments supported by local R&D and technology transfer. This will help create jobs and lower the cost compared to imported technologies. Quality standards are critical to avoid the creation of a bad image due to technological failure or misuse.

- In relation to poor and middle population sectors, to support and develop projects oriented to income generation and productive activities as a means to ensure sustainability and decreasing the level of subsidies over time (in this sense not all the technologies are equivalent)
- To develop an adequate O&M infrastructure based on existing infrastructure.
- To develop capacity of stakeholders in the diverse issues related to renewable energies, particularly for non-technological issues (policies, incentives, financing, project design and management, installation, use, etc.)
- To provide access to conventional energy networks when feasible.

The limitations of some RE systems to provide adequate energy services at a reasonable cost must be recognized and since most of Argentina´s poor population inhabits urban areas, the access to conventional energy networks should be an important part of the solution for the energization problem. The use of RE in complement with conventional energies for caloric uses and mechanical power seems to offer the best trade-off between adequate energy provision, cost and sustainability.

The conclusions remark that:

- Institutional and policy issues have first to be solved to allow RE penetration
- It will be difficult, though not impossible, to satisfy poor population energy requirements exclusively with RE
- For the majority of poor population (urban) access to conventional energies networks would be part of the most rational solution to meet unsatisfied requirements in the short and mid term. Conventional fuels are still very important to meet unsatisfied energy requirements of the poor population (LPG, diesel oil and natural gas)
- The role and potential penetration of RE could be significant, particularly for grid-connected RE projects (wind, hydro, biomass), for caloric uses (biomass, solar thermal), and as liquid fuel (biodiesel)
- Most RE initiatives will not be sustainable unless income generation and productive activities are included (needs driven rather than technology driven)

1. BACKGROUND

Up to some years ago Argentina presented a unique situation in the Latin American context in terms of income distribution and basic development indicators. Argentina used to have a relatively even income distribution, but this characteristic has reverted in recent years, with an increasing social inequality and a larger income gap between higher and lower classes. During the 1990s essential services such as education and health deteriorated and undergone deep changes, with increasing private participation in these areas. As a result, the poor population which traditionally made use of public services has lowered their quality of life and employment opportunities.

Both the number of poor and indigent population and unemployed or underemployed population rose abruptly after the 2001 crisis and currency devaluation. Most of this population is surviving through the scarce funds provided by a social welfare program. Presently, more than 90 % of the population lives in urban areas (settlements of more than 2000 inhabitants) and more than 40% of the population is considered poor, that is, with incomes that are below the level for paying for essential goods and services.

In terms of resources, Argentina is a country well endowed with natural resources and with a relatively large geography spanning several bioclimatic regions. Thus, the country is self sufficient in most raw materials and energy, and a net exporter of agricultural products and other primary goods. However, the attractive exchange rate leads to the prevalence of exports over the supply to the local market, creating a condition of inadequate food provision for a large sector of the population who cannot afford these goods.

Argentina has a long tradition in the use of renewable energy resources, mainly large hydro plants for electricity generation and to a lesser extent biomass. However, in recent years we have witnessed a decline of hydro share in the energy mix and an increase in natural gas use. Both large hydro and nuclear energy developments are at a stand still due to financing problems and internal discussions concerning the environmental impacts. On the other side, the potential for wind energy generation in Patagonia is large and is advocated by some groups as a partial solution to the hydro/nuclear dilemma, but the lack of interconnection with the national grid and the low population density in Patagonia are obstacles for tapping this resource.

Presently, the country is moving from a diversified energy mix towards a higher dependency on natural gas and fossil fuels supply by private energy enterprises, and the resulting vulnerability and risk of shortages due to technological or speculative causes (G. Bravo, 2003).

Also in contrast to the energy situation of most Latin American countries, biomass use in the Argentinean household sector is relatively low, with more diversification and use of natural gas and LPG. However, the recent socioeconomic crisis and the abrupt rise in fossil fuels prices have stimulated a return to non-commercial sources of energy, mainly firewood use in poor households.

Argentina also counts with one of the highest electrification rates of Latin America, but it is experiencing a slowdown due to saturation and the privatization of former public power enterprises. In some urban areas, poor population cannot afford to pay for electricity or the associated appliances, increasing the odds of resorting to electricity theft. In rural areas, low population densities and/or low payment capacity make these areas unattractive to private electricity companies.

As a result of these processes there is still a large portion of the population, both in urban and rural areas, which suffers a deficit in energy supply, for basic households´ requirements, essential services, and productive activities.

2. RATIONALE AND MOTIVATION

When analyzing the structural causes of poverty in Argentina, one cannot avoid noticing how certain policies - or the lack of them - have contributed significantly to its permanence and increase in intensity. The results gathered by the *Access* study within the energy field clearly show the generally negative effects that the deregulation of the energy sector has had on the low-income population, slowing down and hampering the access to energy in areas viewed by private stakeholders as of low profitability (Kozulj, 2003).

Renewable energies can be regarded as a significant option to consider for meeting some key needs of settlements that will probably lack access to conventional energy supply in the short and medium term (Dubrovsky, 2004). However, the efforts made for decades to promote these systems have translated into meager results due to different barriers in this area. The implementation of these systems has clashed against substantial obstacles that have notably restricted the promotion of these technologies and their sustainability over time. For this reason, it becomes relevant to analyze in detail the sources of these problems in order to be able to contribute to their overcoming.

A preliminary analysis of the renewable energies issue shows that a lack of policies, the priority given to purely economic aspects, and organizational/institutional errors contrast with the following issues: the existence of a wide variety and quality of renewable resources throughout the Argentine territory; the unsatisfied energy requirements of a large part of the population; and, finally, the availability of renewable technologies and human resources.

Taking into account such contrast, the present study aims at moving forward towards the formulation of policies for the renewable energy sector. For this purpose, the first part of the study will present an evaluation of the situation and of the potential of renewable energies to meet the energy requirements of the poor and indigent population of Argentina. This evaluation will serve as basis for the identification of the problems affecting the sector and of the possible niches where it would be feasible to use renewable energies in the short term. All these aspects will be further used in the process to design policies and strategies towards an adequate implementation.

3. INITIAL ASSESSMENT

3.1 Characterization of population and zones

This chapter presents an estimation of poor and indigent population as per climate region, classified into urban, rural community, and rural dispersed. It also describes the methodological aspects related to the estimation of the number of poor and indigent people in Argentina by climate region, also sorted according to whether they live in urban areas, in rural areas in groups, or are scattered in rural areas. The results gathered are presented, and shall serve as basis for the calculation of the different energy consumption levels.

Argentina has been divided into four bioclimatic zones: warm, temperate, arid and cold. In some cases, the availability of information at provincial level allowed the presentation of data with a higher degree of detail than for bioclimatic zones. The correspondence between bioclimatic zones and provinces is given in appendix 3.1, as a reference. It is worth mentioning that arid zones present many of the features of cold zones and consequently they are treated as one in some of the analysis performed in this study (e.g. energy requirements).

3.1.1 On the calculation methodology and information sources used

The basic information used was extracted from the Argentine Population and Household Census for the year 2001, carried out by the Argentine Statistics and Censuses Institute (INDEC, 2001). This information allowed classifying the total population of each province into urban and grouped in small rural settlements, and, through difference, obtaining the scattered rural population. In turn, we classified all cities, settlements, and regions in each province in accordance with the climate area to which they belong, namely: warm, temperate, arid, and cold.

On the basis of this classification, - specified in Appendix 3.1 -, we estimated the possible universe of poor and indigent persons classified into urban, rural community, and rural dispersed population, in accordance with the climate region type.

In this sense, it is worth pointing out that there are two alternative sources to calculate the number of poor and indigent persons, and that the calculation methodology also differs both as to conceptual and geographic coverage terms. These sources are a) the Permanent Household Survey carried out twice a year by INDEC in the main urban centres of each province (INDEC, 2003); and b) the reports on the social situation of each province issued by the Social Program Information, Monitoring, and Evaluation System (SIEMPRO, 2004), a body that works within the sphere of action of the Argentine Social Policy Coordination Board of the Office of the President of the Argentine Republic.

In the case of the Permanent Household Survey (EPH), the calculation methodology consists in determining first what is known as *indigence line* value. This value corresponds to that of the cost of a basic food product basket calculated on the basis of the minimum calories required by a male adult in order not to begin consuming his own body mass, value that is extrapolated to a family made up of a male adult, a female adult, and two small children, also differentiated as to sex and age. As the consumption of calories by the male adult represents the maximum reference value, the calorie consumption of the remaining members of the standard family are estimated on the basis of smaller coefficients with respect to that reference, considering the age and sex factors. Once the calories of the family group to be met through a balanced diet are determined, the cost of such diet at market prices in each survey was estimated.

Once the *indigence line* value as explained is determined, we estimate the *poverty line* value using the opposite of Engel's coefficient, which determines the existing relation between the expenditure made in food products by a standard urban family with respect to the total expenditure that includes meeting staple needs such as housing, clothing, basic services, transport, education, health, and others.

The *indigence line* and *poverty line* values from each survey are used to determine the number of households and persons whose income falls below one of those lines. The information processed by INDEC yields results on indigent and poor household percentages with respect to the total population of each urban area surveyed, as well as the income gap with respect to the *indigence line* and *poverty line* values.

In the case of the social situation reports, the data related to poverty and indigence corresponds to the total of each province on the basis of the expansion of the results of INDEC's EPHs. Nevertheless, the methodology to expand these results is not explained in the respective reports. These reports also provide valuable information on the occupational situation, the distribution of income, and other indicators, which allow appreciating the poverty issue in a more comprehensive way. However, even when the expansion is made on all the different provincial territories, urban and rural poverty data is neither discriminated in the SIEMPRO reports.

One was thus forced to assume hypotheses with reference to rural poverty in areas with grouped and scattered population.

On the basis of the information analysed, we determined that a double migratory trend was registered: from scattered rural areas to grouped rural areas, and from all rural areas to different urban areas within each province and outside them. This was the result of a rising mechanization in agricultural activities, the concentration of property, and the change in the use of the land in terms of crops (CNA, 2002). This migratory wave resulted in a higher relative concentration of indigent persons in grouped rural and urban areas - although in higher proportions in the former -, with a lower influence of indigence in the remaining scattered rural population (Gallo Mendoza, 2004). According to these estimates, we may assume that some 35% of the total grouped rural population is either indigent or poor - although at levels quite close to that of indigence -, as the monetization of these economies is lower; and, on the other hand, that the needs met in these areas differ in quality and quantity from the urban ones considered in the EPHs.

Therefore, and with a view to estimating the influence of rural poverty and indigence in areas with grouped population, a differentiation was carried out by province considering the difference of the indigence and poverty coefficients of each province with respect to the nation's average.

With the data on the influence of indigence and poverty at urban level in each province and the estimation of the rural poor and indigent obtained in accordance with the explanation above, we gathered through difference the influence of poverty and indigence on the scattered rural population. This necessarily required assuming that the total indigence and poverty percentages obtained either from the SIEMPRO reports, the EPHs, or INDEC apply to the entire population of each province.

Although the method used necessarily contains error margins, and as it is impossible to apply indigence and poverty coefficients to different climate regions within the same province in a differentiated way, these are nonetheless reasonable estimates to quantify the total universe of persons in accordance with the desired classification, especially when considering that the total rural population of Argentina represents only 10.7% of the nation's total population.

On the other hand, and even when the methodology to expand the results of the EPHs carried out by SIEMPRO remains unknown, these last results seem to better contemplate the higher relative influence of the poverty and indigence levels on the less populated centres with respect to the most populated ones. The expanded results from SIEMPRO yield higher levels than those resulting from applying to each province the EPH data on the influence of indigence and poverty on the large urban centres within each province. This is inferred from the fact that even when viewing 100% of the rural population as poor, this would not suffice to explain the differences between the number of urban poor and indigent resulting from the application of the indigence and poverty coefficients using data from the EPHs and SIEMPRO in an alternative way[1].

Nevertheless, as poverty and indigence levels have risen considerably after the devaluation experienced in 2002 due to its influence on the cost of food products and other staple goods and to the fact that salaries did not increase in the same proportion, we decided to use the most recent information on the proportion of indigent and poor with respect to the total population. The reason for this was the desire to show in the best possible way the actual present universe of poor and indigent even when the total population data corresponds to the year 2001, prior to the devaluation that resulted from a monetary overvaluation applied for one decade on the basis of a fixed exchange rate sustained by means of rising foreign loans.

To sum up, the following are the steps taken to calculate the universe of poor and indigent people classified into urban, rural communities, and rural dispersed population as per climate region:

[1] For example, were we to apply the poverty coefficient by province given in the SIEMPRO reports on the entire population of each province, as well as the poverty coefficients gathered from the EPHs on the entire urban population of each province, the number of rural poor obtained through difference would exceed the total rural population, something clearly impossible. From this, we infer that the expansion of EPH results carried out by SIEMPRO assumes higher poverty levels in smaller populated centers than those considered by the EPH survey.

1. Gather data on population by province classified into urban and rural, in accordance with the 2001 census.
2. Elaborate on this census data at settlement level towards a classification by climate region within each province.
3. Apply on the total and urban population data corresponding to 2001 the indigence and poverty coefficients recalculated to consider the population difference between 2001 and the total population corresponding to the dates of the EPH (May 2003) and SIEMPRO (2002) data.
4. Obtain through difference the total rural poor population and sort among them assuming that rural areas with grouped population register a mean poverty influence close to 35%, a result that in turn is modified in accordance with the relation of each province with respect to the nation's average as concerns poverty and indigence indicators.
5. Obtain through difference the number of poor and indigent people corresponding to the scattered rural population, in accordance with the application of EPH and SIEMPRO data.
6. Recalculate the resulting poor and indigent percentages in each category, and verify the consistency of the data obtained from the application of the set of hypotheses, making minor adjustments when the application of this general method leads to inconsistencies (e.g. the number of rural poor or indigent in scattered areas being zero or below zero, which was registered in two specific cases of scarce numerical significance).

The following section presents the results obtained in accordance with the application of EPH and SIEMPRO data with a view to having an alternative range of possible poor and indigent population universes, classified in a useful way to determine their energy consumption and their potential to meet it through different alternative sources.

3.1.2 Estimation of the poor and indigent universe

Table 1 provides the summary of the estimates with respect to the poor and indigent universe in accordance with alternative sources of information and the given classification. Table 2 shows these results as percentage of the total population corresponding to 2001, which allows appreciating the different situations of poverty and indigence in each climate region, as well as the relative weight of each with respect to the total population.

Annex 2.1 provides the specification of this information by provinces.

Table 1
Estimate of the universe of indigent and poor persons as per climate region and area of residence (inhabitants)

	Nation's total				
Nation's total	**32,352,909**	**3,871,038**	**1,282,226**	**2,588,812**	**36,223,947**
INDEC Indigence 2001	6,305,244	739,369	418,819	320,550	7,044,614
SIEMPRO Indigence 2001	8,565,216	1,195,076	471,606	723,470	9,760,291
INDEC Poverty 2001	13,324,652	1,563,430	438,744	1,124,687	14,888,082
SIEMPR0 Poverty 2001	17,518,312	2,301,031	460,474	1,840,557	19,819,344
	Warm				
Population	**Urban**	**Rural**	**Rural community**	**Rural dispersed**	**Total**
Warm region population	**6,468,137**	**1,790,220**	**437,984**	**1,352,236**	**8,258,357**
INDEC Indigence 2001	1,266,399	345,893	150,060	195,833	1,612,293
SIEMPRO Indigence 2001	2,509,983	692,805	224,627	468,179	3,202,789
INDEC Poverty 2001	2,504,387	686,652	141,222	545,431	3,191,040
SIEMPR0 Poverty 2001	4,547,933	1,256,678	202,869	1,053,809	5,804,611
	Temperate				
Temperate region population	**21,920,741**	**1,297,365**	**568,058**	**729,307**	**23,218,106**
INDEC Indigence 2001	4,364,582	252,928	193,982	58,945	4,617,510
SIEMPRO Indigence 2001	5,099,370	298,725	165,755	132,970	5,398,095
INDEC Poverty 2001	9,088,342	525,387	192,788	332,598	9,613,729
SIEMPR0 Poverty 2001	10,995,878	626,967	174,045	452,922	11,622,845
	Arid				
Arid region population	**3,866,040**	**780,484**	**274,920**	**505,564**	**4,646,524**
INDEC Indigence 2001	658,311	140,065	74,407	65,658	798,376
SIEMPRO Indigence 2001	939,145	203,038	80,939	122,099	1,142,184
INDEC Poverty 2001	1,689,649	350,110	104,270	245,840	2,039,760
SIEMPR0 Poverty 2001	1,936,604	416,238	83,238	333,000	2,352,842
	Cold				
Cold region population	**97,991**	**2,969**	**1,264**	**1,705**	**100,960**
INDEC Indigence 2001	15,952	483	370	114	16,435
SIEMPRO Indigence 2001	16,717	507	285	222	17,224
INDEC Poverty 2001	42,273	1,281	463	817	43,554
SIEMPR0 Poverty 2001	37,897	1,148	322	826	39,046

Source: Own estimates based on data from INDEC and SIEMPRO.

Table 2
Influence of indigence and poverty as per climate region and area of residence (% of inhabitants)

	Nation's total				
Regional % over the nation's total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
INDEC Indigence 2001	19.5%	19.1%	32.7%	12.4%	19.4%
SIEMPRO Indigence 2001	26.5%	30.9%	36.8%	27.9%	26.9%
INDEC Poverty 2001	41.2%	40.4%	34.2%	43.4%	41.1%
SIEMPR0 Poverty 2001	54.1%	59.4%	35.9%	71.1%	54.7%
	Warm				
Population	**Urban**	**Rural**	**Rural community**	**Rural dispersed**	**Total**
Regional % over the nation's total	**20.0%**	**46.2%**	**34.2%**	**52.2%**	**22.8%**
INDEC Indigence 2001	19.6%	19.3%	34.3%	14.5%	19.5%
SIEMPRO Indigence 2001	38.8%	38.7%	51.3%	34.6%	38.8%
INDEC Poverty 2001	38.7%	38.4%	32.2%	40.3%	38.6%
SIEMPR0 Poverty 2001	70.3%	70.2%	46.3%	77.9%	70.3%
	Temperate				
Regional % over the nation's total	**67.8%**	**33.5%**	**44.3%**	**28.2%**	**64.1%**
INDEC Indigence 2001	19.9%	19.5%	34.1%	8.1%	19.9%
SIEMPRO Indigence 2001	23.3%	23.0%	29.2%	18.2%	23.2%
INDEC Poverty 2001	41.5%	40.5%	33.9%	45.6%	41.4%
SIEMPR0 Poverty 2001	50.2%	48.3%	30.6%	62.1%	50.1%
	Arid				
Regional % over the nation's total	**11.9%**	**20.2%**	**21.4%**	**19.5%**	**12.8%**
INDEC Indigence 2001	17.0%	17.9%	27.1%	13.0%	17.2%
SIEMPRO Indigence 2001	24.3%	26.0%	29.4%	24.2%	24.6%
INDEC Poverty 2001	43.7%	44.9%	37.9%	48.6%	43.9%
SIEMPR0 Poverty 2001	50.1%	53.3%	30.3%	65.9%	50.6%
	Cold				
Regional % over the nation's total	**0.3%**	**0.1%**	**0.1%**	**0.1%**	**0.3%**
INDEC Indigence 2001	16.3%	16.3%	29.2%	6.7%	16.3%
SIEMPRO Indigence 2001	17.1%	17.1%	22.5%	13.0%	17.1%
INDEC Poverty 2001	43.1%	43.1%	36.7%	47.9%	43.1%
SIEMPR0 Poverty 2001	38.7%	38.7%	25.5%	48.5%	38.7%

Source: Own estimates based on data from INDEC and SIEMPRO.

3.2 Energy Needs and requirements

The present chapter estimates the Basic and Minimum Energy Requirements of Poor and Indigent Rural Dwellers in Argentina (in terms of Net and Useful Energy), defining standard households sorted into Urban and Rural within each of the three Climate Areas into which the country was divided (V. Bravo, 2004a,b,c; IDEE/FB, 1986)).

First, we classified the Poor and Indigent Population within each area (Warm, Temperate, Arid/Cold) into the following modules:

- Urban population with electricity
- Urban population without electricity
- Grouped rural population with electricity
- Grouped rural population without electricity
- Dispersed rural population with electricity
- Dispersed rural population without electricity

The urban and rural populations with electricity supply represent only an estimate based on the levels of existing electrification level in each province.

We have assumed that urban dwellers in all areas have electricity supply.

Table 3
Low Income Population (Inhabitants)

Type	Warm Zone	Temperate Zone	Arid Zone	Cold Zone	Total
Urban	**4,547,933**	**10,995,878**	**1,936,604**	**37,897**	**17,518,312**
Grid Connected	4,547,933	10,995,878	1936604	37897	17,518,312
Not Connected	0	0	0	0	0
Rural	**1,256,678**	**626,967**	**416,238**	**1,148**	**2,301,031**
Rural communities	**202,869**	**174,045**	**83,238**	**322**	**460,474**
Grid Connected	39,663	132,974	66732	0	239,369
Not Connected	163,206	41,071	16506	322	221,106
Rural dispersed	**1,053,809**	**452,922**	**333,000**	**826**	**1,840,557**
Grid Connected	5,300	87,070	138557	0	230,927
Not Connected	1,048,509	365,852	194443	826	1,609,630
Total	**5,804,611**	**11,622,845**	**2,352,842**	**39,046**	**19,819,344**
Grid Connected	4,592,896	11,215,922	2,141,893	37,897	17,988,608
Not Connected	1,211,715	406,923	210,949	1,148	1,830,736

Source: Own estimates.

It can be seen in table 3 that the distribution of not connected poor population among climatic zones is correlated to the rural dispersed poor population of each zone. Thus, the higher percentages of not connected poor population are found in the warm zone (20.9%) and the arid zone (9%), while the temperate and cold zones present relatively low values (3.5% and 2.9% respectively). This uneven distribution has some relation to the degree of development, living conditions and climatic characteristics of each region and has a strong influence on the viability of conventional energy supply schemes and the setting of priorities for rural electrification programs.

A qualitative description of the energy requirements and the corresponding renewable and conventional technologies that could be used for their satisfaction is included in Appendix 3.2

All the requirements have been calculated starting from the requirements of a functional unit (family, health centre, school, micro-venture), based on equipment power, annual and daily hours of use and efficiency.

3.2.1 Household Requirements

We further indicate the basic and minimum annual useful energy requirements in poor and indigent rural and urban households. The difference between basic and minimum energy requirements is that the latter excludes washing and TV. Both of them include lighting, cooking, water supply, water heating, heating, air conditioning and food preservation.

Table 4
Energy requirements Argentina: Residential (Useful energy)

Category	Type of requirement	Basic Energy requirement (useful energy)(TOE/year)	Share (%)	Impact (million inhabitants)	Priority
Residential	Lighting	13,522	1.7	19.8	H
	Cooking	273,154	33.5		VH
	Water heating	162,315	19.9		H
	Water pumping	5,066	0.6		VH
	Heating	128,655	15.8		VH
	Air conditioning	20,853	2.6		L
	Food refrigeration	123,688	15.2		M
	Other appliances	87,777	10.8		M to H
	Total	815,030	100.0		
Category	**Type of requirement**	**Minimum Energy requirement (useful energy) (TOE/year)**	**Share (%)**	**Impact (million inhabitants)**	**Priority**
Residential	Lighting	5,155	0.8	19.8	H
	Cooking	197,620	29.7		VH
	Water heating	162,315	24.4		H
	Water pumping	243	0.0		VH
	Heating	128,655	19.3		VH
	Air conditioning	12,299	1.8		L
	Food refrigeration	123,688	18.6		M
	Other appliances	36,235	5.4		M to H
	Total	666,209	100.0		

Source: Own estimates. VH=Very High, H= High, M= Medium, L= Low

The following table summarises the results obtained after analyzing the energy requirements of the poor and indigent population of the entire nation:

Table 5
Residential requirements

Nº	Item	Value	Fraction (%)
	Household requirements (poor and indigent)		
	Net energy consumption		
1	Net energy consumption - Basic	2,447 10^3 TOE	27% (1/3)
2	Net energy consumption - Minimum	1,944 10^3 TOE	21.4% (2/3)
3	Argentina household sector consumption - 2001	9,078 10^3 TOE	
	Power		
4	Simultaneous power demand - Basic	5,170 MW	24% (4/6)
5	Simultaneous power demand - Minimum	3,693 MW	16% (5/6)
6	Argentina installed power	23,189 MW	
7	Argentina household sector power demand - 2001	8,400 MW	
	Electricity consumption		
8	Electricity requirement - Basic	6,804 GWh	30.7% (8/10)
9	Electricity requirement - Minimum	4,660 GWh	21.1% (9/10)
10	Argentina household sector EE consumption - 2001	22,116 GWh	
	GLP		
11	Basic	1,190 10^3 ton	103% (11/13)
12	Minimum	1,078 10^3 ton	93.5% (12/13)
13	Argentina household consumption	1,153 10^3 ton	
14	Argentina production	2,873 10^3 ton	
	Firewood		
15	Basic	2,226 10^3 ton	470% (15/17)
16	Minimum	2,115 10^3 ton	450% (16/17)
17	Fuelwood in Argentina´s Energy Balance	469 10^3 ton	
18	Sustainable potential	17,280 10^3 ton	
	Batteries		
19	Basic	458 10^3	
20	Minimum	303 10^3	
21	Argentina´s present vehicle fleet requirement	2,700 10^3	

With reference to the demand of electric power from the national grid, we notice that the basic power requirements of the electric appliances of the poor and indigent population would reach 8,617 MW for the entire nation. In the case of the minimum energy requirements, the demand would reach 6,155 MW (71% of the demand for the case of basic needs).

Assuming that the simultaneous power of these appliances is of some 60% of the installed power, the basic requirements would represent a demand of electric power from the national grid of 5,170 MW, equivalent to nearly 24% of the 23,189 MW of installed power in Argentina in 2001. On the other hand, the total maximum demand ranged around 13,000 MW. Considering the household electricity demand in 2001, and assuming a load factor of 0.30, the maximum power demand of the household sector would reach some 8400 MW. Thus, the basic requirements power demand would represent 62% of the household power demand. For the minimum requirements, power demand would amount to 3,693 MW, equivalent to nearly 17% of the 23,189 MW of installed power in Argentina in 2001 and to 44% of the household sector power demand.

In relation to firewood consumption it is worth noting that the national energy balance does not detect the actual firewood consumption of the population, essentially within rural areas, as a large part of such consumption is registered outside the commercial circuit.

Nevertheless, when comparing the calculated 2,226 and 2,115 thousand tons of firewood that poor and indigent dwellers should consume with the yearly sustainable exploitable resource potential in Argentina, we notice that such consumptions would represent 13% and 12.2%, respectively, of the 17,280 thousand tons of such potential.

The use of batteries is related to those households without electricity that use them for powering DC TV sets and radios.

We must point out that neither the 24% of electric power nor the 30.7% of electricity consumption, the 103% of LPG consumption, or the nearly 4.7 times of the firewood consumption resulting from the respective basic power or energy requirements of the poor and indigent population, as estimated in the present document, are incremental values in relation to the level actually consumed by the nation’s total population (poor and not poor). The same applies for the figures corresponding to minimum requirements (17% of electricity power; 21.1% of electricity consumption; 93.5% of LPG consumption; 4.5 times the firewood consumption).

The truth is that we ignore the actual energy or power consumption of the poor and indigent, although it is a fact that part of the 23,189 MW, 22,116 GWh, 1,153 thousand tons of LPG, and 469 thousand tons of firewood detected in the Argentine Energy Balance of 2001 include the probably quite low consumptions of the poor and indigent (with the exception of firewood). To the uncertainty on the actual consumption level of the poor, we must add the fact that there are clandestine connections in urban areas that allow a quite high consumption at no cost at all. Attempts to correct this clandestine consumption situation began failing after the deepening of the crisis as from 1999, and further after 2002, to the extent that service cuts are in some cases resisted with violence by dwellers of urban neighbourhoods where poor and indigent sectors concentrate. Strikingly, some illegal connections where also detected in high level private neighbourhoods.

3.2.2 Community Services Requirements

In relation to community services, we have only considered the poor and indigent population from rural areas, both in settlements of up to 2,000 inhabitants and dispersed. The rendering of these two services in urban areas (public schools and hospitals) also includes the middle class in the case of Argentina, and this population segment falls beyond the scope of the present work. In rural areas, instead, schools (particularly those lodging students throughout a large part of the school term) and health centres (establishments that essentially provide basic care and, when the cases so require it, derive their patients to better-equipped regional hospitals) basically cater for poor and indigent dwellers. In the same sense it is worth pointing out that the requirements for rural schools and health centres are those that are considered adequate for satisfying these needs.

Education

The number of rural schools per climate area that would be supplied with energy would reach 6,842 throughout the country, distributed per type of establishment and climate area, as shown in Table 6. These schools would meet the building and energy needs of 513,938 poor and indigent students from the nation's rural areas.

Table 6
Rural Schools by climatic zone

	Warm	Temperate	Arid-Cold	Total
Number of Schools	4,026	1,618	1,198	6,842
Share (%)	58.8	23.6	17.5	100

Table 7
Energy requirements Argentina: Rural Schools

Category	Type of requirement	Energy requirement (useful energy TOE/yr)	Energy requirement (net energy TOE/yr)	Share useful energy (%)	Impact (# of schools and pupils)	Priority
Rural School	Lighting	56	280	0.4	6842 rural schools (513938 pupils from poor and indigent households)	VH
	Cooking	1,469	1,264	10.5		VH
	Water heating	9,941	3,264	71.1		VH
	Water pumping	101	16,667	0.7		VH
	Heating	1,561	3,468	11.2		VH
	Air conditioning	229	538	1.6		M
	Food refrigeration	47	111	0.3		H
	Workshop	4	5.5	0.0		M
	Other appliances	575	777	4.1		M
	Total	13,982	25,349	100.0		

Source: Own estimates. VH=Very High, H= High, M= Medium, L= Low

The following table summarises the results obtained after performing an analysis of the requirements of rural schools:

Table 8
Rural Schools´ requirements

Nº	Item	Value	Fraction (%)
	Education		
1	**Net energy consumption**	25.3 10^3 TOE	0.9% (1/2)
2	Argentina´s commercial and public sector - 2001	2,892 10^3 TOE	
3	**Power**	46.3 MW	0.2% (3/4)
4	Installed power in Argentina	23,189 MW	
5	**Electricity consumption**	22.7 GWh	0.1% (5/6)
6	Argentina´s Commercial and public sector - 2001	19,140 GWh	
7	**LPG**	6.5 10^3 ton	0.4% (7/8)
8	Argentina consumption - 2001	1,397 10^3 ton	
9	**Diesel**	56.4 10^3 m^3	72% (9/10)
10	Argentina´s Commercial and public sector - 2001	78.3 10^3 m^3	
11	Argentina consumption - 2001	9,400 10^3 m^3	

It must be pointed out that the consumption of the commercial and public sector is not actually known, while the figures published are estimates essentially based on data gathered on electricity and natural gas sales, for which there are billing-based records within the corresponding companies.

To meet the electric power requirements of rural schools not connected to a grid (5,428, i.e. 79% of all rural schools calculated in the present study), 28.56 MW of diesel power units (some 5,428 units yielding a mean power of 5.3 kW) would be needed.

The consumption of electricity - both that purchased from the grid and that self-generated - by all 6,841 rural schools analyzed would reach 22.7 GWh, representing 0.1% of the 19,140 GWh consumed from the electric system by the commercial and public sectors in Argentina during 2001, in accordance with the Argentine Energy Balance for 2001.

Diesel consumption, adding that used for heating (18.8 thousand m^3) and for the operation of power generators (37.6 thousand m^3) would reach 56.4 thousand m^3, representing 72% of the diesel consumption in Argentina registered within the commercial and public sectors by the Argentine Energy Balance during 2001, and 0.6% of the total diesel consumption in 2001.

Health Care Centres

The number of rural health centres per climate area to be supplied with electricity would reach 6,903, as shown in Table 9. These health centres would meet the energy and building needs of the 2,301,031 poor and indigent from the nation's rural areas.

Table 9
Health Care Centres by climatic zone

	Warm	Temperate	Arid-Cold	Total
Number of Centres	3,851	1,800	1,252	6,903
Share (%)	55.8	26.1	18.1	100

Table 10
Energy requirements Argentina: Health Care Centres

Category	Type of requirement	Energy requirement (useful energy kep/yr)	Energy requirement (net energy kep/yr)	Share useful energy (%)	Impact (# of sanitary outposts)	Priority
Health Care Centre	Lighting	65	327	1.5	6903 sanitary outposts (2,301,031 poor and indigent rural inhabitants)	VH
	Cooking	923	2,050	21.0		H
	Water heating	1,276	2,836	29.1		VH
	Water pumping	72	114	1.6		VH
	Heating	1,070	2,378	24.4		VH
	Air conditioning	301	708	6.9		H
	Food and vaccine refrigeration	76	180	1.7		VH
	Other appliances	605	1,201	13.8		M
	Total	4,388	9,795	100.0		

Source: Own estimates. VH=Very High, H= High, M= Medium, L= Low

Table 11
Health Care Centres requirements

Nº	Item	Value	Fraction (%)
	Health Care Centres		
1	**Net energy consumption**	9.8 10^3 TOE	0.3% (1/2)
2	Argentina´s commercial and public sector - 2001	2,892 10^3 TOE	
3	**Power**	14.2 MW	0.1% (3/4)
4	Installed power in Argentina	23,189 MW	
5	**Electricity consumption**	19.2 GWh	0.1% (5/6)
6	Argentina´s Commercial and public sector - 2001	19,140 GWh	
7	**LPG**	7.4 10^3 ton	0.5% (7/8)
8	Argentina consumption - 2001	1,397 10^3 ton	
9	**Diesel**	16.1 10^3 m^3	20.5% (9/10)
10	Argentina´s Commercial and public sector - 2001	78.3 10^3 m^3	
11	Argentina consumption - 2001	9,400 10^3 m^3	

To meet the electric power requirements of health centres not connected to a system (5,734 centres, i.e. 83% of all centres), 11.2 MW of diesel power units (some 5,734 units yielding a mean power of 2 KW per unit) would be needed.

The consumption of electricity - both that purchased from the grid and that self-generated - by rural health centres would reach 19.2 GWh, representing less than 0.1% of the 19,140 GWh consumed from the electric grid by the commercial and public sectors in Argentina during 2001, in accordance with the Argentine Energy Balance for 2001.

The consumption of diesel to run the power generators (16.1 thousand m^3) represents 20.5% of the diesel consumption by the commercial and public sectors in Argentina during 2001, in accordance with the Argentine Energy Balance for 2001, and 0.2% of the total diesel consumption registered in Argentina in 2001.

3.2.3 Productive Requirements

Grouped rural and urban dwellers (micro-ventures)

We understand as micro-venture the production or service activity carried out by a small number of people (the present document considers up to five household units), generally using adapted technologies – to a large extent homemade – where the key element is human effort. These micro-ventures include workshops, carpentry, food preparation, bakeries, jam and preserve making, clothing mending, laundry, lodging, iron works, ceramics, handicrafts, candles, and honey processing.

The following is the total number of micro-ventures estimated for grouped rural and urban unemployed dwellers:

Zone	# micro-ventures
Warm zone	39.102
Temperate zone	161.781
Arid-Cold zone	18.156
Total	219.039

Of which the following corresponds to grouped rural unemployed dwellers without electricity per area and for the nation's total:

Zone	% micro-ventures
Warm zone	3.1%
Temperate zone	0.9%
Arid-Cold zone	0.8%
Total	1.3%

In other words, in comparison with the micro-ventures for grouped rural and urban unemployed dwellers with electricity, those corresponding to grouped rural unemployed dwellers without electricity are practically negligible.

Table 12
Energy requirements Argentina: Productive - Urban and rural grouped

Category	Type of requirement	Energy requirement (useful energy TOE/yr)	Energy requirement (net energy TOE/yr)	Share useful energy (%)	Impact (# of micro enterprises and workers)	Priority(*)
Productive - Urban and rural grouped	Lighting	809	4,046	1.0	219039 micro enterprises (563000 workers)	
	Cooking	27,266	60,590	35.1		
	Water heating	15,294	33,988	19.7		
	Heating	462	1,027	0.6		
	Food refrigeration	3,263	5,406	4.2		
	Air conditioning	98	230	0.1		
	Other appliances	571	985	0.7		
	Process heat	16,746	25,409	21.6		
	Mechanic power	13,141	26,202	16.9		
	Total	77,650	157,884	100.0		

(*) It depends on the characteristics of each micro enterprise.
Source: Own estimates.

Table 13
Productive requirements (Urban and rural grouped)

Nº	Item	Value	Fraction (%)
	Productive (Urban and rural grouped)		
1	**Net energy consumption**	158 10^3 TOE	1.3% (1/2)
2	Argentina´s industrial sector - 2001	12,619 10^3 TOE	
	Power		
3	Population lacking electricity	9 MW	0.04% (3/5)
4	All microenterprises	727 MW	3.3% (4/5)
5	Installed power in Argentina	23,189 MW	
	Electricity consumption		
6	Population lacking electricity	5.9 GWh	
7	All microenterprises	472 GWh	1.4% (7/8)
8	Argentina´s industrial sector - 2001	33,663 GWh	
9	**LPG**	102 10^3 ton	7.3% (9/10)
10	Argentina consumption - 2001	1,397 10^3 ton	

To meet the electric power requirements of the micro-ventures of the grouped rural unemployed or underemployed population lacking electricity, 9 MW should be installed throughout the country, which would allow a yearly consumption of 5.9 GWh.

This supply could be guaranteed either expanding the public grid or else installing conventional power units (running on motor gasoline, diesel, or LPG) or micro hydro stations, wind chargers, or other equipments driven with renewable energies.

Some 563,000 people would work in these 219,039 micro-ventures, which would generate some kind of income for the 4,214,536 unemployed and underemployed from urban and grouped rural areas with electricity and 55,628 unemployed and underemployed from grouped rural areas without electricity.

Other productive activities of Grouped and Dispersed rural dwellers

These productive activities are typical of the rural area and are characterized for being carried out by small groups of families (between 5 and 20), associated into cooperatives and generally using adapted technology. These are labour intensive activities with some use of rented agricultural machinery. Some of the activities are related to the production of: honey, poultry products, rabbits, wool, vegetables, milk, soybeans, corn, potatoes, Yucca yucca, tea, and yerba mate.

The following table presents the number and type of productive activity by climatic region.

Table 14
Other Rural productive activities

Number of families per activity	Type of activity	Warm	Temperate	Arid-Cold	Total
5	Honey	488	147	474	1109
20	Poultry	122	37	118	277
5	Rabbits	0	147	236	383
10	Wool	0	0	1066	1066
10	Vegetables	488	74	356	918
5	Milk	977	441	474	1892
10	Soybeans	1222	441	0	1663
10	Corn	977	441	0	1418
10	Potatoes	488	74	118	680
5	Yucca	488	0	0	488
5	Tea	488	0	0	488
5	Yerba Mate	488	0	0	488
	Total	6226	1802	2842	10870
	Share (%)	57.3	16.6	26.1	100

Table 15 presents the population that would be employed in all the micro-ventures and their relationship with rural unemployed population:

Table 15
Population employed in rural micro-ventures

	Employed	as % of total rural unemployed
Warm zone	131,913	67.5
Temperate zone	39,924	67.9
Arid-Cold zone	43,819	46.3
Total	215,656	61.8

All the productive activities would demand a land area equivalent to 3.1% of the total arable land of Argentina, as shown in table 16.

Table 16
Land used in micro-ventures

	Land used (hectares)	as % of total arable land
Warm zone	1,409,510	4.1
Temperate zone	555,849	0.8
Arid-Cold zone	3,325,514	5.3
Total	5,290,873	3.1

Table 17 present the energy consumption by type of requirement (mechanic power includes animal and human labour)

Table 17
Energy requirements: Other productive activities -– Rural

Category	Type of requirement	Energy requirement (useful energy TOE/yr)	Energy requirement (useful energy TOE/yr)	Share useful energy (%)	Impact (# of micro enterprises and workers)	Priority(*)
Other Productive - rural	Lighting	90	448	0.2	10870 micro enterprises (215,656 workers)	
	Cooking	0	0	0.0		
	Water heating	8,020	17,821	15.0		
	Heating	0	0	0.0		
	Food refrigeration	7	12	0.0		
	Drying	0	0	0.0		
	Process heat	460	1,012	0.9		
	Mechanic power	43,743	182,452	81.6		
	Refrigeration	78	123	0.1		
	Irrigation	155	258	0.3		
	Water pumping	1,050	427	2.0		
	Total	53,602	202,554	100.0		

(*) It depends on the characteristics of each micro enterprise.
Source: Own estimates.

Table 18 presents a summary of the results.

It is worth pointing out that under agricultural sector consumption the national energy balance only includes the consumption of gas oil for agricultural machinery, and some electricity and biomass residues.

Gas oil represents 84.8% of the net energy consumed in all the productive activities and human and animal energies provide 4.4%. GLP supplies 9.3% and electricity only 1.5%

Table 18
Other Productive requirements (Rural)

Nº	Item	Value	Fraction (%)
	Other Productive (Rural)		
1	**Net energy consumption**	202.6 10^3 TOE	8.0% (1/3)
2	Net Energy without animal and human energy	193.7 10^3 TOE	7.6% (2/3)
3	Argentina´s agricultural and livestock sector - 2001	2,525 10^3 TOE	
	Power		
4	All microenterprises	32.2 MW	0.15% (4/6)
5	Microenterprises within areas with public EE supply	6.5 MW	0.03% (5/6)
6	Installed power in Argentina - 2001	23,189 MW	
7	**Electricity consumption**	33 GWh	7% (7/8)
8	Argentina´s agricultural and livestock sector - 2001	476.73 GWh	
9	**LPG**	15.3 10^3 ton	1% (9/10)
10	Argentina consumption - 2001	1,550 10^3 ton	
11	**Gas Oil for agricultural machinery**	199.3 10^3 m^3	7% (9/10)
12	Consumed in agricultural machinery in Argentina	2,826 10^3 m^3	
13	**Diesel gensets**	18.1 MW	0.7% (13/14)
14	Autoproducers in Argentina -2001	2,586 MW	
15	**Gas Oil for gensets**	11.4 10^3 m^3	42.6% (15/16)
16	Autoproducers in Argentina - 2001	26.8 10^3 m^3	

3.2.4 Summary of requirements

Table 19
Energy requirements by subsector

Sector	Net energy requirement (TOE/yr)	Useful energy requirement (TOE/yr)	As % of national energy consumption in 2001
Urban and rural households (Basic)	2,453,103	830,950	6.42
Rural health care centres	9,795	4,388	0.03
Rural schools	25,349	13,982	0.07
Urban productive	157,883	77,650	0.41
Rural productive	202,555	53,603	0.53
Total	2,848,685	980,573	7.46

Table 20
Energy requirements by zone

Zone	Net energy requirement (10^3 TOE/yr)	Share (%)
Warm	737	25.9
Temperate	1,529	53.7
Arid - Cold	582	20.4
Total	2,848	100.0

It can be seen that the main requirement is that of the residential sector, with 86%, followed by the productive sector, with 7.1% of the total requirements. In comparison, at national level the main sector is transport, with 32%, followed by industry, with 29.7%.

As to the energy consumption by source, the main source is LPG, with 51% of net consumption, followed by electricity, with 22%, and firewood, with 18%. Al national level, the national energy balance of 2001 shows that the main energy sources were natural gas (35.2%), gas oil (23.3%), and electricity (17%). LPG only represented 3.1% and commercial firewood 3.7%.

Table 21
Summary and comparison of energy requirements by source

Nº	Item	Value	Fraction (%)
	All sectors		
1	**Net energy consumption**	2,848 10^3 TOE	7.4% (1/2)
2	Argentina - 2001	38,205 10^3 TOE	
3	**Power**		
4	Total	9,437 MW	
5	Simultaneous	5,662 MW	26% (5/6)
6	Installed power in Argentina - 2001	23,189 MW	
7	**Electricity consumption**	7,356 GWh	9.7% (7/8)
8	Argentina - 2001	75,895 GWh	
9	**LPG**	1,320 10^3 ton	94% (9/10)
10	Argentina consumption - 2001	1,405 10^3 ton	
11	**Gas Oil**	218 10^3 m^3	2.1% (9/10)
12	Argentina - 2001	10,322 10^3 m^3	
13	**Gasoline**	53 10^3 m^3	1.1% (13/14)
14	Argentina -2001	4,900 10^3 m^3	
15	**Firewood**	2,226 10^3 ton	13% (15/16)
16	Sustainable potential	17,280 10^3 ton	

We must point out that neither the 26% of electric power nor the 9.7% of electricity consumption, the 94% of LPG consumption, the 2.1% of gas oil consumption, the 1.1% of gasoline, or the nearly 2.4 times of the firewood consumption resulting from the respective basic power or energy requirements of the poor and indigent population, as estimated in the present document, are incremental values in relation to those actually consumed by the nation's total population (poor and not poor).

3.3 Technologies

As may be appreciated in Appendix 3.3, Argentina has an interesting number of public and private stakeholders who work in all the range of activities concerning renewable technologies (R&D, manufacture, distribution, etc.). A large part of the activity carried out for decades was maintained over time by different research centres linked to State institutions, which have acted as reservoirs of the local knowledge on the issue (Barney, 1993; Saravia, 1993; Horta Nogueira, 1993, Hilbert, 1993; Muguerza, 1999).

In the field of R&D, practically all the renewable technologies analyzed register some level of activity, although in a quite variable way. In contrast to this, only some of the technologies reached manufacture and commercialization stages at local level (wind for electricity generation and water pumping, mini hydro, solar water heaters for hot water, ethanol, and incipient industrial developments in biogas, biodiesel and large wind turbines).

The lowest levels of research and development are related to photovoltaic energy, solar concentrator systems for electricity generation, due perhaps to the relative complexity of these technologies, the associated infrastructure requirements, and the difficulty to compete with foreign research institutes that have been devoting their work to these issues for decades. Notwithstanding the fact that the most critical components of the photovoltaic systems are not commercially manufactured in Argentina, different parts of the balance of system are indeed domestically produced, and there is even a module-assembly factory. Photovoltaic cells are produced in Argentina at research level and for satellite applications but never reached mass production development scale. Presently, the National Atomic Commission manufactures cells and assembles high quality modules for the national aerospace industry in an artisanal way, which constitutes a promising step in this high technology field. Quality control is also carried out locally, based on the highest standards available for this demanding application (Durán, 2004).

In the field of wind power, there is potential capacity to manufacture several components of large wind turbines through an adequate transfer of technology, and this possibility has already been considered within the framework of the importation of turbines as an initial way to reduce transport costs and contribute to the development of a local industry. However, there is also local capacity for the development of large equipments and presently there are two industrial development projects that involve the design and building of MW class wind turbines specifically adapted to the Patagonian region and also aiming at technology export. The components of these large turbines would be produced by small and medium enterprises which presently supply and provide services to the oil industry. The first prototypes would be installed during 2006.

In contrast, mini hydro, solar water heater, small and medium wind turbines, and wind pump technologies have been the object of much research, prototype development, and demonstration projects. A large part of the applied research and prototypes were developed by research institutes associated to national universities with a regional area of influence, encouraged in general by the existence of a significant renewable resource and unmet energy requirements in the area. In some cases, the existence of companies linked to R&D institutions has allowed transferring technology and reaching the stages of local manufacture of nearly all components, commercialization, and even exportation, as in the case of mini hydro, although always at a very small scale and taking advantage of certain market niches linked to intermediate and high consumption sectors that may face the initial investment. These technologies traditionally reach the poorest consumers hand in hand with provincial or national programs, or else through NGOs projects that channel funds from foreign institutions. In both cases, the degree of subsidy is high or complete. In the case of the mini hydro and wind systems, the applications are restricted to areas isolated from the electricity grids, where these systems are more viable than the expansion of the grid, or even gasoline or diesel generator sets. In opposition, solar water heaters are also used in certain urban areas for domestic and service applications to cut down the consumption of conventional fuels. Wind pump systems saw their heyday in the past for agricultural applications, with several local manufacturers and an adequate O&M infrastructure. However, their use ceased on account of the higher penetration of conventional energy sources registered during the last decades.

In turn, the technology and activity associated to the production of biodiesel, although incipient, has been much promoted as it is linked to an important economic group in Argentina, the agricultural latifundium sector, and on account of its potential to replace diesel. The fuel is now in the process of being standardized by IRAM (Argentine Material Rationalization Institute) for use in diesel engines. There is also local development of prototype plants in batch and continuous mode with relatively-simple technology, and even exportation of equipments at a small scale. This degree of development in a relatively-short period shows that, in general terms, technologies with a potentially attractive market behind them have reached certain commercial development, even if restricted by the nearly complete lack of specific promotion measures.

In contrast to this, softer technologies lacking this potential market have not gone beyond the research, demonstration and dissemination stages carried out by the institutions studying them (in general, universities and associated institutions) or NGOs, notwithstanding the fact that they are comparatively simpler and relatively cheap. Such is the case of some solar and small scale biomass technologies (efficient firewood stoves built using local materials, solar driers for agricultural product preservation, passive solar architecture for arid areas, solar cookers and ovens, solar ponds for production applications, solar stills, biogas, solar Stirling engine, small scale combustion and gasification). In all these cases, there are prototypes and installations in different areas of the country, although the commercial development and manufacture of national equipments is scarce, notwithstanding the existing potential to produce them wholly in Argentina.

With reference to large-scale biomass distillation, combustion, and gasification technologies (bagasse, forestry and agro-industrial waste), there is good experience in their use, although the level of research and development at present is quite low, due perhaps to the high degree of maturity reached and the more conventional nature of these industrial conversion plants. These technologies are used in many cases by the same establishments that produce the waste, due to which the available equipments are usually medium and high power ones, and there is capacity within the local industry to manufacture them on request. There has also been local development of technology for wood pyrolisis and the efficient production of charcoal. However, there is an important technological void in low scale biomass equipment for domestic or small productive activities, which contrasts with the unmet requirements and the ample availability of biomass resources in some regions of Argentina. In this sense, it would be interesting the development of small gasification units and engines able to run on the produced fuel, as well as small biomass steam power plants for rural communities.

In the field of geothermal energy, the present development is mainly aimed at the direct use of the thermal fluid, setting aside cogeneration of heat and power as it is deemed costly with respect to conventional sources. The activity is almost solely promoted by SEGEMAR (Argentine Mining Geological Service), which provides technical assistance for the implementation of projects to make use of high-and-low-enthalpy thermal fluids. The technologies for the direct use of the thermal fluid are simple (water-powered heating installations), their components are locally available, and they are usually integrated in accordance with each project. The incipient activity is due to the fact that the resource evaluation stage is being completed to further increase exploitation.

It is also worth pointing out in general terms that the R&D area registers a significant overlapping of efforts and a lack of coordination with respect to the meeting of concrete application objectives. Furthermore, there are no adequate links between R&D institutions and small-and-medium-sized-company sectors to allow a fluent transfer of technology. In some cases, the statutes and regulations of the research institutes place barriers against such cooperation.

With reference to the manufacture of equipments in Argentina, the recent devaluation and consequent rise in the cost of imported equipment has favoured the reappearance and strengthening of a few firms that manufacture and sell renewable systems (mainly wind systems for electricity generation and mechanical pumping, mini hydro, and solar water heaters), although this activity is still quite modest and subject to the cycles of the national economy, the price of conventional fuels, and the expansion of the electricity grid. Moreover, it is hard to sort manufacturers from dealers and know with accuracy the existing degree of local manufacture, as the information supplied is scarce. On the other hand, quality standards in general are not followed at local level for the manufacture of equipments, with a resulting commercialization of equipments of quite variable quality. In general, the potential consumer lacks sufficient information to adequately base his choice of an specific equipment, and ends up purchasing the equipment offered to him or that on which he has some reference. In some cases, the importation of technologies is favoured by the existence of associated credits that are not usually available for local technologies, and which cut down competitiveness and possibilities for domestic manufacturers. Nevertheless, the cost of spare parts for the locally-manufactured equipments is still significantly lower than that of imported spares, which after the devaluation reached prohibitive levels. However, it is not always easy to find local spare parts (discontinued models, closing firms, etc.)

Local technology manufacturers demand tax exemptions and incentives until the technological maturity and assimilation process is consolidated. In relation to this, we notice that the scarce legislation in the field of renewable energies usually places emphasis on the incentives to use these technologies rather than on those to locally manufacture the equipments. An interesting exception are the wind laws of the provinces of Chubut and Buenos Aires, which relate the incentives to the local manufacture of certain components as a way to promote these activities.

In the commercial field, there is a large number of firms and consulting agencies that distribute solar, wind, and mini hydro units, and that design and install generation systems, mostly for isolated consumers. In contrast, the maintenance infrastructure is in general quite weak, restricted to the area of influence of a certain manufacturer, dealer, or R&D organization located in the area. For the rest of the cases, there are long waiting periods and costs as a result of the distances involved, which translate into a difficult observance of the guarantees on the part of the dealer or firm in charge of the maintenance. It is not uncommon that consumers located far from the equipment dealer decide to install the equipments themselves to lower costs, which leads to deficient installations. This situation is worsened by deficiencies in the training of the consumer, with the resulting overloading and eventual breaking of the generation equipment. Consequently, the unit ceases to be used or assistance is required from a local technician or mechanic - usually with a low degree of specialization in renewable technologies -, with the consequent risk of loss of guarantee, permanent breaking, or reduction of the lifetime of the unit. In every case, the consequences are quite negative due to the bad image perceived by the consumer, which is further spread by the latter. This lack of adequate O&M infrastructure is also closely related to the still little specific training of human resources in the field of renewable energies, the scattering and isolation of consumers, and their low payment capacity. Nonetheless, it represents a critical aspect, together with the training of consumers, to achieve the acceptance and promotion of these technologies. Wind systems are in general those having more maintenance problems, together with photovoltaic equipments, which register an inadequate use. With respect to mini hydro systems, their installation generally involves sufficient consumer training to prevent many of the known problems. It would be necessary to implement a mechanism to guarantee the adequate maintenance of all equipments installed through a responsibility shared by the seller, the installer, and the consumer.

In general terms, there is a good degree of technological maturity in the demonstration and commercial equipments available at local level, especially as regards electricity generation or co-generation technologies and those with medium and high power applications. Nevertheless, as mentioned earlier, quality is highly variable. In contrast, low-power heat producing technologies or passive systems are those that are less developed (with the exception of solar water heaters), although from the standpoint of the present study they are sometimes the most needed to meet the energy requirements of the poorest sectors.

Among the main disadvantages of renewable energies technologies in the context of the present study are the high initial cost, the absence of credit, the variability of the generation and the associated need for storage, power limitation and the difficulty of providing both heat and power. In relation to power generation, PV systems seem to be the most limited in terms of cost per unit power and the uses that can be satisfied with the traditional SHSs. In the other end are mini hydro stations, generally presenting a good availability of power and a cost per unit power that is much lower than for PV systems. Wind turbines are in between in terms of cost per unit power.

The costs per installed power unit for electricity generation systems in general are high with respect to conventional systems, with the exception of certain intermediate power hydro installations. However, when including operation and maintenance costs, the balance is in favour of renewable systems. The same applies when comparing the costs of biogas with those of LPG, while the selling price of diesel at present is close to the production cost of biodiesel on account of the high price of oil and the taxes on diesel.

These features will affect the degree in which each technology will be able to meet production requirements.

Only a few of the renewable technologies available in Argentina are versatile enough to provide both heat and power and consequently satisfy many requirements simultaneously. These technologies are those that produce a fuel (biogas, biodiesel, ethanol, biomass residues) and geothermal energy. Among these only a few are available for low power applications (biogas and maybe biodiesel). The rest of the technologies are more viable for medium and high power and consequently more adequate for rural communities than for dispersed rural households (biomass gasification, ethanol, biomass boiler).

The advantages of renewable systems include a low operation cost, a reduction of the dependence and supply problems related to fossil fuels, a lower cost throughout the lifetime of the equipment, and a reduction of the impacts on the environment and on human health.

To sum up, we may say that, with proper incentives; an adequate organization and coordination of the available human and financial resources; financing of research, development, and demonstration activities; a good relation with industry - especially small and medium sized companies; the development of quality standards for equipment manufacture and installation; and a technological transfer and cooperation program with other nations, Argentina would be in conditions, in the medium and long term, to produce and develop all renewable technologies that have reached the commercial stage within the industrialized world, with an adequate quality level, and also to contribute to the development of those technologies presently in pre-commercial stages.

In the short term, it is essential to provide training and guidance to potential consumers, improve the quality of locally-produced equipments, and ensure their adequate maintenance.

In Appendix 3.3 a summary of some of the main characteristics of renewable energies technologies is presented and of associated R&D capacities.

3.4 Renewable Resources

Argentina has many and varied energy resources, ranging from traditional non-renewable ones (oil, natural gas, coal, and uranium) to the most diverse renewable ones (hydro, geothermal, biomass, wind, solar, etc.)

With reference to non-renewable sources, there is detailed and updated information at national level on the geographical location of proven reserves, extraction, etc. Nevertheless, with respect to renewable sources, the information on their utilization, production, and potential is partly scattered and unsystematized, and partly insufficiently known.

In relation to wind resources, there is good information about the Patagonia region from 1981 to the present, allowing an identification of high potential areas suitable for wind farm installation (SEE, 2004a).

Hydro resources have also been grossly estimated for large and medium flow-rate rivers based on river basin information (EVARSA, 1997). However, local information is generally lacking and the potential of small rivers for micro-hydro energy is largely ignored in this estimation.

The solar resources available in Argentina are estimated by different means and with different degree of accuracy. Here we present data with low spatial resolution published by the Energy Secretariat and based on satellite information (SEE, 2004a). However, there are also other data sets based on direct information produced by a network of solar measurement stations started in 1978, and on indirect information based on daily solar radiation hours from the National Weather Service stations. Unluckily, some solar measurement stations were gradually closed due to lack of resources for proper maintenance, and thus the production of adequate solar maps depends on careful extrapolation of direct measurements from 26 stations to the rest of the country using standard data from 131 weather stations (Righini, 2003).

The present chapter aims at making a contribution to this issue, in light of which a comprehensive gathering of data from different sources was carried out to systematize such data and calculate in turn the production and potential of renewable energies at national and provincial levels for the year 2002.

We further present the approach followed for the classification of renewable resources, as from which production and, in those cases where it corresponded, potential at national and provincial levels were calculated:

1. **Firewood** (Natural Forests & Shrubs and Artificial Forests)
2. **Wood waste** (from the forestry industry)
3. **Sugar Cane bagasse**
4. **Agricultural waste**
5. **Agroindustrial waste**
6. **Livestock manure**
7. **Solar energy**
8. **Wind energy**
9. **Small hydro stations (< 10 MW)**
10. **Geothermal energy**

By way of a summary, the Table below indicates the annual production of firewood, wood wastes, bagasse, agricultural wastes, agro-industrial wastes, and livestock manure; as well as the solar and wind energy potentials; and the projects in the portfolio of the Energy Secretariat in the field of small hydro stations.

Table 22
Renewable energies resources annual production and potential in Argentina in 2002

Province	Wood ton	Other wood ton	Bagasse ton	Agricultural Residues ton	Agroindustrial Residues ton	Animal Manure ton	Solar kWh/m2.day inc.=latitude	Wind m/sec annual average	Small Hydro MW (projects) Small, mini and micro	Geothermal Number of geothermal zones by province
Buenos Aires	162,844	47,930		9,706,286	395,343	4,512,014	4.0 - 5.0	3-5		3
Catamarca	44,237	55		93,197	1,278	80,561	4.5 - 5.5	1-3	6.13	1
Córdoba	31,650	9,316		10,040,348	256,714	1,801,969	4.5 - 5.0	2-4	7.95	1
Corrientes	386,544	113,562	514	138,989	67,586	981,611	4.5 - 5.5	2-4		2
Chaco	1,319,177	57,507		1,689,703	180,473	589,534	4.5 - 5.5	2-4		
Chubut	46,285	6,713				229,603	3.5 - 4.5	6-9	15.99	
Entre Ríos	214,564	60,942		2,692,159	116,610	1,020,436	4.5 - 5.0	2-4		7
Formosa	26,420	11,417		83,369	8,826	406,430	5.0 - 5.5	2-4		
Jujuy	32,126	3,238	1,002,694	131,306	380	56,414	4.5 - 5.5	2-3		2
La Pampa	44,954	7,939		707,046	121,160	986,071	4.5 - 5.5	2-5	2.25	1
La Rioja	15,556	5		3,996	599	87,616	4.5 - 5.5	2-3	30.17	
Mendoza	21,193	3,817				135,854	4.5 - 5.5	1-3	41.52	1
Misiones	450,753	159,518	15,120	6,081	98	152,360	4.0 - 5.0	1-2	0.04	1
Neuquen	21,164	2,602				85,859	4.5 - 5.0	3-8	35.25	2
Río Negro	22,892	5,453				226,803	4.5 - 5.0	3-8	22.59	
Salta	44,303	29,954	328,479	571,286	10,750	166,572	4.0 - 5.0	1-3		2
San Juan	473	0				18,309	5.0 - 6.0	2-3	24.10	1
San Luis	104,690	975		245,060	10,050	415,082	4.5 - 5.5	3-4		
Santa Cruz	3,346	13				119,250	3.0 - 4.0	4->10	10.58	
Santa Fe	33,936	7,722	73,908	7,899,576	156,057	1,740,759	4.5 - 5.5	2-4		
Santiago del Estero	413,994	2,115		1,332,817	65,159	372,564	4.5 - 5.0	2-4	1.06	1
Tierra del Fuego	814	4,136				31,989	4.0 - 5.0	1-3	53.60	1
Tucumán	24,688	1,439	3,034,285	759,018	5,840	35,368	2.5 - 3.5	4-5	9.44	
Total Country	**3,466,603**	**536,367**	**4,455,000**	**36,100,236**	**1,396,922**	**14,253,026**			**260.66**	**26**

Source: Own calculation (Di Sbroiavacca, 2004).

Some of the energy resources in this table have not yet been affected by the availability coefficient, as in the case of Agricultural Waste and Agro-industrial Waste. For the former, although it would represent one of the nation's most significant resources in terms of annually produced tons, it has zero availability, as it must be left on the ground to reduce the constant loss of nutrients resulting from consecutive harvests. In turn, agro-industrial waste must be affected by a coefficient equal to 60% to obtain its availability.

Hence, when considering only the available renewable resources from biomass, and transforming them into TOE, we note an annual availability of 6.6 million TOE. We need to bear in mind that Argentina currently produces approximately 2.9 million TOE between firewood, bagasse, and agroindustrial waste, from which we conclude that the production of renewable energy from biomass could at least be more than doubled. So, at present, some 3.7 million TOE of this energy resource are not utilized for energy purposes.

It is also important to mention that this annual availability of 6.6 million TOE of renewable resources from biomass, represents 10% of the national primary energy supply of Argentina (year 2002)

We may see that 75% of this available energy comes from livestock manure. It is worth pointing out here that the energy content of this source must be affected by a 15% yield coefficient to be utilized as biogas, thus bringing down its relative significance. But even in this case the amount of biogas energy (745 ktep) would represent almost 10% of non electric energy demand of the residential sector in year 2000.

Table 23
Biomass annual availability as renewable energy resource in Argentina in 2002

Available for energy uses (TOE)	Wood	Other wood	Bagasse	Agricultural Residues	Agroindustrial Residues	Animal Manure	Total Biomass
Buenos Aires	32,569	8,627	0	0	54,557	1,579,205	1,674,958
Catamarca	8,847	10	0	0	176	28,196	37,230
Chaco	263,835	10,351	0	0	24,905	206,337	505,429
Chubut	9,257	1,208	0	0	0	80,361	90,826
Córdoba	6,330	1,677	0	0	35,427	630,689	674,122
Corrientes	77,309	20,441	77	0	9,327	343,564	450,718
Entre Ríos	42,913	10,970	0	0	16,092	357,152	427,127
Formosa	5,284	2,055	0	0	1,218	142,250	150,807
Jujuy	6,425	583	150,404	0	52	19,745	177,209
La Pampa	8,991	1,429	0	0	16,720	345,125	372,265
La Rioja	3,111	1	0	0	83	30,666	33,861
Mendoza	4,239	687	0	0	0	47,549	52,475
Misiones	90,151	28,713	2,268	0	13	53,326	174,471
Neuquen	4,233	468	0	0	0	30,051	34,752
Río Negro	4,578	982	0	0	0	79,381	84,941
Salta	8,861	5,392	49,272	0	1,484	58,300	123,308
San Juan	95	0	0	0	0	6,408	6,503
San Luis	20,938	176	0	0	1,387	145,279	167,779
Santa Cruz	669	2	0	0	0	41,737	42,409
Santa Fe	6,787	1,390	11,086	0	21,536	609,266	650,065
Santiago del Estero	82,799	381	0	0	8,992	130,398	222,569
Tierra del Fuego	163	745	0	0	0	11,196	12,103
Tucumán	4,938	259	455,143	0	806	12,379	473,524
Total Country	**693,321**	**96,546**	**668,250**	**0**	**192,775**	**4,988,559**	**6,639,451**
Percentage (%)	10.4	1.5	10.1	0.0	2.9	75.1	100

Source: Own calculation made specifically for the present study.

We should keep in mind that in the case of wood from native forests, the annual sustainable extractable potential is estimated around 27 million tons of wood per year (5.4 million TOE/year), 8 times the present declared extraction (64% of this production is used for firewood).

It is worth commenting that Argentina had in 2002 some 33.17 million hectares of natural forests, as well as 0.78 million hectares of artificial forests. Moreover, the total wood production from native forests reached some 3,240,000 tons. This implies the implementation of a utilization equivalent to the mean productivity of the native forests as to wood production of 0.10 tons of wood/hectare-year, while wood extraction for firewood from artificial forests was 18 times higher, reaching 1.77 tons of firewood/hectare-year (Esper, 2001; SAyDS, 2002, SAyDS, 2003).

We thus conclude that firewood (extracted in a sustainable way) and livestock manure (with its further conversion into biogas) would be those biomass renewable resources with the highest potential to meet the energy needs of the poor. However, we still need to know in detail the availability of firewood and livestock manure at local level, as well as the existence of the resource close to potential consumers. In this respect, we estimate that a large part of the firewood within reach of rural and urban dwellers is already being utilized (although not in a sustainable way and with lack of adequate management of the resource), while most of the livestock manure is still not utilized for energy purposes.

With reference to wind energy, we notice the existence of significant potential at national level - both due to the high national coverage of the resource and as a result of its quality -, mainly from Río Colorado towards the Argentine South (mostly Patagonia). Nonetheless, if the aim is to use this resource to meet a wide proportion of the energy needs of low-income households, it is worth pointing out that wind energy is at a disadvantage against other traditional energy resources such as biomass, on account of investment and maintenance costs. In table 24 we present a gross estimate of the potential of wind energy generation in the provinces of the Patagonia region based on data aggregated at county level. The calculation takes into account both the geographical distribution of the resource, land suitability factor, and the population density. Two extreme values for the power density are presented due to the large uncertainty in the determination of this parameter.

Table 24
Wind Energy potential in Patagonia

Power density 0.09 MW/km^2 f_c > 20	Power (MW)	Energy (GWh/yr)	Capacity factor
Chubut	85	238	32
Neuquén	15	34	25
Río Negro	26	63	27
Santa Cruz	40	109	31
Tierra del Fuego	0	0	
Patagonia	167	445	

Power density 4 MW/km^2 f_c > 20	Power (MW)	Energy (GWh/yr)	Capacity factor
Chubut	3,786	10,589	32
Neuquén	685	1,523	25
Río Negro	1,177	2,793	27
Santa Cruz	1,781	4,864	31
Tierra del Fuego	0	0	
Patagonia	7,429	19,769	

The wind energy potential generation represents between 6% and 277% of the electricity demand in Patagonia in year 2000, or between 0.6% and 25% of the electricity demand in Argentina in year 2000. In order to tap this potential it would be necessary to link the Patagonian grid with the national grid, and civil works in this direction have begun in 2004. When this interconnection and voltage upgrading is completed Patagonia could be able to contribute up to 15% to 20% of national installed capacity with wind power, which represents approximately 4,000 MW.

Solar energy to produce electricity has less potential at national level with respect to wind energy if we consider that radiation level as from which the installation of photovoltaic panels (5 KWh/m^2-day) becomes feasible. As in the case of wind energy, cost, maintenance, and cultural reasons place it at a disadvantage with respect to biomass. On the other hand, the available resources for caloric uses are quite significant, while technologies in this case are more accessible, due to which there is quite an interesting potential here. The highest availability of this resource is registered from Río Colorado towards the Argentine North.

Small hydro stations represent an attractive solution for cities or settlements located within a few hundred meters from them. A more thorough market analysis of the projects surveyed by the Energy Secretariat would yield an estimate of the magnitude of the energy needs that could be met through small, mini and micro hydro options (SEE, 2004b).

Finally, concrete actions have been taken in order to evaluate and implement geothermal projects in different provinces since the 70's. First studies were orientated to electricity generation, then to develop industrial applications such as greenhouses, hatcheries, road ice elimination, home heating system generation, health spas, beach therapy, etc. An interesting potential has been identified in several provinces (SEGEMAR, 2004).

3.5 Case Studies

The crossing of the information from the detailed study of energy requirements within the different socioeconomic sectors, of renewable resources available in each region of the country, of capacities, and of renewable technologies with a degree of commercial development have led to the design of certain case studies that are deemed relevant towards the identification of potential niches for the incorporation of renewable energies in Argentina.

The analysis of the data on the geographic distribution of the poor population of the rural areas in Argentina indicates that the rural population is grouped within the following categories, in decreasing order of magnitude:

Table 25
Rural poor population – SIEMPRO

Category	Population	Share (%)	Renewable resources
Rural dispersed – Warm zone	1,053,809	45.80	Solar, biomass, hydro
Rural dispersed – Temperate zone	452,922	19.68	Biomass, solar, wind, hydro
Rural dispersed – Arid zone	333,000	14.47	Solar, wind, biomass, hydro
Rural community – Warm zone	202,869	8.82	Solar, biomass, hydro
Rural community – Temperate zone	174,045	7.56	Biomass, solar, wind, hydro
Rural community – Arid zone	83,238	3.62	Solar, wind, biomass, hydro
Rural dispersed – Cold zone	826	0.04	Biomass, wind, hydro
Rural community – Cold zone	322	0.01	Biomass, wind, hydro
Total rural	2,301,031	100.00	

Source: Own estimates.

The same analysis yields the following figures for the poor urban population:

Table 26
Urban poor population – SIEMPRO

Category	Population	Share (%)	Renewable resources
Urban – Temperate zone	10,995,878	62.77	Biomass, solar, wind, hydro
Urban – Warm zone	4,547,933	25.96	Solar, biomass, hydro
Urban – Arid zone	1,936,604	11.05	Solar, wind, biomass, hydro
Urban – Cold zone	37,897	0.22	Biomass, wind, hydro
Total urban	17,518,312	100.00	

Source: Own estimates.

On the other hand, the analysis of the technologies and of the respective capacities has allowed identifying the following as the most viable ones to apply in the short term in Argentina to meet the energy requirements of the poor and indigent sectors of the population: mini hydro, wind chargers, wind pumps, efficient biomass cookers, solar water heaters, solar cookers and ovens, solar driers, photovoltaic systems, and biogas digesters.

The following case studies were selected on the basis of the crossing of data on population, resources, technologies, and capacities:

Table 27
Case Studies

Case Study	Population	Zone	Uses	Renewable technologies
1	Urban with EE	Temperate and warm	Residential, workshop and other productive activities	Solar water heater, biomass stove
2	Rural dispersed	Warm and temperate	Residential, cattle raising, agriculture	biomass stove, biogas, PV, solar drier
3	Rural dispersed	Temperate	Residential, cattle raising, agriculture, workshop	Biogas, wind pump, wind turbine, biomass stove
4	Rural dispersed	Arid	Residential, cattle raising, agriculture, workshop	Wind turbine, solar water heater, solar stove, wind pump, biomass stove
5	Rural community	Warm	Residential, community services, workshop	Biogas, minihydro, solar drier, biomass stove
6	Rural community	Temperate	Residential, community services, workshop	Biogas, wind turbine, wind pump
7	Rural community	Cold/Arid	Residential, cattle raising, workshop	Wind turbine, biomass stove, wind pump

Source: Own estimates.

The remaining requirements to meet would be transport and agricultural machinery, which could be satisfied in temperate and warm areas through the community production of biodiesel, although it is considered that both this possibility and the production of ethanol are more within the reach of the medium and high socioeconomic sectors on account of the production scale involved and the requirements of the agricultural machinery for the harvesting, storage, transportation, and processing of biomass.

The case studies were sorted in descending order of representativeness, as may be deducted from the population distribution given in tables 25 and 26. Replicability is in general quite good within the specified area, although it is clearly subject to the availability of the corresponding renewable resource. In relation to this, case study number 5 could be questioned due to the inclusion of mini hydro, although we must bear in mind that this resource is available practically in every region of the country, and is thus of high interest, even when only the specific exploitations close to settlements and that meet certain minimum flow and head requirements are viable. The following case studies in decreasing order of replicability would be those including biogas and firewood, considering certain restrictions as to constant and adequate biomass supply. Finally, those with the highest potential to be replicated are based on wind and solar resources, given their free availability within the adequate areas.

The degree of complexity (range of requirements that could be met with a given technology) of the case studies is variable, the lowest being that corresponding to case study number 1 (only caloric uses). Nevertheless, it is assumed that electricity and motive power applications in urban areas would be met through the connection to the electricity system. The next case in order of complexity is that of certain isolated rural consumers, as the power of the respective equipments sometimes excludes certain uses. Finally, there are grouped rural dwellers, where the higher scale economy justifies the installation of higher power equipments meeting a wider range of requirements.

In general, meeting the basic energy requirements of the poor population with renewable energy systems would demand the combination of several technologies.

To estimate the percentage of each requirement that could be met with renewable energies, we assume that the renewable system has sufficient power to meet the requirement when there is no available substitute (e.g. electricity in the case of isolated rural dwellers). In those cases where there is an energy substitute, we evaluate the degree of penetration that the renewable systems could have against such substitute to further estimate the percentage of the requirement that may be met through the use of renewable energies.

As the present analysis only considers technical aspects, the viability of these installations will be dealt with further along the document, when other aspects such as the economic one are incorporated to the discussion. In certain extreme cases, such as that of PV systems, although it is technically possible to size an installation to power the washing machine or refrigerator of a household consumer, there is strong advice against this on account of the high cost per kWh of this electricity.

The tables summarizing Case Studies data are presented in Appendix 3.5

3.5.1 Case Study Nº 1

This is the only case study corresponding to an urban area, notwithstanding the fact that most of the poor and indigent population in Argentina lives in urban areas. However, we consider that, for most uses, access to the conventional energy systems would represent the most rational solution to the energy problems of these sectors, given the proximity of the conventional energy grids and the costs involved against those of renewable systems, especially those for electricity generation aimed at productive uses. This case includes two technologies with good penetration potential in temperate and arid areas. The first is that of solar water heaters for hot water production, which have been successfully applied to substantially cut down the consumption of conventional fuels in urban areas with adequate solar resource. Some studies show that the hot water needs of those areas may be fully met at least six months a year, while complementation with a conventional system is required for the rest of the year.

The second technology considered is improved firewood cookers. Although the use of firewood stoves to cook and provide heating is common in many urban and peri-urban areas, their efficiency is quite low. Hence, the introduction of improved cookers would not represent a significant change of habit, although it would bring about substantial firewood savings and great advantages for the health of the population.

It is assumed that all electricity uses are met through the connection to the grid due to the advantages of this from the standpoint of available power and comparative costs with relation to renewable generation systems.

We may say that in this case the adequate meeting of the basic and minimum requirements of the population is viable through the combination of conventional and renewable systems.

3.5.2 Case Study Nº 2

This case study is focused on the scattered rural population of a warm area with livestock manure and firewood availability, and adequate solar resource. Hence, the technologies selected were PV for electricity generation, and biogas and improved firewood cooker for caloric uses. There is here great asymmetry between the PV system and the biomass systems with respect to the percentage of the requirements that may be met with one or the other. While both systems may technically meet up to 100% of the requirements, the PV system - although it could in theory reach high percentages - would not be viable in practice due to the high cost of the installation required. Uses such as ironing, food refrigeration, and laundering would imply peaks in the power demanded not below 600 W, with the implications this would have on the size of the photovoltaic system. Instead, water pumping and television would be viable, although the costs involved would be much higher than those of a traditional SHS unit used only for lighting and radio.

In this case, meeting the basic and minimum electricity requirements only with PV systems would not be viable from an economic standpoint, and other alternatives should be considered (electricity generation on the basis of biomass or a hybrid system).

Caloric uses could instead be adequately met through the combination of firewood and biogas. A domestic biogas installation yielding 1 m^3 of biogas a day could meet household cooking and water heating requirements. If these uses were met only with firewood, the biogas could be used for food refrigeration or electricity generation purposes.

This case study puts in evidence the inadequacy of domestic PV systems to meet the significant requirements – both domestic and production – of the rural dweller. However, they could have an important role in uses such as lighting, communications, and water pumping. The versatility of biogas as energy product to meet multiple requirements is also clear.

3.5.3 Case Study Nº 3

This study is focused on the scattered rural population of temperate areas, where there would be availability of livestock manure and firewood, and, in contrast with the previous case, there would be adequate wind rather than solar resource.

As in the previous case, the combination of biogas and firewood allows the adequate meeting of caloric needs. In contrast with the previous case, the possibility to make use of the wind resource allows resorting to wind pumping to supply water, while a wind charger is used to meet electricity needs. With the exception of ironing, the meeting of the rest of the uses is deemed viable through adequate demand management and a power system close to 2 KW, with its corresponding set of batteries. Demand management should be aimed at having demand follow the generation curve through the adequate scheduling of certain uses. In practice, and due to the dimensions involved and the relatively high investment cost, this is an installation more easily found in the hands of a rural community or isolated consumer of high socioeconomic level.

3.5.4 Case Study Nº 4

The population to which this case study is aimed at is the scattered population of arid areas with availability of wind, sun, and some firewood. In this case, water pumping and electricity generation are the same as in the previous case, although caloric uses are largely met with the solar resource (Mueller, 2003) and, to a lesser extent, with firewood.

A solar water heater meets all hot water requirements (water above 40ºC) during six months a year, although this must be complemented with other systems to cover the rest of the year or when the temperature of the water needs to be increased. Solar cookers, or, eventually, efficient biomass cookers must be used in these cases, and also for heating purposes. Hence, biomass plays a complementary but nevertheless essential role. We must add here the low availability of this resource in arid areas, rendering the supply structure somewhat fragile. Only adequate firewood management would allow meeting 100% of the caloric requirements with renewable energies in a sustainable way over time.

3.5.5 Case Study Nº 5

This case study focuses on a grouped rural population from an arid area. We could say that this case is the most favoured one in terms of resources, as it has both hydro and biomass (livestock manure and firewood) resources, both yielding high versatility and power. Electricity needs are adequately met with a mini hydro station, even for production and caloric uses when it becomes necessary to dissipate energy. Caloric requirements are in turn met as in other case studies through the complementation of biogas and an efficient firewood cooker. The existence of several households allows making use of scale economies to design the mini hydro station and the biodigester, reducing costs per household and improving the quality of the service with respect to the isolated consumer. However, this also poses challenges with respect to the O&M of the system and the allocation of costs to each consumer. The mini hydro station has also potential to produce motive power and develop certain production or recreational activities when a small dam is built, in this case the supply of drinking water.

3.5.6 Case Study Nº 6

This case is similar to case study Nº 3, except that a grouped rather than scattered rural population is involved here. As in the previous case, this situation allows profiting from scale economies, in light of which consumers will enjoy a better service and higher power availability per household. Challenges are related to the management and O&M of the system.

3.5.7 Case Study Nº 7

This is the only case study corresponding to a cold area. The population here is scattered, and there is adequate wind resource and firewood. As in case study Nº 3, a wind pump and a wind charger are used to meet water and electricity needs. The latter faces the same limitations as in case study Nº 3. Here, the low temperature does not allow having biogas, due to which firewood plays a key role in the meeting of caloric needs. The use of efficient cookers becomes critical towards a better use of the resource during winter or in bad weather conditions. Only an adequate management of the resource would allow meeting 100% of the minimum caloric requirements through the use of firewood.

The following considerations serve as summary:

- The key and hard to replace role played by the use of firewood in efficient cookers to yield caloric energy in most of the country, and the significance of the adequate management of the resource
- The difficulty experienced by many renewable energy generation systems to meet 100% of the electricity requirements (with the exception of mini hydro stations) and the high cost involved, especially for isolated rural dwellers and production purposes
- The wide versatility of biogas as energy carrier to meet multiple requirements
- The significance of mini hydro stations to meet production uses in isolated areas
- The necessary complementation of several technologies to meet multiple uses
- The comparative advantage of grouped rural consumers with respect to scattered rural consumers as to the cost of the systems per household and the quality and range of the service
- The importance of certain renewable energy technologies as a complement to cut down expenses on conventional fuels in urban areas (solar water heaters and efficient firewood cookers)
- The significance of the research, development, and fine tuning of small and medium power electricity generation and motive power systems based on biomass (firewood, waste, biogas) and at an adequate cost (areas with abundant biomass but lacking adequate wind or hydro resources)

3.6 Assessment of Capacities

3.6.1 Beyond conventional Capacity Development concepts

The nature of some of the barriers that face developing countries when trying to disseminate renewable energies demand adopting a broad definition of the CD concept, a concept that goes beyond technical and educational aspects to cover policy, institutional, legal, regulatory, and R&D/industry coordination issues. In the end we aim at developing the capacity for innovation and the development of alternative visions which could complement and make it possible to adapt with a critic eye the transference of knowledge from other countries and regions. This will make it possible to go beyond know-how transference, sometimes linked to the promotion of energy technologies and services, to walk towards local technological and knowledge developments which could give a better prospect for the dissemination of renewable energies in Argentina, among other related advantages (employment, technology exports, possibility of other technological developments, cost reduction, lack of foreign conditioning when taking loans, etc.).

It is also important to recognise the limitations of CD approaches when trying to remove barriers which are not directly related to a lack of knowledge or access to it, but rather to different interests and ideologies.

3.6.2 R&D

Argentina registers a moderate R&D activity with respect to renewable energies, involving technologies such as photovoltaic, wind, solar thermal, mini hydro, biomass, and hydrogen. In the field of human resource training, many of the academic RE research and development units associated to national universities offer sporadic training or transfer courses, or else incorporate to the study programs of the respective institutions a module related to the aspects of the renewable energies studied there. This activity comprises more than 20 national universities and associated research institutes, with good geographic coverage of Argentina and issues that vary in accordance with the renewable resources and, in some cases, with the needs detected in each region. We may infer from these figures that there has been quite a moderate increase as to the academic and training supply and human and technical R&D resources with respect to the situation observed 25 years ago (OLADE/PNUD, 1979). At the same time, there are few courses specializing in renewable energies at BSc. or MSc. level that provide comprehensive training to those striving to work in the field beyond purely academic circles (UNSa-UNCa, 2004).

Hence, those aspiring to a technical specialization in any renewable energy source in particular must be connected to an academic unit that carries out research on the field, being unable in general to access such specialized training through the study programs of most national universities. However, college courses in general provide adequate training that serves as basis for a specialization on renewable energies.

In general terms, there is very good potential of human resources available in the country for R&D, with the possibility of dealing with extremely complex technological issues at the level of many industrialized nations, as shown by the different experiences in the field of renewable and other energy sources (development of photovoltaic cells, modules and satellites, nuclear industry, hydrogen technology, etc.) Restrictions are more of a financial, organizational, and institutional rather than human resource nature, although in recent years the training stage has been threatened by the deterioration process registered within the public education sector. There is also an overlapping of efforts in certain areas, and, thus, lack of coordination, resulting in deficient organization and information availability on the part of the renewable energies stakeholders in Argentina and the region.

3.6.3 Manufacturers and industrial capacity

Within the industrial area, and in light of the degree of development of the metal-mechanic, electro-mechanic, electronic, and chemical industries, there is good potential capacity to fine tune and manufacture most of the renewable energy technologies that have reached the commercial stage within the industrialized world. As regards less complex technologies with an associated market niche, this capacity is shown or has been shown in the past through the existence of small companies that manufacture equipments in the fields of hydro energy, small wind chargers, wind pumping, solar water heaters, biodiesel, geothermal energy, ethanol, gasifiers, biomass boilers, and different photovoltaic system components. However, the quality of these equipments is highly variable, and it would be necessary for the manufacturers to be aware of and apply adequate quality standards. Some of the simpler technologies could be very easily developed at industrial level, as there is more than sufficient capacity for it, although the lack of an attractive market explains the nearly zero level of application and installed capacity in these areas, even when there is abundant R&D. The industrial capacity associated to the mentioned technologies could be strengthened or developed in the short and medium term. One such example is the planned production of large wind energy turbines´ components by small and medium enterprises which provide services to the oil industry.

3.6.4 O&M dealers and infrastructure

The O&M structure in general shows substantial deficiencies with respect to geographic coverage throughout the country and the time periods involved in the repair of equipments. This calls for more efforts so that those designing a project may plan this aspect in depth, and so that equipment manufacturers and dealers expand their O&M networks and the scope of their guarantees to reduce the rejection of the technology due to lack of or inadequate maintenance. It is also necessary here that the technicians be aware of the quality standards and regulations to comply with during the installation and maintenance of the equipments. Finally, it is necessary that the installation work be carried out by trained personnel, and that there be a shared responsibility among the manufacturer, the dealer, the installer, and the consumer towards the proper operation of a system throughout its lifetime.

3.6.5 Government

As regards institutional aspects, notwithstanding the existence within the framework of the Energy Secretariat of a body dedicated to renewable energies, it is still necessary to strengthen the areas related to energy planning and the use of the resources, the coherent design of energy and development policies, and the establishment of adequate regulatory, legal, and incentive frameworks for renewable energies.

There is insufficient capacity to gather, organize, and promote information. The deregulation of the energy sector has compromised the gathering of reliable information within the energy field provided in the past by different State companies, most of which are now in private hands. Moreover, it has hampered the link between certain stakeholders that previously cooperated and acted jointly, as they all worked within the State orbit. There is thus a need to learn and develop instruments to allow proper operation within the framework of the new scheme.

It is also necessary to strengthen those actions aimed at coordinating the human resources working in the field of renewable energies and development towards the meeting of common goals, as well as certain aspects related to the connection of stakeholders, allocation of financial resources, and institutional adaptation to promote the development of renewable energies. The multiplicity of stakeholders involved in a renewable energy source project renders more critical the coordination by any State institution. There are also restrictions for a detailed evaluation of renewable resources that may perfect at local level the information rendered by prior studies. This is related to the lack of adequate measuring infrastructure and sufficient human and financial resources to cope with the task.

There is still a view within the political sphere, not always made explicit, that renewable energies are immature in relation to conventional energies, in light of which they are given a secondary role, notwithstanding the public acknowledgement of their significance.

There are strong legal voids, lack of regulatory coherence and deficiencies in the implementation of incentives in general. The few existing legal mechanisms towards the promotion of certain renewable energies (solar, wind, biodiesel) are still hard to implement, and in some cases somewhat deficient as to their scope, or even obsolete on account of the lack of adaptation to the nation's socioeconomic reality and the weakness of the organizations in charge of their application. Furthermore, the experience gathered by witnessing the substantial difficulties associated to the passing of these instruments allows stating that there is a need to provide congressmen and those in charge of formulating rules and regulations with reliable information on renewable energies, and to increase and coordinate the lobbying capacity of pro-RE sectors (NGOs, companies, R&D organizations), on the basis of accurate information and realistic development plans aimed at formulating renewable energies as an instrument within a wider development context. In light of this experience, there is also need of an institutional structure that may ensure the observance of the legal instruments.

The PERMER program has also allowed identifying the need to cut down the excessive degree of red tape and consulting work involved in certain projects.

3.6.6 Financial institutions

In general, public and private financial institutions in Argentina lack specific regulations and experience in handling renewable energy projects or special incentives that contemplate their social and strategic significance and peculiarities from the standpoint of the amounts, periods, and other conditions of the loans for this sector. There are no specific credit schemes to finance this type of projects, and many projects involving renewable energies in Argentina have been partially financed with provincial funds, electricity development funds, and funds from the Ministry of Education with the support of international bodies.

3.6.7 Consumers

With reference to consumers, training has proved to be essential as it is linked to the adequate operation of the systems and their higher acceptance, both being critical aspects to ensure the sustainability of a project over time. In particular, it is important in the case of low power projects that the consumer is aware of the limitations of his energy generation system and what this implies in terms of the adequate management of the energy demand and the longer lifetime of the equipments.

The significance of cultural aspects is also presently acknowledged at the time of introducing a new technology to estimate its degree of compatibility and, thus, potential acceptance. The consumer needs to be guided by someone with adequate training in the installation of the system.

To sum up, we may point out that the highest training needs are evident within government spheres, both in relation to energy planning and resource coordination and to the design and implementation of an adequate legal and institutional framework. It also seems to be essential to develop adequate O&M infrastructure and training specifically aimed at financial organizations and users.

A summary of capacities in the renewable energies area can be found in Appendix 3.6

3.7 Renewable energies niches

Possible niches were identified based on the results gathered in previous chapters and the evaluation of certain indicators (Villavicencio, 2003) included in Appendix 3.7 .

We sum up below the most prominent features of the identified niches (see more detailed data in Appendix 3.7).

Table 28
Renewable Energies´ Niches

Source / Technology	Zones	Population	Type of Use
Biogas	Temperate and arid/cold	Rural communities and dispersed	R (P, S)
Wind Mill	Temperate and arid/cold	Rural communities and dispersed	R, P, S
Solar Water Heater	Arid and temperate	All	R (P, S)
Improved Cookstove	All	Rural and peri-urban	R (P, S)
Solar Cookers	Arid and warm	Rural communities and dispersed; peri-urban	R, S (P)
Wind Turbine	Temperate and arid/cold	Rural communities and dispersed	R, S (P)
Mini Hydro Power	All	Rural communities and dispersed	R, P, S
Solar Driers	Warm, arid and temperate	Rural communities and dispersed	P, R
PV for community services	Warm, arid and temperate	Rural communities	S (R, P)
Biodiesel and mechanical power	Warm and temperate	Rural communities	P, R, S
R= residential, P= productive, S= services; ( ) means that could be used for this uses also			

Source: Own estimates.

It is worth pointing out that, although many of the systems are technically capable of meeting 100% of the relevant requirements, they could prove quite costly - even for the middle and high socioeconomic sectors - and this particularly applies to electricity generation systems and productive requirements.

3.7.1 Household sector

Niche Nº 1

Use of biogas in temperate and warm areas, both rural grouped and rural scattered

In accordance with the estimation of the resource made in a previous chapter, there is quite good availability of livestock manure that could be used to produce biogas at domestic and communal scales for low-income scattered and grouped rural dwellers in warm and temperate areas in Argentina (close to 1.9 million people). These systems could serve to meet a considerable part of the caloric requirements of these households throughout a year. The technology involved is quite simple, and may be built with materials that are easily available at local level, although almost daily attention is required to maintain the process, which thus demands wide participation on the part of the consumers. This involves an adequate provision of water, maintaining the temperature of the digester and a correct nitrogen/carbon ratio for optimal bacterial activity. The system has the added benefit of producing a soil amendment that can increase agriculture productivity. Furthermore, the system has the potential of being combined with a generator system that produces electricity and motive power, and of being powered with a flexible set of agricultural/livestock and domestic waste. Nevertheless, there are apparently cultural barriers in this area related to the handling of manure that should be overcome in order to allow the massive implementation of the system. The experience in Argentina is still limited, although there are pilot plants and certain models are being commercialized. There are also several universities and INTA (Argentine Agricultural Technology Institute) dedicated to its R&D.

A domestic-size system could meet from 30% to 60% of the basic caloric requirements. On the other hand, the potential is even higher when ignoring the cost barrier, as an adequately designed and sized system where the resource is sufficient could meet nearly 100% of the caloric requirements, and even certain electricity requirements in combination with a generator. However, the cost of the latter alternative seems to make it viable only in the case of rural communities.

Niche Nº 2

Use of wind power for water pumping in temperate and arid/cold areas, both rural grouped and rural scattered

Argentina has significant and positive experience as to the use of these systems, although they saw their heyday some decades ago, and many systems were left unused on account of the penetration of conventional sources (motor generators and expansion of the electricity system). Nonetheless, there are still local manufacturers and wide knowledge as to their adequate use and O&M. They are reliable systems that require little attention for their operation and could meet 100% of the water requirements (in the event that the resource may be accessed) for domestic and production use by a large part of the population of temperate, arid, and cold areas of the country. As such, it represents a critical aspect towards higher productivity in agricultural/livestock activities, and could thus have favourable repercussions on the generation of income, if the initial investment barrier could be surmounted.

Niche Nº 3

Use of solar water heaters in arid and warm areas, both urban and rural

Argentina has had some experience in the use of these systems at domestic, service, and production levels, the highest activity being registered in the Cuyo and San Luis areas. What makes this technology interesting is the feasibility of its application not only in rural but also in urban areas, where it proves to be especially adequate due to its accessible investment cost and its excellent complementation with other water heating systems, which results in significant fuel savings and, thus, economic benefits. There are local manufacturers, and technology R&D activities have been carried out. However, more research is needed to produce simpler and cheaper models without large reductions in efficiency.

These systems could meet close to 50% of household hot water requirements (water at a temperature close to 40ºC) (Fasulo, 2002; Follari, 1998).

The use of these systems may also be expanded to temperate areas and certain production and service uses (lodging, food preparation, etc.), although precautions should be taken in areas where it freezes frequently during certain periods of the year.

Niche Nº 4

Use of efficient firewood and charcoal cookers and ovens in all rural and periurban areas

Although this technology could be labelled as simple, and even primitive, the wide use of firewood among poor and indigent dwellers in rural and periurban areas in Argentina results in a quite significant influence of improved cookstoves over firewood consumption and the health of the population. As long as this population lacks access to natural gas systems or is not adequately supplied with LPG on account of its cost, direct firewood combustion will remain the means par excellence to meet several of the minimum energy requirements of this sector of the population (cooking, heating, water heating). 100% of the basic caloric requirements may be met through this system. On the other hand, it is necessary to bear in mind that an adequate energy policy should promote the access by all consumers to the most modern energy sources, such as natural gas and LPG.

Hence, it would be desirable that firewood be replaced with these fuels in the short run within urban and periurban areas, which could increase the degree of obsolescence of this technology. However, the low cost of the equipment, together with the probable persistence for many years of the lack of access to energy by the poor and indigent sectors, would justify the wide expansion of these systems in both rural and periurban areas. It would also allow the development of certain production activities and community services related to cooking, water heating, heating, and drying.

It should be taken into account that quality standards are needed also for this technology.

Niche Nº 5

Use of solar cookers in arid and warm areas

One of the main problems with this technology is the change of habit implied by the adoption of a way of cooking quite different from the traditional one. Cooking periods become longer, the food tastes different, and the process takes place out of the house.

Nonetheless, experiences held demonstrated the great unexploited potential of solar cookers and ovens in the northern region of Argentina, as well as its positive influence over firewood consumption, the time devoted to firewood gathering, and the health of the consumers. The system must be complemented with some alternative that could be used in cloudy days, in cases of urgency, or during the night, as this system would allow meeting from 30% to 70% of the basic cooking requirements. It would also allow the development of certain production activities and community services where cooking, steam production, or water heating is required.

Niche Nº 6

Use of wind chargers in temperate and arid/cold areas

These systems have been applied by scattered rural dwellers and isolated rural communities, mostly for domestic uses and the supply of basic services (lighting, communications), although it is also possible to power medium-voltage appliances (certain tools, water pumping, etc.), in accordance with the power of the system and the set of batteries. It thus represents a significant technology to meet certain minimum non-caloric household and production needs throughout a large part of the country, as well as an alternative in general more adequate and less costly per power unit than photovoltaic systems. In the case of a typical individual equipment, its power to meet household electricity requirements depends on the management of the demand. It would be technically possible to meet 100% of the electricity requiremehe limiting factor here is given by the cost of the equipment and of the batteries. A 2kW equipment would allow meeting from 55 to 100% of the minimum requirements, depending on the degree of use simultaneity.

There are local manufacturers, although the degree of quality of the equipments varies.

Niche Nº 7

Use of mini hydro stations in water courses close to all types of rural communities

This is one of the most adequate renewable technologies for electricity generation to meet both household and production requirements, while it represents one of the cheapest per power unit, and one with the lowest variability. Its drawback has to do with the access to the resource, which must be located close to the consumer. Nonetheless, its utilization potential is significant in practically the entire nation, and it would even allow the development of certain areas not populated at present. There has been local R&D on this technology for decades, yielding much significant experience and expertise, and the equipments are also manufactured and commercialized at national level. This type of installation favours other non-energy uses of the hydro resource. It is one of the few renewable systems with which an electromechanic workshop may be fully powered, and 100% of the domestic requirements may be met in an accessible way, and, in the case of systems with a dam, without need of batteries. The simultaneous meeting of household and production requirements will probably require an adequate management of the energy demand.

3.7.2 Urban and Rural grouped Services and Productive sector

Niche Nº 8

Solar driers in warm, arid, and temperate areas

Although these systems have a very specific use, they may have a highly significant impact on income generation in certain agricultural activities. Crop drying may prevent the loss of a significant fraction of the harvest of a perishable product in the period from its gathering to its commercialization. This is particularly critical for producers who are distant from the markets or have difficult access to them. The technology also allows storing goods to sell them at different seasons, resulting in a better income distribution over time.

It is estimated that the meeting of drying requirements is quite high, although this depends on the availability of the solar resource in each area during the harvesting period.

Niche Nº 9

Use of biodiesel in rural communities of warm and temperate areas

Although the consideration of this technology as a niche is of a preliminary nature given its incipient degree of development, such technology was included on account of the swift evolution it has experienced, its cost-reduction potential, and the potential significance of the production of a renewable liquid fuel that may replace diesel (85% of net energy requirements for rural productive activities correspond to diesel consumption. See Chapter on energy requirements). As negative aspects, the minimum application scale would still require vast extensions of crops and access to a significant agricultural infrastructure, which makes the technology less viable as energy self-production option for the poor and indigent population of Argentina.

A plant yielding 400l/day of biodiesel could meet 100% of the minimum LPG and gasoline requirements of some 240 rural households without electricity (changing the respective equipment).

Other potential niches

Solar water heaters may partially or wholly substitute the use of LPG for water heating in areas with sufficient solar radiation. These systems could be used in the preparation of meals, bakery, preparation of marmalades and conserves, laundry, B&B, among other services and productive activities. The fraction of the requirements covered with solar water heaters would be limited to near 50% of hot water consumption at 40ºC, assuming that the capacity of the equipments is adequate to cover this demand.

Photovoltaic systems may partially or wholly substitute grid electricity for lighting purposes. Even when the cost per unit power of this technology is high, this kind of use generally requires low power installations.

Wind chargers and mini hydro stations may substitute part of the electricity supply from the public service system and are critical components to power productive activities where electromechanical equipment is being used (usually between 100W and 5kW power requirements). Mini hydro stations present the highest potential to cover adequately these requirements thanks to the relatively high power output, the cost per unit power, and the capacity for regulation and storage.

The use of biogas in some productive rural activities is well worth considering (poultry, rabbits, dairy products).

3.7.3 Community services

Niche Nº 10

Photovoltaic systems for community services in warm, arid, and temperate areas

PV systems become essential to meet certain electricity and water pumping requirements in some regions of the country where other resources such as wind, water, and biomass are not abundant. However, its use is only considered for essential community services such as vaccine refrigeration, pumping, drinking water, communications, and lighting, on account of its high cost per unit power. The typical installations for household consumers are deemed inadequate to meet minimum energy requirements. They frequently capture the meager economic resources of poor and indigent dwellers, and rarely represent an income-generation tool. The exceptions could be water pumping, the supply of certain services, communications and lighting, although the cost of the systems places them only within the reach of the middle-and-high-income consumption sectors.

Photovoltaic systems could be used to meet part of the lighting (960 W in schools with lodging, and 430 W in schools without lodging) and communications needs (TV, VHS, sound equipments, ranging from 60 to 100 W by type of equipment).

For health care centres PV could be used to meet lighting and specific appliance needs (this would represent from 0.24 to 1 KW per health centre).

Niche Nº 11

Solar passive systems for heating in Schools and Health Care Centres of arid and temperate regions

An adequate integration of solar passive elements into the design of schools, health care centres and other services´ infrastructure could sharply reduce the demand of fuels for heating. There are some experiences carried out in Cuyo (centre west) and northwest regions of Argentina which show promising results at relatively low cost and with the use of conventional materials.

Other potential Niches

In relation to the caloric requirements of schools with lodging (cooking and heating) and health care centres, the substitution of LPG and/or diesel could take place using firewood stoves, with a 25-30% yield in areas with abundant availability of forestry resources that may be exploited in a sustainable way.

Furthermore, biogas could be produced making use of the availability of animal or human faeces and vegetal waste in isolated rural areas.

Solar water heaters could be used to heat water wherever the radiation allows it. For health care centres these systems could substitute LPG for water heating purposes (e.g. from 145.8 Koe/year and 194.4 Koe/year of LPG are required for this use in warm and temperate areas, respectively).

Windmills could be used to pump water (electric pumps range from 250 to 450 W for schools and 150 W for health care centres, while ground water plus load losses up to the reserve tank are estimated in 20 meters, with a daily flow of 2,500 to 4,100 litres/hour during approximately four hours a day and 2000lt/hour during two hours a day for schools and health care centres respectively).

Wind chargers and mini hydro stations could be used to partially or wholly replace diesel generation (the power of motor generators ranges from 2.7 to 5.7 KW and 2 kW for schools and health care centres respectively).

On a large scale, although not directly linked to the well being of the poor population, it is worth mentioning the important niche represented by the potential exploitation of the wind resources of the Patagonia region and the associated projects for the development of capacities and large wind turbine technology. This niche could make a significant contribution to Argentina´s national electricity grid.

3.8 Assessment of other experiences

Current State of Decentralized Renewable Energy Activities

3.8.1 Background

The actions carried out by consecutive governments towards the study and implementation of renewable energies projects were of a different nature, effectiveness, and duration. A historical survey of these actions indicates that they were initiated several decades ago as an energy self-supply and diversification strategy. In this frame a considerable number of RET projects has been implemented, but its impact has been low in the national energy mix.

In a recently published report from CEPAL-GTZ (Coviello, 2003) is mentioned that the overall contribution of renewable energies is quite low, reaching only 7,8% of the national primary energy supply. Within this figure, the participation of hydroenergy (3,7%) and of non-woody biomass (sugar cane products and other biomass, 3,5%) is significant; the role of renewable firewood and charcoal is not significant (0,6%); the contribution of the new renewable energies is almost null (wind, photovoltaic and geothermal energy).

There is no centralized record of these projects. A preliminary survey of them was made consulting official bodies, university research groups, NGOs, experts, and equipment selling companies. Information was requested from them on the following: location, technology, destination, installation cost, maintenance cost, origin of the equipment, etc.

A table included in Appendix 3.8 summarizes the results of that research work, which most likely represents only part of the actual inventory. The work also includes certain projects implemented in the past that have already vanished, e.g. gasohol, as well as others which still have development possibilities, e.g. fuel cells, electricity generation with biogas, etc.

Within the scarce quantification achieved we can observe the main following aspects:

There is a wide range of RETs installed where the basic objectives are electricity generation and thermal uses; the rural sector is the main addressee; there are low levels of RETs penetration and high installation costs in relation to the mean income of the poor rural inhabitants, below US$100/month, who in turn spend less than US$ 5 in substitute energy due to lack of electricity.

Below are presented some of the characteristics of the projects that have been implemented. Those that have to do with isolated power generation for lighting and communications are presented first. These are: the Permer Programme (Renewable Energies Programme in Rural Markets) and some highlights of the Jujuy province experience; the Direction of Alternative Energies Program to attend scattered populations in Neuquen, the Program to Energize Rural Schools in the Province of Buenos Aires and wind electricity generation in the south of the country.

Then, the main characteristics of the projects related to solar pumping, biofuels, and geothermal energy are presented.

Finally, for some of these projects the conditions that have contributed to their success or failure are summarised by means of indicators (see Appendix 3.8).

3.8.2 Electricity Generation Projects

PERMER Project

Towards the end of 1999, the board of directors of the World Bank approved a loan to Argentina for USD30 million under the name "Renewable Energy Project for Rural Electricity Markets" (PERMER), with an additional donation of USD10 million from the Global Environment Fund to eliminate the existing barriers for the use of new technologies. This amount, together with the provincial funds, those of the concession holders and those of consumers, would allow providing basic electricity services to some 85,000 scattered consumers and some 3,500 public services (World Bank, 1999).

In sum, PERMER is the instrument for the provinces to be able to use the funds from the World Bank and GEF for their rural electrification plans within the framework of the federal public service privatization policy, and leaving for the State the role of controller of these services. It is worth pointing out that PERMER funds for investment are only for those provinces that have begun the reform of their electricity sectors, while technical assistance funds lack such restriction. The project aims at developing sustainable electricity markets in scattered areas, being supplied and partially financed by private concession holders and using renewable resources and environmentally-clean technologies whenever possible. In turn, the idea is to minimize government subsidies and allow profitable management for the private investor. In general terms, the project may be viewed as comprising subprojects in each of the participating provinces, consisting in the concession of the electricity services in the scattered electricity market to a private company that is technically and financially capable of meeting in its area the general objectives of PERMER.

This project contemplates the implementation of only two pilot subprojects to evaluate the viability of household electricity supply through individual wind energy systems in those cases where the scattered rural population to supply is located in regions with sufficient wind resource and this represents an economically and technically feasible option to implement and sustain within the framework of the rural market given in concession.

Only one contract was implemented in this direction. This Wind Pilot Project is within the province of Chubut and the contract was signed with the Regional Wind Energy Centre (CREE) in March 2003, adding to it the implementation of wind developments in natural reserves according to an agreement to be soon signed with the Tourism and Sports Undersecretariat. The signing of an addendum to the participation agreement is pending.

During 2002[2], the implementation of the project was seriously undermined by the well-known financial and economic events in Argentina, particularly the significant devaluation of the Argentine currency. Towards the end of that year, the project came to a complete standstill due to lack of disbursements from the World Bank, which were re-established by the end of January 2003. The execution of the project as of March 2003 presented a modest degree of progress, except for Jujuy province, where 1400 SHS have already been installed. Approximately 200 PV systems are soon to be installed in rural schools of Tucuman and Salta.

At present, in 15 of the 24 Argentine provinces the PERMER programme shows different levels of progress, Jujuy being the province with the highest degree of advancement. The status of PERMER programme in this province is described below (PERMER, 2003).

PERMER in Jujuy

Within the PERMER Programme, the Project corresponding to Jujuy province is the one that shows the highest degree of progress. Many have been the causes for this relative difference with other provinces and some of its characteristics are presented below.

The supply of the scattered market began with the provincial state company through diesel, solar and hydro generation systems[3] and was further taken up by the concession holder within the framework of the PERMER program.

EJSEDSA was the company awarded with the scattered market, comprising the scattered market with networks and that without networks. The main objective of the PERMER program in this province was to supply electricity to the scattered settlements - the characteristics of which were previously mentioned - to specifically meet lighting (education, indirectly) and, partly, social communication needs with decentralized sources based on technologies mostly using renewable resources.

Before the implementation of the project most of the families lighted their houses with burners of kerosene, the kitchen area with wood, and sometimes with lanterns. The amount of money expended in these elements was approximately between U$S 4 to 8/month according to level of income of the population. Radios connected them with the rest of the world but they spent in them approximately U$S 3.4 per month per household.

As a positive environmental impact of the project, there would be a reduction in the emissions from the replaced diesel units, and from the kerosene and LPG lamps and candles.

A system of subsidies was decided due to the scale diseconomies resulting from the capital used and the small per capita income of the consumers. This amount contemplates a percentage for the supply and mounting of the system. The consumer pays U$S 20, while the province subsidizes the remaining U$S 183 with resources from specific electricity funds (FEDEI or FCT). The amount to complete the required sum to install the system is provided by the concession holder, which recovers its investment with the monthly rate. The activity of the concession holder is deemed of little risk, as 90% of its income comes from the State - which reduces market risk - and the remaining 10% comes from its clients.

Surveys were carried out on settlements to define the scattered market to supply and detect the expenditure on energy sources for lighting and social communication, the degree of interest in the

[2] Project Coordination Unit, PERMER Project, Report on the Present Situation, March 2003
[3] Ministry of Economy, Energy Secretariat, 2001, Op. Cit.

availability of electric lighting, the acceptance of the installation of the units and the potential future demand of lighting and social communication. It was thus determined, on the one hand, that the expenditure was too high, which allowed contemplating the possibility of charging at least part of the service; and, on the other, that there was good acceptance on the part of the inhabitants, especially with regard to the possibilities of increasing the time devoted to tasks that required lighting, such as handicraft weaving.

The status of development as of the end of year 2000 was: 1. Development of minigrids for 531 users connected to mini hydro power plants and 421 users connected to hybrid solar-wind systems; 2. Solar home systems: electricity supply to 1,077 users.

The project was deemed successful both by the actual consumers and by the future ones demanding the installation of the units to provide lighting, as they are aware of their benefits. EJSEDSA considers that part of the success was because they took into account from the beginning of the concession, the social, economic and cultural characteristics of the people. In this direction the company created a special section to listen to social matters. Also, the main professionals involved in the project were from the zone, and they visited all the remote rural homes as well and contacted with the future consumers to know all their needs. They knew that people had a limited scope in their domestic economy and communication, and their life was limited to hours with solar lighting, and spent an important quantity of money (in relation to their income) in a low quality of energy that had impacts on their health (specially emissions of kerosene lamps).

Projects outside of PERMER

There are many renewable energies´ installations, a lot of them are outside of PERMER Program. In this section some projects developed in different provinces will be briefly presented.

Province of Buenos Aires

The project known as Program to Energize Rural Schools with Renewable Energies, comprises 362 schools distributed in 100 districts with power differing substantially from school to school. The program is not contemplated by any law but was only initiated through the decree that established the former Energy Provincial Regulatory Organism (EPRE), which entrusts the body with the development of alternative sources of energy and their use to supply isolated settlements. The decree is backed today by provincial law 12 603/2000 of Renewable Energy. The program was instrumented through the Ministry of Works and Public Services, under which EPRE operated, and was only aimed at schools. Works are being carried out at present (recently) between PERMER and the Energy Secretariat. The program was financed with provincial funds (Law 7290/2002) and with funds from FEDEI (Inland Electrification Fund). The corresponding operation and maintenance, of high complexity due to the number of scattered schools involved, was always in the hands of EPRE, while the transfer of the installations to the General School Board for it to be in charge of them is presently under development. The community is interested in receiving electricity, due to which it was decided to join PERMER, adapting it to the situation of the province.

Province of Neuquén[4]

The electricity company that supplies the provincial electrical market is State-owned, and it did not accessed to the benefits granted by PERMER to electricity supply concession holders.

[4] We kindly acknowledge the collaboration provided by Eng. Graciela Pedro, Director of Alternative Energies Department of the Ente Provincial de Energía del Neuquén (EPEN)

Diesel generators were always the main equipment used to supply electricity to the scattered market. A substitution process was initiated by the mid-1980s, and the generators were replaced with alternative photovoltaic systems. The company created the Direction of Alternative Energies to attend scattered populations. Since 1987, EPEN is in charge of the installation and maintenance of these units, with financing from international organizations and specific provincial funds. No fee has been charged so far for the service provided.

The project was deemed successful as the inhabitants visited - future consumers - requested the installation of the panels, having heard of the benefits they provided. Both investment and O&M are completely subsidized.

27 rural schools were surveyed and are part of the scattered provincial market supplied with electricity through photovoltaic systems, with a total installed power of 13.6 kW - some 500 W per school -, 27 health centres with an average installed power of 500 W, 475 rural households - 100 W average each - and a hybrid system of nearly 2 kW. The total installed power reaches some 80 kW.

Wind Power Generation in Patagonia and Buenos Aires

At the end of the 1990s and thanks to a set of measures related to the promotion of wind energy, some electricity cooperatives and private investors installed small wind farms and generators, mainly in the south of Buenos Aires and Chubut provinces[5]. The incentives included a subsidy of 1 to 2 cents/kwh (local currency), and an extension of the time allowed for the payment of the value added tax (IVA) for 15 years (see Wind and solar energy promotion laws section).

As a result of this favourable context, plans for the installation of up to 3000 MW of wind power in Buenos Aires and Patagonia were mentioned. Investments were made for capacity building, resource measurement and buying wind converters, mainly from German and Danish manufacturers. The time needed to recover the investment was estimated in less than 10 years.

Before the financial crisis this was perceived as an interesting business but not without risk, mainly due to the uncertainty and lack of experience. But as a consequence of the 2001 crisis and the following devaluation of the local currency the context suddenly changed. The relative advantages introduced by wind and solar energy promotion laws were drastically reduced. Utilities now estimate recovering their investment in 25 years instead of the previous 9 years, and are supporting an updating of electricity fees to revert this situation.

Before the devaluation an electricity cooperative near Bahia Blanca (Buenos Aires province) received almost U$S30/MWh generated, which turned into U$S 9/MWh after it. This incentive is much lower than those existing in Brazil and Chile and consequently Argentina is less attractive for wind investors.

However, the particular conditions of some sites and a greater generation and performance than expected, still make it an acceptable business for those who invested before the crisis. This is the case for some sites in the south of Buenos Aires province, were both the National and local governments should pay a 1c/kWh subsidy to wind generators.

Setting apart financial issues, few of the investors of the projects under operation regret their decision, mainly when they consider the environmental advantages, their good performance and the long term perspectives.

[5] These initiatives are not included within the framework of PERMER Project

The case of wind energy exemplifies the impact of a financial crisis on those renewable energy projects based on imported systems, and stresses the limitation of the legal instruments put into practice and the need for a stronger public commitment. It is generally acknowledged now that an update of the incentives included in the law are needed if the wind energy sector is to gain impetus. Another important measures needed are the introduction of modifications to the wholesale power market, allowing long term transactions and contemplating the special characteristics of electricity cooperatives, and the upgrading and interconnection of the Patagonian grid with the national grid. Meanwhile, the political support for large wind energy projects in the Patagonia is increasing, and this fact would allow the provision of financial resources for capacity building and a MW class prototype development aimed at industrial production at local level.

The natural gas supply crisis that manifested since the beginning of 2004 has created a whole new perspective in the wholesale electricity market. Prices have risen according to the price of the substitute fuels, though they have not been transferred to the users. Even when generators do not receive all the production costs, they are accumulating an important credit. In this context, electricity generation with renewable energies may turn into an appealing business, as prices will reflect the higher costs of marginal generators.

3.8.3 Solar Water Pumping in Catamarca (Herrera, 1999)

A large part of the territory of the province of Catamarca is a semi-desert, with scarce rainfall and surface water draining. In some cases, this results in the use of water accumulated in dams for drinking (both for human beings and animals), with the risk of contracting different intestinal diseases. In other cases, there are small services in which underground water is extracted with diesel or gasoline pumps, resulting in high operational costs borne both by consumers and by the State company providing the service. This factor and the high levels of solar radiation in the area contributed to the decision to implement the use of photovoltaic technology to pump underground water.

The project was developed by the Argentine – German Program of photovoltaic pumping and was financed with funds from the German Agency of Cooperation (GTZ) and the provincial government. The institutions that coordinated and executed the project were the Science and Technology Secretariat (SECyT) and the Company of Sanitary Infrastructure (not existent today). The corresponding operation and maintenance is made by the mentioned Secretariat.

The demonstration through the installation of pumping systems allowed showing the inhabitants that the technology is reliable and real. The advantages of automation are considerable due to the lack of trained personnel to operate other systems such as power generators. Moreover, the maintenance costs of systems with inverters are quite low.

So far, the photovoltaic modules used in water pumping systems in the province do not meet the efficiency specifications guaranteed by the manufacturers. This leads to an unfavourable opinion among consumers, where the drop in the amount of available water makes the inhabitants long for the old diesel pumping system or request the installation of both systems to offset the deficiency. The impact was higher in places where the technology transfer to the community had a strong educational component, as a result of which other projects were generated that efficiently contributed to the achievement of the proposed objective. The establishment of inter-disciplinary groups (sociologists, educators, engineers, etc.) is important to agree on common working criteria that may yield a coherent analysis for the transfer of technologies.

The continuity and quality of the service must be guaranteed through the permanent technical follow-up of the installed equipments. This prevents the “fall” of the technology and the return to the situation prior to the transfer.

3.8.4 Biofuels

Alconafta Plan

The Alconafta Plan[6] was a program implemented in 1981 by the Government and was aimed at promoting the use of ethyl alcohol (from sugar cane) as a fuel, and evaluating the feasibility of using "alconafta". This was a mix of 12% of ethyl alcohol and regular gasoline which yielded an 83-octane fuel capable of fully replacing the consumption of regular gasoline. Towards the beginning of 1987, the 12 provinces integrated to the plan consumed approximately 250 million litres of anhydrous alcohol per year, while the existing industry and sugar cane plantations had an estimated capacity to produce 450 million of litres of alcohol, with the elimination of all sugar exports. Alconafta was subsidized, as the State yielded the tax on fuels over 15% of the alcohol present in the mix.

In 1985, even when the Plan had increased alconafta sales consistently and produced 2900 thousand additional tons of sugar cane with a direct labour occupation of approximately two million labour-days and produced important direct and indirect revenues, and while the Nacional Congress passed the Alconafta Law declaring alconafta of special national interest, the geographical expansion of the plan progressively stopped and the law was never reglamented. Sugar cane harvests were poor in the following years, and the necessary alcohol consumption was not met. On the other hand, the international price of sugar regained profitability, adding to the pressure held on the State by the oil companies who needed the alcohol well in advance in order to mix it with gasoline in the refineries. Hence, the gasohol plan was gradually left aside until it completely vanished.

It should be noted that the plan included one further stage where 450 millions of litres of alcohol per year where deemed necessary. In order to accomplish this, several investments were required to increase milling, distillation, and dehydration capacity and raw material production. This stage was never implemented.

The conditions prevalent today are substantially different from those of the 1980s. Experience shows that the use of an anhydrous alcohol-gasoline mix demands an impositive sacrifice and government support that protects the stakeholders from the high risk associated to the considerable initial investment. This seems difficult to implement in the context of the present deregulated oil economy subject to international prices.

Taking into account the price of gasoline (including taxes), the penetration of ethanol in the transport sector as anti-knocking agent could be feasible and desirable (it is environmentally more benign than other aromatic compounds like benzene). However, in Argentina there is an excess production of gasoline, and if there were an increase in its substitution by NCG and potentially ethanol, there would be problems in the refineries linked to the difficulty in exporting the surplus gasoline at convenient prices. The international market is demanding more diesel and fuel oil than gasoline.

Biodiesel

Another regulation aimed at promoting renewable sources of energy, although oriented to agricultural transport and machinery, corresponds to the Biodiesel Competitiveness Plan (2001), which establishes the following benefits for biodiesel activities:

- Exemption from the so-called Fuel Transfer Tax (ITC = U$S 0.05/l for diesel oil) for 10 years
- A special arrangement concerning the capital gains tax, with an accelerated repayment for new investments

[6] http://www.alconafta.com.ar/index.htm

- Companies engaged in biodiesel activities are exempted from the alleged minimum capital gains tax, as from 1 January 2002
- Other provinces are invited to adhere to this legislation. The adherence should be accompanied by a compromise to exempt producers, storage and sales operators from the following for 10 years:
- Gross income tax on industrialization and sales
- Seals tax
- Real Estate tax on biodiesel production and storage facilities

In addition, there is a feeling that this area has strategic importance, and, consequently, many decision makers have shown interest, such as both Congress chambers, local authorities from the Santa Fe, Cordoba and Entre Ríos provinces, and the Grains Stock Exchange.

There are also specific financial instruments for the promotion of biodiesel and a certain degree of competition between local governments to attract investors, although they are working towards promotion at national level. As a result of these promotion measures, there are in Argentina several projects for biodiesel production, 17 of which are already in sporadic operation. However, further development is prevented due to the lack of adequate incentives.

A law Project was recently presented to the National Congress for the Promotion of the research, development, production and use of biofuels and oleochemical products (Falco, 2004). However, the project is being delayed and modified due to objections from the Economy Ministry related to its potential impact over tax revenues. Thus, if the incentives included in the final version of the law are not enough, the legal instrument runs the risk of being inadequate for the promotion of biodiesel production and its application will not be feasible (similar to what happened in the final stages of the Alconafta Plan). Furthermore, the final content of the law and its regulatory decree could determine if only large enterprises or also small and medium ones will enter this business (Tecnoil, 2005).

In opposition to what occurs with gasoline, Argentina has no Gas Oil surplus and some supply problems have been experienced in the agricultural sector which resulted in the import of gas oil. Hence, the production of biodiesel based on local raw materials would be very convenient and a concrete opportunity for de-centralizing its production using portable equipment. A 5-10% mix with gas oil seems to be a good measure for massive dissemination but some problems affecting the quality of biodiesel have still to be solved (Corradini, 2004).

3.8.5 National Geothermal Programme

The SEGEMAR, an organism that depends from the Nacional Mining Secretariat, has been carrying out prospecting, information collection and geothermal resource potential assessment for more than 30 years. This activities are performed with own funds and those of the provinces and private sector (both national and international). Is also provides users and producers with the necessary information and technical knowledge in order to use geothermal fluids in profitable enterprises. In general, the development aims at productive and services applications such as greenhouses, fish hatcheries, road snow melting, heating systems for houses, health spas and beach therapy, among others.

There are 104 installations that use geothermal fluids directly, with an accumulated capacity of 25,7 MWth. Among the different applications health spas and beach therapy are the most common, with 13,56 MWth representing 52,7% of the installed capacity. Other applications are residential use, with 24,6% of installed capacity (6,33 MWth); residential heating, with 4,6%, equivalent to 1,17 MWth (including a 12 storey building); greenhouses, with 4,5% of installed capacity (1,14 MWth); aquaculture, with 1,5% (0,38 MWth, where colour fishes, frogs, and trouts are hatchered); industrial uses (pasta production and textile industry), with 6,7% of installed capacity (1,72 MWth) and snow melting with 5,4% (although this installation is not always working, it allowed extending the tourism season from three to eight months per year with the associated economic revenue), which correspond to an installed capacity of 1,4 MWth. All these installations produce an equivalent energy of 450 TJ/yr and represent savings of 77000 oil barrels per year.

A summary of some of these experiences and a classification according to certain indicators can be found in Appendix 3.8

Some of the conclusions that we can extract form the analysis of these experiences are:

- RETs experience in Argentina spans different technologies that have a different outreach related to their scale and target sector or population. In the same sense, each of these projects is within the responsibility of different institutional entities and under different implementation strategies, not conceived as an integral Plan or strategy for the sectors involved. This lack of coordination in terms of objectives, efforts, and lessons learned seems to be an important obstacle to the temporal sustainability of the initiatives.

In relation to those projects concerned about electricity supply for household requirements we can mention the following common issues:

- The sustainability of these projects seems to depend to a great extent on the consideration of not only lightning and communication uses but also productive uses. The latter will allow the users to generate extra income to improve the quality of life and cover, among other expenses, the fee for the service or the O&M cost of the systems.
- Renewable technologies (in many cases imposed upon the users) have some technical drawbacks and local suppliers not always have the technical and economic capacity to overcome them (even less in the case of users). The results improved when the implementation of the projects was made with an active participation of the local population and institutions.

Some of these issues are revisited and further analyzed under section 2.9.5.

3.9 Overall assessment and Identification of problems

Argentina has shown in the past the huge potential available for the development of highly complex technologies, from its laboratory stages into the production of equipment for export. The development of Argentina's nuclear industry is such an example, where a clear political decision sustained through time produced and coordinated at national level the necessary resources to carry out successfully a technological development project. In comparison, it is difficult to imagine renewable energies technologies which demand a higher degree of commitment and effort than the nuclear industry, but the degree of development in the two cases has been completely different. However, in the case of renewable energies several factors make the situation even more complex, among them we can mention the cost of the technologies in relation to the income of the potential beneficiaries, and the diversity of stakeholders playing in this field.

A systematic analysis of the problems that are described below can be found in Appendix 3.9

3.9.1 Policy and Institutional issues

Ultimately, the causes for the slow development of renewable energies in Argentina seem to be partially associated to the lack of an adequate national energy policy, energy planning, and an articulated strategy at national level in the renewable energies area. Within this context the success or failure of isolated activities depends on many aspects which are difficult to identify and transform by each stakeholder without the framework of a national strategy and policy. This void derives in part from a strong inertia and conditioning produced by more than a decade of energy restructuring processes and the dominant ideology behind it, which prioritizes short term economic growth. On one side, both renewable energies and sustainable development concepts are highly praised, even at political levels, but on the other side there still exists a vision of their limited usefulness due to their cost and reliability and a lack of practical recognition of non economic benefits of RE.

From the structural lack of an integrated policy in this issue and from the context imposed by international conditions derive many other problems which define the present situation of the renewable energy stakeholders and the degree of dissemination of these technologies. These range from the lack of an adequate institutional framework and a public institution devoted to activities coordination, to problems while setting priorities and linking efforts which are presently dispersed and isolated.

3.9.2 Private Stakeholders in Argentina

The private investment sector demands a coordinated national policy that articulates stakeholders and activities at national and provincial levels. They claim stronger incentives than those included in wind and solar promotion laws, which in practice have proven insufficient to initiate a process of massive dissemination. The situation deteriorated even more after the deep financial and social crisis at the end of 2001. The huge and sudden devaluation of the national currency makes it very difficult to import equipment and many projects stagnated. Paradoxically, the crisis is favouring the development of local industry.

Concerning the needs of the few equipment manufacturers, there is a lack of optimization of production processes, and commercial models still have handcraft characteristics and are far from mass production. There also exists the need to implement quality control standards for the production and installation of renewable systems since at present quality is highly variable, and in some cases is affecting negatively the acceptance of the technologies. In this sense, the private sector has not been able to implement an adequate O&M infrastructure and after sales service for renewable systems that guarantees a high useful lifetime for the systems and reduces technology rejection due to unattended failures.

Private investors still fight against neutral or adverse legal and regulatory frameworks at national and provincial level and an excessive bureaucracy to approve projects. They claim more financial support from national banks, ad-hoc funds and instruments for promotion, adequate timeframes for electricity purchase contracts since those corresponding to conventional plants tend to be too short, access to the grids and revision of allowed limits to installed capacity of grid connected renewable energy systems.

Other barriers for private stakeholders are the difficulty in finding adequate partners (reduced availability of reliable information and links), reaching the demand and associating with public R&D institutions. Low energy prices are a further barrier, particularly to those investors interested in participating in the electricity market. For this reason the main opportunities present for those enterprises and cooperatives who serve isolated networks and users of medium to high income levels.

Risk management and insurance are also main issues for private investors that are not solved yet, and that could help improve the economic performance of medium and large scale renewable energy projects (CEPAL/GTZ, 2004).

3.9.3 Financing and economic barriers

Renewable energies projects in general face higher transaction costs than conventional projects, requiring specific financing schemes, particularly in the case of poor population sectors where payment capacity is very low. However, public banking institutions lack experience in granting loans for renewable energies projects and their normative concerning this issue either does not exist or is vague. Neither there exist specific credit lines for the acquisition of these systems. The perception of increased risk and uncertainty in RE projects worsens this situation and specific instruments are needed to deal with this issue. In this context the role of the international cooperation has proven crucial for the development of many renewable energies projects, but the status of development of Argentina has prevented further assistance.

Financing is a key aspect to take into account in order to improve the dissemination of renewable energies. At national level, the funds devoted specifically to the issue are scarce or face instrumentation problems. However, it is possible to use funds aimed at education or rural development, incorporating indirectly the energy issue. The amount of the funds is generally low and there is a lack of access to information concerning the various programs that could be used for this aim. In the case of the projects supported by international organizations, the provision of credit is often linked to the import of some technologies (mostly PV systems), to a given equipment supplier and to specific uses. These conditions seriously undermine the scope and the sustainability of some projects since their design is biased by technological aspects rather than being based on energy requirements and other needs.

Finally, funds are available through the Science and Technology Secretariat, but access to them can be slow and troublesome. In the end, the existence of funds to finance the initial investment does not guarantee the sustainability of projects in time. In the case of poor and indigent population it seems to be necessary an important and long term financial support from the Government, and the linking with income generation through production activities and services that may have a long ripening period. These social groups could hardly be considered as a standard market since covering their fundamental needs is more a question of social responsibility. Furthermore, their payment capacity is generally very low and do not attract the interest of investors, unless there is some kind of credit, as is the case for some projects linked to the import of technology. The Government should determine what are the valid options to create the funds needed in order to satisfy the energy requirements of the poor population and the priorities in assigning them. The power of the public sector and of consumers from non-poor sectors could be instrumental for the initial development of market conditions for renewable energies technologies.

3.9.4 Energy Requirements and Resources

As may be gathered from the study on requirements, the poor are not consuming in average the energy levels estimated as required to meet their basic and minimum needs.

The supply of electricity from the public service to meet the basic and minimum power and electricity requirements of the poor and indigent population would demand a significant effort, although it would not be unachievable since in terms of electricity demand represents only 10% of the national consumption and 26% of the installed power in 2001. Overall, net energy consumption from these sectors would represent less than 8% that of Argentina in year 2001. Needless to say, this type of demand should be considered in the same way as that of the non-poor population sectors, industries, services, and commerce.

It is clear that renewable energies can contribute significantly to the satisfaction of the energy needs of poor population sectors and bring down the impact on the Public Electricity Service, but conventional energies still seem to have an important role to play in the short and mid term, particularly in urban and peri-urban areas where access to conventional grids would be the most rational solution.

One of the conventional energy carriers that are most needed is LPG. An explicit policy (adequate prices of LPG, bottled natural gas, and equipment for poor and indigent consumers) should be set with respect to the use of LPG by the poor and indigent population, as there is sufficient LPG production in the country. The production is 2.6 times the basic requirement and 2.7 times the minimum requirement of LPG for the poor and indigent. At present, the exportation of LPG exceeds the total household consumption of this fuel by more than 50%. However, concerning the supply of conventional fuels and grid electricity to the rural dispersed and a part of the rural grouped population, there are logistic problems that would have to be solved to guarantee an adequate provision. Consequently, consideration should be paid to the contribution made by renewable sources such as firewood, solar heaters and biogas, as well as the expansion of the natural gas networks within urban areas.

The pressure that the supply of firewood would have on forestry resources (to meet basic and minimum caloric requirements of the poor and indigent) would be quite high. This would imply on the one hand substituting the little-efficient firewood-consuming equipments with better units that may even double the efficiency, and thus bring down firewood consumption by half without affecting the meeting of basic and minimum needs (cooking, water heating, heating). Consideration should also be paid to firewood substitution with other renewable energies, such as biogas and solar energy, and to the development of modern biomass technologies for domestic and productive uses. Adequate forestry plans are also required, with the implantation of high-productivity species that do not affect natural soil conditions.

This study also confirmed the lack of detailed and reliable information on renewable energies resources that could be used for planning at local level. Except perhaps for wind energy data in Patagonia, the information available on resources lacks spatial detail and stems from extrapolation of a few scattered measurements. Furthermore, long temporal series of data are lacking, except for specific locations associated with weather data stations, and constitute a barrier for project development, adding to uncertainty and risk and consequently affecting negatively the economics of the projects and the possibility of obtaining loans. However, some data does exist for hydro, solar, wind and biomass resources and can serve as a good basis for the selection of regions where more detailed studies are needed. A related problem is the lack of detailed information describing the spatial distribution of the poor population and their energy needs. A local level mapping of this distribution jointly with energy resources would constitute an extremely useful planning tool.

A further problem related to biomass resources is the seasonal availability of some biomass crops and residues used for energy purposes, which will require careful planning in order to guarantee the provision along the year and overcome other problems related to labour stability.

3.9.5 RETs R&D in Argentina

In this area the lack of a national policy is perceived as a lack of human and economic resources, or at least a lack of priorities and a place for renewable energies within them. However, Argentina counts with a considerable number of R&D Centres related to renewable energy issues, mainly associated with universities and other public institutions, and together they cover a broad spectrum of technologies.

The lack of an adequate policy also generates that the degree to which each R&D Centre develops and also the research preferences are almost exclusive responsibility of their members, which produces lack of co-ordination towards the fulfilment of national objectives, the superposition of efforts and the misuse of scarce resources. Neither there is a clear definition of priority areas for research or pressure to attain concrete results. In many research institutions there still exist a preference towards academic excellence instead of useful results.

There is a huge need for capacity development concerning project development and assessment, for strengthening the relationship with industry, for understanding its language and needs, and for the commercialization of research results. In recent years some academic and research institutions have devoted their time to improving these areas through specific bodies but their activity is still incipient.

The approach taken by most university careers still do not make it easy to devote human resources to R&D in renewable energies issues. From a purely technological point of view there is still a need to introduce this issue into regular university courses, and to strengthen and adapt some research areas such as materials and plant engineering towards specific objectives.

Finally, many public institutions still present huge legal and bureaucratic obstacles to technological developments with commercial aims, which make it even more difficult to associate with private stakeholders and to develop patents and associated enterprises.

3.9.6 Technical and infrastructure barriers

In contrast to conventional energies projects, most rural area renewable energies projects are characterized by low population densities and the intervention of multiple stakeholders which need to be coordinated, some of which are not physically present in the area where the project is implemented. This requires the existence of an adequate network for O&M, for developing capacity of users and to provide financial support, a weak link in the case of Argentina. Some infrastructure already exists in the rural areas and should be used, supported and expanded in order to overcome this barrier.

Large renewable energies resources are located in areas with low population density and which lack adequate energy transmission infrastructure. This represents a further barrier for tapping these resources in large scale, as occurs in Patagonia with the wind resource. Thus, the development of power transmission infrastructure is a prerequisite in these cases in order to provide access to the national grid and make investments economically feasible.

Some technological voids exist in the biomass area, where low and mid power equipment for domestic and productive uses seems to be unavailable. More R&D is needed for uses such as food refrigeration, and water pumping based on biogas, and biomass combustion and gasification.

Renewable technologies for grid connection also face problems related to the lack of recognition of capacity credit, voltage regulation characteristics, and contribution to the strength and reliability of the grid.

3.9.7 Some Lessons Learned during Project Implementation

A survey carried out[7] on the supply of electricity through RETs to isolated settlements both within and outside PERMER has provided information on many of the benefits yielded, as the extension of useful daytime or the possibility of reading after nightfall, which in some cases promoted social activities, productive activities, security, access to further and more diversified information, etc. The following significant lessons and knowledge were gathered (without a special order):

- The imposition of technologies (with their limitations), and equipment without considering the characteristics of the demand or the available expertise and natural resources poses problems that affect both the sustainability of the project and the potential stakeholders connected to it (research and local suppliers).
- The process of implementation adopted by the person or institution responsible for the project is one of the main factors affecting the degree of success. When the institutions made an important

[7] We interviewed professionals that worked in the implementation and pursuing some RETs projects in provinces of: Jujuy, Neuquén, Catamarca, Buenos Aires, Santa Fe and authorities of the Secretariat of Energy.

effort of approximation to people in inhospitable places with adverse climatic and terrain conditions, the work of their professionals allowed to gather knowledge on their basic needs of energy, economics, social aspects, cultural traits, and health.

- Experience indicated that where there existed community places as schools (Buenos Aires, Santa Fe), health care centres, mothers halls (Jujuy), social clubs, etc, they were good points to initiate contact with people. In some cases projects began there, and then they were extended to private houses and public lighting services.
- In projects in which work was developed by multidisciplinary teams, results were better. It is important to agree on a common methodology, giving a coherent framework for the penetration of renewable technologies.
- In some of the projects it was necessary first to overcome distrust to the unknown and to diverse bad past experiences.
- The implementation of a participative process to discuss the level of subsidy and the fees to be applied has a positive impact (government, company, and community)
- The isolation of the users and the lack of proper O&M infrastructure made necessary to initiate a process of users training in O&M (and demand management), particularly for PV systems.
- Renewable energies systems allowed to substitute kerosene, LPG, candles, and batteries and to avoid the difficulties to obtain them. In this way people saves money (between 3 to 10US$/family/month), and reduces local emissions that may affect health and security.
- Habits of seasonal migration related to productive activities generate possible situations of theft of the renewable systems (Jujuy).
- The high cost of efficient light bulbs and other appliances is charged to the user, and the companies have not implemented financial schemes to provide them easily and cheaper.
- In general the “sustainability” of the projects has only been associated to the continuity of the subsidy provided by the State or an Institution. However, the existence of a development strategy that considers the incorporation of different productive technologies and the provision of proper training for their use (irrigation, soil management, reforestation, proper housing, quality seeds, etc) would provide real sustainability to the projects and a better quality of life. These would be the real tools to reduce rural-urban migration patterns.
- Bureaucratic administration that makes difficult the coordination between governmental entities which are responsible for a project is a great problem in general.

3.9.8 Barriers and the role of Capacity Development

We have previously mentioned many barriers which could be successfully treated with programs for the development of capacities, while others are more complex and deep and involve cultural and ideological aspects which are difficult to modify with conventional strategies. This is the case of the more fundamental barriers, namely the lack of implementation of an energy policy at national level and of an adequate institutional framework. The causes could be many but working on the following aspects could be helpful to move forward:

- capacity for the development of policies, technologies, RE projects and financing (partially present within Argentina, capacity development in public institutions is needed)
- knowledge/capacity for counselling those involved in the approval and implementation of policies
- capacity to gain political consensus and creating coalitions that favour the proposed policies (weak)
- will power to apply the policies (ideology/culture/interests, uncertain)
- understanding of the process of priorities assignment

Somewhat below this level is the capacity for carrying out these policies, which tend to be complex and involve many actors, instruments, and institutional and individual capacity to apply them.

Finally, each of the barriers identified below these fundamental levels are prone to be modified with an adequate development of capacities of all the stakeholders involved, in order to articulate their activities towards clearly defined aims.

3.9.9 Links with other development problems

Statistics show that the lack of access to adequate energy sources by poor rural dwellers is part of a complex situation. The number of households with Unsatisfied Basic Needs (NBI) indicates the prevalence of the following problems in the sector, among others: inadequate housing, poor sanitary conditions, minors not attending school, no means of support (four or more people per working member and head of family not having completed third grade of elementary school), etc (Combetto, 2002).

This proves that the energy issue and, particularly, the energization process via RETs should not be approached in isolation. On the one hand, it would be important to frame the issue within a development strategy, basically considering socioeconomic and cultural aspects, without neglecting the fact that this type of actions may be approached as promoters of rural development and local economies, and not as countermeasures to a lack of equity or migration barriers.

In turn, the development strategy should result from the organization and consensus of the different government areas (national, provincial, ministries, secretariats, etc.)[8], as well as of other civil organizations (especially local ones) simultaneously working within the sector, although at the moment without coordination.

3.9.10 Selected problems

All the aspects discussed above would make up the ideal basis on which successful RET implementation processes should be sustained. Nevertheless, reality shows that there are serious delays and difficulties to achieve such goals, which calls for the simultaneous preparation of schemes that may allow progress in the implementation of this type of projects.

These schemes should differ as to the support and political commitment given by the government, without which - so experience shows - action margins become quite restricted.

The barriers discussed so far will be analyzed below in order to assign priorities and link them to specific objectives and strategic policy outlines in Chapter 4.

Of all the problems mentioned, the <u>institutional weakness</u> seems to be the most important one (see section 3.9.1). To overcome it, an institutionally-defined place should be set up within the Energy Secretariat where all aspects required for the implementation of renewable projects may converge. This institution should coordinate activities and stakeholders (province governments, users, developers, NGOs, etc.), and the human resources within this area should be capacitated to formulate policies and instruments to carry them out. It would also concentrate all the energy related information as a comprehensive reference for all stakeholders (as geographically segregated as possible on, for example, socioeconomic rural problems and energy needs). Existing electricity supply schemes and projects, both interconnected and scattered, should be surveyed. At the same time, the potential magnitude of the existing renewable resources should be available, as geographically segregated as possible. This database (or system) would allow delving into the situation (preliminary diagnosis) of supplied and non-supplied settlements. The information should be widely promoted among government bodies (particularly with provincial and local governments, and other areas

[8] The Agriculture, Social Development, Environment, and Science & Technology Secretariats are especially devoted to the rural field.

involved in development issues) and within the private sector so that it may be completed and even expanded, and so that a participative process of the sectors involved may be initiated, involving a two way exchange.
Once priorities are set, which may be based on different aspects (e.g. level of impact in terms of meeting unsatisfied basic needs, employment, income, environmental impact, etc.) a project and proposal drafting process may be initiated concerning settlements without adequate energy supply[9]. These proposals should have a single format, basically comprising the socioeconomic diagnosis and the economic and energy potentials (available resources) of the beneficiary area. Once again, this progress should be promoted, focusing both on the stakeholders potentially linked to the selected area and on all finance sources that could be interested in the issues dealt with by this projects. Should interests be detected, a close authority should be defined for the implementation and management of the project (in which representatives of the inhabitants would also take part)[10].

The second main problem seems to be the lack of incentives and an adequate framework (institutional, legal and regulatory) for the application of RETs for the satisfaction of social and energy needs. In this sense, the passing of the law on the **National Promotion System for the Use of Renewable Energies for Electricity Production**, and its regulation, would represent a necessary - although not sufficient - step in the expected direction.

In third place RETs dissemination face an important cost and financing problem compounded by very low user payment capacity. The problem is further aggravated since most of RE projects focus more on residential rather than on productive uses, and thus have relatively low impact on family income that could help finance growth in energy infrastructure. Additionally, financial institutions usually lack knowledge on RETs and tend to view this sector as risky and of low profitability.

Experience shows that the participation of the population in the financing of energy generation systems is something recommended and convenient, as it brings awareness on the value of energy and thus improves sustainability possibilities, although it must go hand in hand with local reality.

This takes us to the next big issue, which is the exclusion of a large part of the population from the development model and an inadequate understanding of their needs and the potential role of RE for their satisfaction. The promotion towards the local population should be increased, reformulating the project proposals on site, and attempting to obtain the support of the community in general and of the local authorities and institutions in particular. Their participation from the beginning of the project partly guarantees its sustainability, especially when technological training is provided.

The last important problem relates to the availability of RE technology and an adequate O&M infrastructure. With respect to the technologies available within the domestic market, there is a certain supply of equipment for RET projects. However, the cost of such equipment, engineering studies, and implementation are still relatively high, even after the devaluation. The Energy Secretariat (as well as the Science and Technology Secretariat) should promote its development.

Private investors (small and local) may be sought for within the framework of Small and Medium-Sized Companies who may make use of credit lines such as those allowed for this sector for the purposes of developing production activities, creating work posts, and promoting new ideas and concepts towards other businesspeople.

Future management and maintenance calls for specific schemes, according to the local characteristics. The following have been the solutions generally found for this type of problems: training of those who are most representative and hold the most stable permanence in the project site, e.g. teachers,

[9] The PERMER project has allowed significant progress in the field of information production and concentration. However, as it was approached as a specific and quite financially powerful scheme, it has indirectly brought about a certain destructuring of the specific government area.
[10] The training of the administrative body to handle the project must be guaranteed in every project for the purposes of ensuring its sustainability.

school janitors, priests, etc. Another organization proposal refers to the establishment of a small agricultural undertaking providing a wide range of services (with technicians trained in college or by the manufacturers of the equipment), and covering such an area that may allow it to be economically feasible. All these actions must be carried out within the framework of population information programs on the existence of this supply option, promotion, and demonstration on the benefits of the new technologies.

Elements for overcoming these barriers will be further analyzed in the next chapter and concrete policy outlines will be designed for each of them.

4. POLICY OUTLINES

4.1 Objectives and policies outlines

The problems presented in table 29 are the result of selecting priority problems from Appendix 3.9. The process of assigning priority is fundamental due to the complexity of the overall renewable energies issue and the limited amount of resources available for intervention. The criteria followed in the selection was to give more priority to those problems higher in the causal chain but rather specific to the renewable energies area. This is the reason why the problems related to the general context are left aside, since they constitute the framework conditions for the renewable energies sector. The selection also reflects the intention to represent adequately each of the main dimensions involved in this issue (Policy, Economy, Social, Energy).

Table 29
Priority Problems and associated Objectives

Problem	Objective
1. Lack of a strong institutional entity that coordinates activities, formulates policies and objectives.	1. A solid public entity that coordinates activities, formulates policies and proposes objectives in the RE area has been conformed. It involves also the organization of a comprehensive database with relevant stakeholders (e.g. technology suppliers and potential users) and the monitoring of ongoing projects.
2. Lack of incentives to promote the development of renewable energies projects. Lack of a comprehensive policy as proper framework for the role of renewable sources within the context of the nation's social and energy needs.	2. Incentives to promote the development of RE in the framework of a comprehensive policy that contemplates the role of RE for the satisfaction of social and energy needs have been implemented
3. High investment cost and risk. Market size; high relative cost of the investment; lack of subsidy policies; lack of sufficient payment capacity on the part of consumers.	3. The problems related to the high initial investment, lack of credit/subsidies, and scarce payment capacity of users have been resolved
4. Exclusion of the modernization processes of poor and indigent population. Conflict politization. Lack of adequate perception of poor and indigent needs	4. The poor and indigent sectors have been included in the development model and their needs and the role of RE for their satisfaction has been understood adequately
5. Lack of an adequate O&M infrastructure. Scarce local development of the equipment-production industry.	5. The RE equipment manufacturing industry and an adequate O&M infrastructure have been developed

As mentioned previously, each objective is related to a very important barrier in the renewable energies area and serve as starting point for the design of the strategic policy outlines that indicate how the objectives are to be reached. These are presented in tables 30 through 34.

In these tables relevant internal and external factors that can affect the feasibility of reaching each objective are identified. Internal factors and external factors are further classified into weaknesses and strengths, and threats and opportunities respectively. A strategic policy outline that indicates how the objective is going to be reached is then designed for each pair of internal and external factors (Pistonesi, 2003).

Those policy outlines that are located at the cross of threats and weaknesses can be regarded as defensive or survival strategies, while those at the cross of opportunities and strengths are considered aggressive strategies.

It is worth pointing out that a further degree of detail is obtained when defining instruments to carry out each policy outline. Although this is beyond the scope of the present work, it would allow making more precise recommendations for the design of a comprehensive policy and consequently is a path to be pursued in future studies.

The policy outlines presented in tables 30 to 34 represent concrete recommendations for policy makers and relevant stakeholders. However, the feasibility of successfully applying these strategies also depends on the relative interests of the different stakeholders, an issue which is also analyzed in section 4.2.

Table 30
Strategic policy outlines for Objective 1

A solid public entity that coordinates activities, formulates policies and proposes objectives in the RE area has been conformed		**Internal factors**	**Weaknesses**		**Strengths**	
			Lack of capacity of some technical human resources from the public administration that are in charge of policy formulation	Low budget and priority assigned to the RE area	There exist diverse institutions working in this area, including a specific and autonomous Programme within the Energy Secretariat	There exist capacitated human resources in diverse public and private institutions
External factors						
Threats	More weight of the sectors linked to conventional energies		Working jointly with other RE institutions	Assigning the budget and the priorities in a more balanced way. Integration within development policy	Strengthening one of these public institutions so that it can assume the coordinating role. Linking stakeholders	Supporting existing institutions. Linking stakeholders
	Reform processes, political and institutional instability and weakness that affect the public sector			Giving more weight to the RE area within the public administration Developing strategic commitment towards RE	Strengthening one of these public institutions so that it can assume the coordinating role	Offering stability and incentives to the qualified human resources
Opportunities	Successful experiences		Assimilating knowledge from successful experiences.	Showing results that work as incentives to give more value to this area	Transferring experience and potential organizational schemes	Supporting existing institutions.
	Opportunities for capacity development and support from various national and international institutions		Capacitating technical human resources in coordination, and policy and instruments formulation activities		Linking stakeholders Supporting and developing capacity in existing institutions.	Capacitating the human resources from public organizations through Universities and research institutions, and linking stakeholders

Table 31
Strategic policy outlines for Objective 2

Incentives to promote the development of RE in the framework of a comprehensive policy that contemplates the role of RE for the satisfaction of social and energy needs have been implemented		Internal factors	Weaknesses			Strengths	
			Lack of effectiveness in the application of incentives	Superfluous bureaucracy for project approval	There exist Project assessment tools that take into account social and environmental issues but they are not applied. Profitability is given priority, considering the projects as business opportunities	There exist legal, normative, and successful projects precedents	There exist stakeholders interested in this kind of developments
External factors							
Threats	Lack of stability of the political and economic context, and consequently of the playing rules					Updating and modifying existing instruments.	Establishing clear goals, targets and roles. Promoting transparency and stability
	Opposition of sectors linked to conventional energies		Building consensus through the diffusion of RE advantages		Showing the comparative environmental and social advantages of RE projects		Mobilizing stakeholders to create consensus
	Conflicts with existing regulations and other priorities		Making regulations compatible, comprehensive and feasible	Providing coherence to the legal and institutional framework	Integrating into other development areas	Updating and modifying existing instruments. Providing coherence to the legal and institutional framework	Providing coherence to the legal and institutional framework
Opportunities	International experiences in incentives and RE projects		Improving application mechanisms	Providing elements to improve the approval mechanisms			Linking stakeholders. Sharing and disseminating information
	Support from diverse social sectors, NGOs and institutions		Controlling the correct application	Providing elements to improve the approval mechanisms. Supporting stakeholder involvement in projects	Providing elements concerning the environmental and social aspects of the projects		Linking stakeholders Sharing and disseminating information
	Interest of the Government		Creating control systems to guarantee the effectiveness of incentives	Improving the approval mechanisms. Simplifying and clarifying	Requiring a multi-objective assessment of the projects Integrating into other development areas		Linking stakeholders Sharing and disseminating information. Establishing clear goals and roles. Promoting transparency

Table 32
Strategic policy outlines for Objective 3

The problems related to the high initial investment, lack of credit/subsidies, and scarce payment capacity of users have been resolved		Internal factors	Weaknesses		Strengths		
			Projects tend to be small and numerous	Perception of high uncertainty and risk in some RE projects	Potential for the improvement of income and payment capacity through productive and services activities	Existence of some incentives	The potential "market", the renewable resources and growth capacity are high
External factors							
Threats	Political, institutional and economic instability and weakness			Guaranteeing long term stability of playing rules		Guaranteeing long term stability of playing rules	
	Inadequate funds (amount and/or mechanisms) and soft loans unavailability		Implementing innovative financing schemes. Integrating into other development areas	Disseminating the positive experiences and advantages of RE among key financial institutions	Implementing credit lines that give priority to those projects oriented to the improvement of income. Integrating into other development areas		Implementing innovative financing schemes.
	Rejection of subsidies policy			Assessing and comparing externalities of conventional and RE projects	Implementing projects oriented to income generation and improving the payment capacity	Levelling the playing field (conventional energies hidden subsidies). Taking into account externalities in comparative assessments. Ensuring transparency and coherence	Using subsidies for sustainable market creation. Creating temporary incentives and tapered support schemes
Opportunities	Public funds are potentially available		Bundling projects. Implementing innovative financing schemes. Simplifying implementation process	Supporting measures to reduce risk and uncertainty (R&D, co-finance specific projects, demonstration projects in public institutions). Constituting support funds.	Supporting income generating projects and associated technologies (including R&D, O&M)	Linking incentives with available funds and expanding outreach	Providing funds for sustainable market creation. Implementing innovative financing schemes.
	International Cooperation financing opportunities		Bundling projects Implementing innovative financing schemes. Simplifying implementation process	Supporting specific projects to reduce perceived risk and uncertainty. Constituting support funds	Supporting income generating projects and associated technologies (including R&D, O&M)		Implementing innovative financing schemes.
	Private investors are potentially interested		Bundling projects Implementing innovative financing schemes. Simplifying implementation process	Informing about improving performance records of RE projects and importance of compliance with quality standards. Conforming guarantee funds and other mechanisms to reduce uncertainty. Solving insurance issues. Creating confidence and stability conditions	Encouraging investment in certain niches	Guaranteeing long term stability of playing rules, and widespread dissemination of available incentives	Encouraging investment in certain niches. Implementing innovative financing schemes.
	Carbon credits commercialization		Bundling projects	Stressing environmental advantages of RE projects			Encouraging investment in certain niches

Table 33
Strategic policy outlines for Objective 4

The poor and indigent sectors have been included in the development model and their needs and the role of RE for their satisfaction has been understood adequately		**Internal factors**	**Weaknesses**			**Strengths**		
			Some changes will only be visible in the mid to long term	There exists a large gap between payment capacity and the cost of equipment and O&M	The use of RETs for productive activities of marginalised sectors is not taken into account (income generation)	Potential for the improvement of income and payment capacity through productive and services activities	There exist enough renewable resources to satisfy some basic energy requirements	There exist diverse local institutions devoted to the improvement of the quality of life of this population
External factors								
Threats	Cultural resistance to the introduction of new technologies		Disseminating in continuous way the advantages of RE in terms of saved time, health, income, etc.			Disseminating positive experiences and potential for income generation	Disseminating the potential for the improvement of quality of life	Working with an adequate methodology that includes monitoring and takes into account cultural issues. Working with existing institutions (school, church, NGOs, etc)
	Government development policies tend to ignore these sectors (high unemployment, inadequate distribution of national income)			Stressing the social relevance of the projects	Showing the advantages of the projects oriented to productive activities	Disseminating the potential advantages of these projects		Proposing mechanisms to satisfy uncovered needs
	The investors do not perceive these sectors as interesting from the economic point of view		Assessing the projects in the framework of sustainable development and looking for complementary financial support existing in the area	Orienting the projects towards income generation that could improve payment capacity	Carrying out demonstration projects and disseminating their potential for income generation	Disseminating positive experiences and potential for income generation		
Opportunities	Compromise and necessity of satisfying basic energy requirements		Providing support to these sectors until reaching the temporal sustainability of projects	Stressing the social relevance of the projects. Integrating to other development areas. Supporting R&D, mass production, and the development of economies of scale. Implementing innovative financing schemes.	Showing the advantages of the projects oriented to productive activities	Clarifying the potential role of RETs concerning this issue	Participating in integrated development plans Mapping resources and requirements	Articulating links with other government institutions and NGOs to provide a comprehensive vision of the issue of poverty
	The users can be included into the project (implementation and/or component manufacturing)				Stressing the fact that the development of these technologies could represent an income increase of users/producers		Developing local capacities. Creating cooperatives oriented to the production of equipments that use local energy resources	Working jointly with the users from the project design stage. Working with existing institutions (school, church, NGOs, etc)

Table 34
Strategic policy outlines for Objective 5

The RE equipment manufacturing industry and an adequate O&M infrastructure have been developed		Internal factors	Weaknesses			Strengths		
			Low quality of some equipments and lack of application of quality standards for production processes and installation	There exists in general a large geographical dispersion of users and a reduced payment capacity	Problems to start-up, upgrade and enlarge enterprises, overcoming artisanal processes and lack of scale economies	There exist accumulated experience and some capacitated personnel	Incentives for the local production of equipments and components	Lower production costs in relation to imported technologies
External factors								
Threats	Equipment imports can affect negatively the local industry and create dependency		Improving the quality of national equipments		Giving priority to national products (under equal quality conditions) in public biddings	Stimulating technology transfer, industrial development and capacity development	Eliminating incentives for equipment imports that can be produced locally	Stimulating technology transfer and capacity development
	Exchange rate changes							Protecting the development of local industry
Opportunities	Capacity development and technological transfer form other countries		Developing capacity and requiring the fulfilment of quality standards		Developing capacity in production processes, commercialization and exporting			
	Good potential for the development of local industry (SME)		Developing capacity Offering technical assistance to solve technology adaptation problems		Transferring experience and exploring foreign markets	Transferring know-how from R&D and improving the links with Universities and research institutions	Improving and extending current incentives for local production, particularly for start-up	
	There exists in general some services infrastructure			Taking advantage of the existing infrastructure. Strengthening and developing goods and services supply infrastructure				

4.2 Stakeholders reactions

As stated above analyzing the stakeholders reactions for each of the policy outlines is fundamental to assess the social and political viability of the recommendations. Thus, a matrix is built where the reaction of each relevant stakeholder to each policy outline is assessed qualitatively (support, conditioned support, acceptance, indifference and opposition). In some cases the assessment is difficult because the policy outline level lacks enough detail to predict a potential reaction. A stakeholder may agree with a policy outline, but may oppose to some ways or instruments used to implement it. In these cases one should go deeper into the instruments´ level or even into the way instruments are put into practice in order to be able to define the possible reaction of the stakeholders.

The analysis of stakeholders´ reactions is the base to organize a participative planning process with the active participation of the stakeholders themselves. However, this is a time consuming task that has been carried out only partially. Thus, many of the reactions were not assessed or were inferred based on current expertise.

Tables 35 through 39 present a preliminary identification of potential stakeholders reactions to each of the policy outlines defined above by the working team. This data should be refined in future studies and complemented with the analysis of the potential conflicts between stakeholders.

In general terms these tables point out the importance on supporting the implementation of policy outlines on certain stakeholders such as users, Universities and R&D institutions, NGOs, professional associations, rural organizations and local RE enterprises. Other stakeholders obviously play key roles in relation to specific policy outlines (e.g. Local government, Cooperation Agencies and Multilateral Banking), while very few of them openly oppose any of them. These results should be contrasted eventually with the opinions of the stakeholders themselves.

Table 35
Stakeholders´ reactions for Objective 1

Specific objective 1	A solid public entity that coordinates activities, formulates policies and proposes objectives in the RE area has been conformed										
Strategic outlines / **Stakeholders**	Working jointly with other RE institutions	Assimilating knowledge from successful experiences	Developing capacities of technical human resources in coordination, and policy and instruments formulation activities	Assigning the budget and the priorities in a more balanced way	Giving more weight to the RE area within the public administration	Showing results that work as incentives to give more value to this area	Strengthening one of these public institutions so that it can assume the coordinating role	Transferring experience and potential organizational schemes	Linking stakeholders. Supporting existing institutions	Offering stability and incentives to the qualified human resources	Capacitating the human resources form public organizations through Universities and research institutions, and linking stakeholders
1. Energy Ministry	CS	A	S	CS	S	S	S	S	CS		S
2. Other Ministries				CS						O	
3. Regulatory Agency		A	A								
4. Environment Ministry							CS	S			
5. Legislative representatives					CS		CS				
6. Political parties											
7. Local Government	S					S					S
8. Rural organizations	S	S				S		S	S		S
9. Indigenous organizations		S				S		S	S		S
10. Local RE enterprises				S	S	S	S	S			S
11. Investors											S
12. Multilateral banking											
13. Commercial banking											
14. Cooperation Agencies			S	S	S	S	S				S
15. Project developers			S	S	S	S	S				S
16. Power Utilities				A	A						
17. Oil companies				O	O						
18. Professional associations	S		S	S	S	S	S	S	S	S	S
19. Transmission companies											
20. Distribution companies											
21. Climate Change Office				S	S	S	S				S
22. Environmental NGOs	S	S	S	S	S	S	S	S	S		S
23. Potential users	S	S			S	S					S
24. Universities, R&D institutes	S	S	S	S	S	S	S	S	S	S	S

S = support; A = acceptance; CS = conditioned support; O = opposition; I = indifference

Table 36
Stakeholders´ reactions for Objective 2

Specific objective 2	Incentives to promote the development of RE in the framework of a comprehensive policy that contemplates the role of RE for the satisfaction of social and energy needs have been implemented														
Strategic outlines / **Stakeholders**	Building consensus through the diffusion of RE advantages	Making regulations compatible	Improving application mechanisms	Controlling the correct application	Creating control systems to guarantee the effectiveness of incentives	Providing elements to improve the approval mechanisms	Improving the approval mechanisms	Showing the comparative environmental and social advantages of RE projects	Integrating into other developmen t areas	Providing elements concerning the environment al and social aspects of the projects	Requiring a multi-objective assessment of the projects	Updating and modifying existing instruments Providing coherence	Establishing clear goals and targets	Mobilizing stakeholders to create consensus	Linking stakeholders
1. Energy Ministry	S	CS	S	S	S	S	S	S	A	S	CS	S		CS	S
2. Other Ministries												CS			
3. Regulatory Agency		CS	CS	S	CS						CS	CS			
4. Environment Ministry	S	CS				CS	CS	S		S	S				S
5. Legislative representatives		CS			CS										
6. Political parties															
7. Local Government	S	S	S	S		S	S	S		S					
8. Rural organizations	S		S	S	S	S	S	S	S	S	S			S	S
9. Indigenous organizations			S	S	S	S	S	S		S	S			S	S
10. Local RE enterprises	S		S	S	S	S	S	S		S		S	S	S	S
11. Investors	S	S	S	S	S	S	S					S		S	S
12. Multilateral banking						S	S								
13. Commercial banking						S	S								
14. Cooperation Agencies	S	S	S			S	S				S			S	S
15. Project developers	S	S	S	S	S	S	S	S	S	S	S	S	S		S
16. Power Utilities		A				CS	CS				CS				S
17. Oil companies	O	A										O		O	
18. Professional associations	S	S	S	S		S	S	S		S		S		S	S
19. Transmission companies		A													
20. Distribution companies		A													
21. Climate Change Office	S	S						S		S	S	S		S	S
22. Environmental NGOs	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
23. Potential users			S	S	S	S	S	S		S		S	S	S	S
24. Universities, R&D institutes	S	S	S	S	S	S	S	S		S	S	S		S	S

S = support; A = acceptance; CS = conditioned support; O = opposition; I = indifference

Table 37
Stakeholders´ reactions for Objective 3

Specific objective 3	The problems related to the high initial investment, lack of credit/subsidies, and scarce payment capacity of users have been resolved												
Strategic outlines / **Stakeholders**	Implementing innovative financing schemes	Integrating into other development areas	Bundling projects	Guaranteeing long term stability of playing rules	Disseminating the positive experiences and advantages of RE	Assessing and comparing externalities	Supporting measures to reduce risk and uncertainty	Implementing credit lines that give priority to those projects oriented to the improvement of income	Implementing projects oriented to income generation and improving the payment capacity	Encouraging investment in certain niches	Guaranteeing long term stability of playing rules	Levelling the playing field	Providing funds for sustainable market creation
1. Energy Ministry	CS	A	S	CS	S		S	S	S	S			
2. Other Ministries								CS	S	S			
3. Regulatory Agency				CS			CS						
4. Environment Ministry			CS		S	S							
5. Legislative representatives				CS									
6. Political parties													
7. Local Government	S		S					S	S	S			
8. Rural organizations	S	S	S	S				S	S	S			S
9. Indigenous organizations	S		S	S				S	S				
10. Local RE enterprises	S		S	S	S					S	S	S	S
11. Investors			S	S			S	S	S	S	S	S	S
12. Multilateral banking			S	S				CS	CS	CS			
13. Commercial banking			S	S				CS	CS	CS			
14. Cooperation Agencies			S	S	S			S	S	S			
15. Project developers	S	S	S	S	S			S	S	S	S		
16. Power Utilities				CS								O	
17. Oil companies												O	
18. Professional associations	S			S	S			S		S		S	
19. Transmission companies							CS						
20. Distribution companies							CS						
21. Climate Change Office			S		S								
22. Environmental NGOs	S	S	S	S	S	S	S	S	S	S	S	S	S
23. Potential users	S		S		S			S	S	S		S	S
24. Universities, R&D institutes	S		S	S	S	S		S	S	S		S	S

S = support; A = acceptance; CS = conditioned support; O = opposition; I = indifference

Table 38
Stakeholders´ reactions for Objective 4

Specific objective 4	The poor and indigent sectors have been included in the development model and their needs and the role of RE for their satisfaction has been understood adequately													
Strategic outlines / **Stakeholders**	Disseminating in continuous way the advantages of RE in terms of saved time, health, income, etc.	Assessing the projects in the framework of sustainable development and looking for complementary financial support existing in the area	Providing support to these sectors until reaching the temporal sustainability of projects	Orienting the projects towards income generation that could improve payment capacity	Stressing the social relevance of the projects	Showing the advantages of the projects oriented to productive activities	Stressing the fact that the development of these technologies could represent an income increase of users/producers	Disseminating the potential for the improvement of quality of life	Participating in integrated development plans	Developing local capacities	Working with an adequate methodology that takes into account cultural issues	Proposing mechanisms to satisfy uncovered needs	Articulating links with other government institutions and NGOs to provide a comprehensive vision of the issue of poverty	Working jointly with the users from the project design stage
1. Energy Ministry	S	S	CS	S	S	CS	S	S	S	S	S	A	S	A
2. Other Ministries			CS	S						CS				
3. Regulatory Agency														
4. Environment Ministry	S	S			S			S	S		S	A	S	
5. Legislative representatives														
6. Political parties														
7. Local Government	S		S	S	S	S	S	S	S	S	S		S	CS
8. Rural organizations	S	S	S	S	S	S	S		S	S	S	S	S	S
9. Indigenous organizations	S	S	S	S	S	S	S		S	S	S	S	S	S
10. Local RE enterprises	S	S		S		S	S	S		CS	S		S	
11. Investors		S	S	S				S					S	
12. Multilateral banking		S		S										
13. Commercial banking		S		S										
14. Cooperation Agencies	S	S	S	S	S	S	S	S	S		S	S	S	
15. Project developers	S	S	S	S	S	S	S	S	S		S		S	CS
16. Power Utilities														
17. Oil companies			O											
18. Professional associations	S	S	S	S		S	S	S	S		S	S	S	CS
19. Transmission companies														
20. Distribution companies														
21. Climate Change Office	S	S	S						S				S	
22. Environmental NGOs	S	S	S	S	S	S	S	S	S	S	S	S	S	S
23. Potential users	S	S	S	S	S	S	S	S	S	S	S	S	S	S
24. Universities, R&D institutes	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S = support; A = acceptance; CS = conditioned support; O = opposition; I = indifference

Table 39
Stakeholders´ reactions for Objective 5

Specific objective 5	The RE equipment manufacturing industry and an adequate O&M infrastructure have been developed									
Strategic outlines / **Stakeholders**	Improving the quality of national equipments	Developing capacity and requiring the fulfilment of quality standards	Offering technical assistance	Taking advantage of the existing infrastructure	Giving priority to national products (under equal quality conditions) in public biddings	Developing capacity in production processes, commercialization and exporting	Transferring experience and exploring foreign markets	Transferring know-how from R&D and improving the links with Universities and research institutions	Eliminating incentives for equipment imports that can be produced locally	Protecting the development of local industry
1. Energy Ministry	S	S		S	CS	S	S	S		S
2. Other Ministries									CS	CS
3. Regulatory Agency										
4. Environment Ministry										
5. Legislative representatives										
6. Political parties										
7. Local Government				CS						
8. Rural organizations	S	S		S						
9. Indigenous organizations	S	S		S						
10. Local RE enterprises	S	A	S	CS	S	S	S	S	S	S
11. Investors										
12. Multilateral banking					A				A	A
13. Commercial banking										
14. Cooperation Agencies	A	CS			A	CS	CS	CS	A	A
15. Project developers	S	S	S	S		S		S		
16. Power Utilities										
17. Oil companies										
18. Professional associations	S	S	S			S	S	S		S
19. Transmission companies										
20. Distribution companies										
21. Climate Change Office										
22. Environmental NGOs	S	S	S	S	CS	S	S	S	S	S
23. Potential users	S	S		S	S	S	S	S	S	S
24. Universities, R&D institutes	S	S	S	S	S	S	S	S	S	S

S = support; A = acceptance; CS = conditioned support; O = opposition; I = indifference

5. KEY FINDINGS AND RECOMMENDATIONS

Although chapter 4 lists all the strategies proposed in order to attain each of the objectives identified, in this section we will synthesize those recommendations, focusing on the most important issues. They are:

- To develop an adequate institutional framework that allows a coordinated functioning of stakeholders and the design of policies to integrate renewable energies into the national development strategy.
- To give coherence and stability to the legal and regulatory framework. To make it supportive of RE and eliminate bias against renewable energies.
- To establish alternative financing mechanisms and incentives that recognize non-economic benefits of RE, with stable rules over time that guarantee the effectiveness of the instruments.
- To develop instruments for risk and uncertainty management in renewable energies projects. Creation of a regional guarantee fund (CEPAL/GTZ (2004)).
- To improve the knowledge of renewable energies resources starting from the existing data for the preliminary identification of the highest potential areas.
- To support R&D in renewable energies technologies aimed at local industrial production and equipment cost reduction
- To develop quality standards and ensure compliance
- In relation to poor and middle population sectors, to support and develop projects oriented to income generation
- To develop an adequate O&M infrastructure
- To develop capacity of stakeholders in the diverse issues related to renewable energies (policies, incentives, financing, project design and management, installation, use, etc.)
- To provide access to conventional energy networks when feasible

6. SUGGESTIONS FOR FUTURE ACTIONS

The policy outlines identified in this study represent a useful starting point for the construction of a coherent policy framework for renewable energies in Argentina. However, these results are of limited practical applicability if no instruments and actions are defined. In this sense, the identification of objectives and policy outlines is only halfway towards obtaining results of concrete applicability. Furthermore, more detailed analysis is needed in order to provide concrete recommendations for the development of specific niches. Thus, a follow up of this work should include:

- An in depth analysis of specific niches.
- An identification of concrete instruments and actions based on the objectives and policy outlines defined in this study and oriented to the development of the identified niches
- Dissemination of results among RE stakeholders and raising awareness of their usefulness among policy makers and potential users
- Building strategic commitment towards RE

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APPENDICES

APPENDIX 3.1
CHARACTERIZATION OF POPULATION AND ZONES

Characterization of poor population by province - INDEC

	Total Country				
Population	Urban	Rural	Rural community	Rural dispersed	Total
Year 2001	13.324.652	1.563.430	438.744	1.124.687	14.888.082
Buenos Aires	6.295.039	246.711	82.473	164.238	6.541.750
Catamarca	114.172	40.057	23.091	16.966	154.229
Ciudad Bs. As.	642.304	0	0	0	642.304
Córdoba	854.443	107.888	42.224	65.665	962.331
Corrientes	264.318	68.535	24.714	43.821	332.853
Chaco	274.103	71.173	11.657	59.516	345.276
Chubut	49.575	5.792	2.700	3.092	55.367
Entre Ríos	265.414	57.166	13.640	43.526	322.581
Formosa	146.870	43.279	6.095	37.184	190.149
Jujuy	205.368	35.408	11.669	23.739	240.775
La Pampa	52.876	12.206	6.410	5.797	65.082
La Rioja	92.375	18.580	9.885	8.695	110.955
Mendoza	543.829	145.469	20.942	124.528	689.298
Misiones	201.455	87.090	10.838	76.251	288.545
Neuquén	138.277	17.794	5.106	12.689	156.072
Río Negro	338.685	62.778	22.633	40.145	401.463
Salta	347.009	69.919	19.823	50.097	416.928
San Juan	254.899	45.273	15.259	30.014	300.172
San Luis	104.839	15.363	6.813	8.550	120.202
Santa Cruz	95.944	3.853	1.267	2.587	99.798
Santa Fe	1.215.931	147.604	58.496	89.107	1.363.534
Santiago del Estero	215.338	111.904	22.595	89.309	327.243
Tierra del Fuego, Antártida e Islas del Atlántico Sur	42.273	1.281	463	817	43.554
Tucumán	569.316	148.307	19.953	128.353	717.622

Source: Own estimates with data from INDEC

Characterization of poor population by province - SIEMPRO

	Total Country				
Population	Urban	Rural	Rural community	Rural dispersed	Total
Year 2001	17.518.312	2.301.031	460.474	1.840.557	19.819.344
Buenos Aires	8.164.214	319.966	82.896	237.070	8.484.180
Catamarca	155.175	54.443	17.373	37.070	209.618
Ciudad Bs. As.	569.307	0	0	0	569.307
Córdoba	356.133	44.968	13.639	31.329	401.101
Corrientes	547.891	142.062	39.703	102.360	689.953
Chaco	558.018	144.893	18.392	126.502	702.911
Chubut	39.747	4.644	1.677	2.966	44.391
Entre Ríos	668.138	143.907	26.611	117.296	812.046
Formosa	259.773	76.548	8.355	68.193	336.321
Jujuy	381.077	65.702	16.781	48.921	446.779
La Pampa	118.549	27.367	7.955	19.412	145.916
La Rioja	31.371	6.310	1.858	4.451	37.681
Mendoza	721.988	193.125	21.547	171.578	915.113
Misiones	472.466	204.248	19.700	184.548	676.714
Neuquén	212.121	27.297	6.070	21.227	239.418
Río Negro	239.844	44.457	12.422	32.035	284.301
Salta	634.614	127.869	28.095	99.774	762.483
San Juan	358.019	63.589	16.610	46.979	421.608
San Luis	201.848	29.579	10.166	19.413	231.427
Santa Cruz	62.293	2.502	637	1.865	64.795
Santa Fe	1.623.125	197.033	60.517	136.516	1.820.158
Santiago del Estero	353.432	183.667	28.741	154.926	537.099
Tierra del Fue-go, Antártida e Islas del Atlántico Sur	37.897	1.148	322	826	39.046
Tucumán	751.272	195.706	20.407	175.300	946.978

Source: Own estimates with data from SIEMPRO

Zones and Provinces of Argentina

	Zone			
	Warm	Temperate	Arid	Cold
Buenos Aires		▓		
Catamarca	░		▓	
Córdoba	░	▓		
Corrientes	▓			
Chaco	▓			
Chubut			▓	
Entre Ríos	░	▓		
Formosa	▓			
Jujuy	▓		░	
La Pampa		▓	░	
La Rioja			▓	
Mendoza			▓	
Misiones	▓			
Neuquen			▓	
Río Negro			▓	
Salta	▓		░	
San Juan			▓	
San Luis		▓		
Santa Cruz			▓	
Santa Fe	░	▓		
Santiago del Estero	▓			
Tucumán	▓			
Tierra del Fuego				▓

Source: own estimates at department level within each province with data from INDEC

Labels

Main Zone	▓
Secondary Zone	░

APPENDIX 3.2
NEEDS AND ENERGY REQUIREMENTS

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	**Activity - Requirement**	**Equipment-Infrastructure**	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/ kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
Rural Residential (dispersed)	Lighting																													
	Water pumping	Pump / Well																												
	Heat for cooking																													
	Hot water																													
	Refrigeration for food storage																													
	Space heating																													
	Air conditioning																													
	Domestic appliances (low power)																													
	Domestic appliances (high power)																													
	Fuel transport																													
Rural Residential (isolated communities)	Lighting																													
	Water pumping	Pump / Well																												
	Heat for cooking																													
	Hot water																													
	Refrigeration for food storage																													
	Space heating																													
	Air conditioning																													
	Domestic appliances (low power)																													
	Domestic appliances (high power)																													
	Fuel transport																													
Rural productive	**Agriculture**																													
	Water pumping for irrigation	Pump / Well																												
	Soil conditioning	Tractor																												
		Animal																												
	Soil amendment production	Digester																												
		Kiln																												
	Residues and amendment transport	Tractor/truck																												
		Animal																												
	Crop management activities	Seed-drill																												
		Cropper																												
		Planting tool																												
		Fertilizing																												
		Pulverizator																												
		Weeder																												
		Pruner																												
		Cutter																												
		Bale tool																												
		Spinner																												
		Transporter																												
		Animal / Man																												
	Storage	Silo																												
	Packing	Packer																												
	Cereal grain processing																													
	Grain milling	Mill																												
	Refrigeration for storage	Compressor																												
	Crop drying	Drier																												
	Bioclimatic control for crops	Greenhouse																												
	Lighting for processing plants																													
	Gathering/transport	Truck																												
		Animal																												
	Cattle raising																													
	Water pumping for cattle	Pump / Well																												
	Forraje	Silo extractor																												
		Silo																												
		Cutter-blender machine																												
	Meat drying	Drier																												
	Esquila	Sheep-shearing machine																												
	Transport	Truck																												
	Dairy products																													
	Milk Processing	Milking																												
	Water heating																													
		Milk cooler																												
		Cooling																												
		Skimmer																												
		Pasteurization process																												
		Packer																												
		Washing machine containers																												

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	Activity - Requirement	Equipment-Infrastructure	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
	Butter manufacturing	Blender																												
	Cheese manufacturing	Mechanical cheesemaker vat																												
	Lighting																													

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	Activity - Requirement	Equipment-Infrastructure	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
	Aviculture																													
	Water pumping for chicken	Pump / Well																												
	Egg and poultry production	Incubator																												
		Born device																												
		Breeder																												
		Infrared lamp																												
		Feed box																												
		Break beak macchine																												
		Scald tool																												
		Pluck macchine																												
		Eggs classifier																												
		Eggs packer																												
	Refrigeration	Compressor																												
	Lighting																													
	Forestry / Wood processing																													
	Land conditioning	Hole maker machine																												
	Plantado	Tractor																												
	Raleo, Desmonte y Cuidados culturales	Motive-saw																												
		Manual Saw-Ax																												
	Transporte	Truck																												
		Animal																												
	Log Sawing	Buzz saw																												
		Band saw																												
		Wind off machine																												
	Wood conditioning	Drier																												
	Apiculture																													
	Honey processing	Extractor																												
		Washing machine																												
		Packer																												
	Hot water																													
	Heat																													
	Lighting																													
	Microenterprise																													
	Preparation of meals																													
	Water pumping	Pump / Well																												
	Lighting																													
	Cooking	Oven / Stove																												
	Hot water																													
	Processing	Domestic appliances																												
	Food Refrigeration	Compressor																												
	Brick manufacture	Kiln																												
	Charcoal production	Kiln																												
	Pottery	Kiln																												
		Electromechanical equipment																												
	Lighting																													
	Weaving/Sewing	Sewing machine																												
		Weaving loom																												
	Lighting																													
	Repair workshop	Electromechanical eq. (low)																												
		Electromechanical eq. (high)																												
		Solderer																												
	Lighting																													
	Beer brewing	Fermentation tank																												
		Electric motor																												
	Lighting																													
	Leather treatment																													
	Lighting																													
	Hot water																													
	Small scale mining	Pump																												
	Transport																													
	Edible oil processing	Press																												
	Hot water																													

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	Activity - Requirement	Equipment-Infrastructure	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/ kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
	Heat																													
	Lighting																													
	Bakeries	Oven / Stove																												
		Kneader																												
	Water pumping	Pump / Well																												
	Lighting																													
	Guest houses																													
	Lighting																													
	Cooking																													
	Hot water																													
	Space heating																													
	Refrigeration	Compressor																												
	Various	Domestic Appliances (low pwr)																												
	Various	Domestic Appliances (high pwr)																												
	Water pumping	Pump / Well																												

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	Activity - Requirement	Equipment-Infrastructure	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/ kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
	Candle wax manufacture																													
	Heat																													
	Lighting																													
	Soap making	Digestor																												
		Electric Motor																												
	Lighting																													
	Blacksmiths																													
	Heat	Muffle																												
	Lighting																													
	Tinsmiths	Solderer																												
	Lighting																													
	General																													
	Communications																													
	Battery charging																													
Urban-periurban	Lighting																													
residential	Water pumping	Pump / Well																												
	Heat for cooking	Oven / Stove																												
	Hot water																													
	Refrigeration for food storage																													
	Space heating																													
	Air conditioning																													
	Domestic appliances (low power)																													
	Domestic appliances (high power)																													
Urban-periurban	**Preparation of meals**																													
productive	Water pumping	Pump / Well																												
	Lighting																													
	Cooking	Oven / Stove																												
	Hot water																													
	Processing	Domestic appliances																												
	Food Refrigeration	Compressor																												
	Fabricacion de dulces y conservas																													
	Heat	Oven / Stove																												
	Hot water																													
	Lighting																													
	Food refrigeration																													
	Pottery	Kiln																												
		Electromechanical equipment																												
	Lighting																													
	Weaving/Sewing	Sewing machine																												
		Weaving loom																												
	Lighting																													
	Carpentry	Winch																												
		Saw																												
		Planing machine																												
		Cast maker																												
		Other electromechanical devices																												
	Lighting																													
	Repair workshop	Electromechanical																												

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	**Activity - Requirement**	**Equipment-Infrastructure**	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/ kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
		eq. (low)																												
		Electromechanical eq. (high)																												
	Welding	Solderer																												
	Lighting																													
	Beer brewing	Fermentation tank																												
		Electric motor																												
	Lighting																													
	Leather treatment																													
	Lighting																													
	Hot water																													
	Bakeries	Oven																												
		Kneader																												
	Water pumping	Pump / Well																												
	Lighting																													
	Guest houses																													
	Lighting																													
	Cooking																													
	Hot water																													
	Space heating																													
	Refrigeration	Compressor																												
	Various	Domestic Appliances (low pwr)																												
	Various	Domestic Appliances (high pwr)																												
	Water pumping	Pump / Well																												
	Candle wax manufacture																													

			Resource/Technologies																											
			Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	**Activity - Requirement**	**Equipment-Infrastructure**	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/ kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
	Heat																													
	Lighting																													
	Soap making	Electric Motor																												
	Heat	Digestor																												
	Lighting																													
	Handcraft workshop	Electromechanical eq. (low)																												
		Electromechanical eq. (high)																												
	Lighting																													
	Blacksmiths																													
	Heat	Muffle																												
	Lighting																													
	Small Shops																													
	Heat																													
	Lighting																													
	Food refrigeration																													
	General																													
	Communications																													
	Battery charging																													
Education	Lighting																													
	Power for TV/video	TV/Video																												
	Power for Computer	Computer/peripherics																												
	Space heating																													
	Hot water																													
	Refrigeration for food storage																													
	Heat for cooking	Oven / Stove																												
	Potable water	Pump / Well																												
	Power for workshop	Electromechanical equipment																												
Health care	Power for medical equipment																													
	Vaccine/medicine refrigeration																													
	Lighting																													
	Space heating																													
	Hot water																													
	Sterilization	Autoclave																												
	Power for transport	Ambulance / Suitable Vehicle																												
Other	Communications																													

			Resource/Technologies Electricity Shaft power	Electricity		Heat - Electricity - Mechanical						Heat								Mechanical power			Competing non-renewable							
Category	**Activity - Requirement**	**Equipment-Infrastructure**	Mini Hydro	Wind turbine	PV	Biogas	Biodiesel	Biomass boiler	Biomass Gasification	Etanol	Geothermal generator	Biomass stove	Biomass kiln	Solar stove/ kiln	Solar Collector	Solar Drier	Solar still	Other passive solar	Geothermal well	Wind mill	Mini Hydro mills	Animate	Candles	Kerosene	Diesel Oil	Gasoline	LPG	Natural Gas	Batteries	Grid
Community																														
Services	Street lighting																													
(Community Centre,	Potable water pumping	Pump / Well																												
Municipality,	Desalination																													
Police outpost, etc.)	Water purification																													
	Battery charging	Charge regulator																												
	Transport	Vehicle																												
	Lighting																													
	Space heating																													
	Heat for cooking																													
	Hot water																													
	Refrigeration for food storage	Compressor																												
	Power for workshop	Electromechanical equipment																												
	Power for TV/video/audio	TV/video/audio																												
	Power for computer	Computer/peripherics																												

Degree of compatibility with user and requirement			
Labels	**Color code**		**Obs.**
Very suitable			Very suitable in general where the resource is available
Suitable			
Could be used			Low suitability in general but could be used under specific conditions
Not reccomended			Could be used but is not reccommended due to low compatibility
Not suitable			

Notes
Available equipment unit power for community and productive uses is assumed to be higher than for residential requirements
Assessment of compatibility takes into account cost, complexity, ecomony of scale, user category, experience
Communal systems present the additional challenge of a more complex logistic, organization and distribution of the responsabilities and benefits of the system among the participants.
However, they tend to be cheaper, provide a better quality of service and a better use of resources thanks to economies of scale.
Many of the productive requirements are satisfied potentially with human or animal work. In the more typical cases this has been clarified.
For the rest of the cases an analysis in depth could estimate the animate energy required to satisfy them.

APPENDIX 3.3
RENEWABLE ENERGIES TECHNOLOGIES

		Degree of technological maturity	**Penetration**	**Advantages**	**Disadvantages**	**Requirements / Obs.**	**Cost range**
Category	**Technology**						
					1050		
Electricity / Shaft power							
Small - Mini - Micro Hydro	Pelton, Francis, Kaplan	High	Low (40 MW)	Used also for irrigation, flood control, drinking water, productive uses of the reservoir and recreation. Lower potential environmental impact than large hydro. Possibility of storage and regulation. Low short term variability. Relatively high rated power allows the use of most electromechanical appliances. Good R&D capacity and demonstration experience in Argentina. Local technology available.	Storage requires dam construction. Load must be close to the generator due to electricity transport losses and cost. Low power systems (<3kW) generate in low voltage and need an inverter in order to use standard appliances.	A minimum value of head*flow is required (in general terms head >2m and flow >0.5lts, but the combination of values depends on technology). For example, for Banki turbines located in a stream with a flow of 70 lt/s the head should be at least 2 metres for an output power of 1kW. The lowest power outputs (~100 w) are achieved with relatively low flows (between 0,5 and 10 lt/s, with heads from 100 to 2 metres respectively). However, in general it is advisable that the flow be greater than 5lts/seg.	USD 600-3000 / kW (imported, only equipment), and for equipment produced in Argentina $5500 to 8600 for low power mobile plants (<1kW), while for stationary stations: $9000/kW for system power between 5 and 10 kW), and as low as $4500/kW for system power between 50 and 100 kW. The cost of the electromechanical equipment without civil works is between $1800/kW y $3000/kW, depending on the kind of turbine (Crossflow, Pelton, etc.)
Electricity							
Wind Turbine	Small Horizontal Axis	High	Low (~1200 systems in agricultural exploitations, total installed ~0.3 MW)	Cheaper than PV. Power could be enough to use some mid power electromechanical appliances. Both low voltage and high voltage systems available. Minimum power around 300 W. Local technology available	Requires batteries for storage in stand alone systems or hybrid systems to guarantee supply. Low power systems generate in low voltage and an inverter is required in order to use standard appliances. Should be located close to the load. Thus, it may produce some noise and interference problems.	Start up wind velocity ~4m/s. Cut off speed >18 m/s. Nominal power reached at around 10 m/s	$ 10000 / 1.5 kW (complete system and installation, including 3day storage batteries). USD 2000 to 5000 / kW depending on system power for imported systems (only generator and regulator). $1600 to 2200 / kW for local technologies (only generator). Battery 12V, 220A deep cycle $450
	Large Horizontal Axis	High	Low (~26 MW)	Some structural components could be built locally	Only imported technology	Start up wind velocity 5m/s. Cut off speed around 36 m/s	1500 USD / kW (turbine nominal power 600 kW)
	Vertical Axis	Low	None	Good stability (Heavy elements located near the floor), improving maintenance. Good rotor efficiency	Needs start up device. No commercial availability in Argentina.		-
Photovoltaic	Mono-crystalline, Poly-crystalline, Amorphous	High	Low (~0.5 MW, 0.2 MW for pumping, ~22000 systems in agricultural exploitations)	No moving parts or noise produced. Little maintenance required. Modular. Very low power and portable systems available. Local BOS components available (batteries, lamps, regulator, inverter, structure). When compared to kerosene or candles for lightning, PV is cleaner and produces no odour.	High cost compared to other renewable energy systems. Needs batteries or hybrid system to guarantee supply. Adequate O&M infrastructure poses a challenge in some areas and is critical for the sustainability of projects. Users tend to require more power than supplied, which generates misuse problems unless proper capacity development is carried out. The low power provided by SHS excludes most productive activities, and a substantial part of the income of poor populations may be devoted to the payment of a system that does not generate extra income. Special appliances may be required if generation is in low voltages, which is generally the case in low power installations. The main component of the modules is imported (cells). Solar pumps are imported. Amorphous cells may have efficiency stability problems	For solar pumps, the maximum pumping head is around 70m, with a minimum daily flow in summer of 300lt.	USD 4000 to 10000 / kWp depending on system power, complexity and storage capacity

Heat - Electricity – Mechanical							
Biogas	Digester	Medium	Very low	Good resource availability. Variety of feedstocks. Sub-product is a good soil conditioner and may increase farm productivity. Local technology available for domestic/community units.	Cultural problems linked with dealing with manure. Recollection and transport requirements (time consuming). Digester must remain above certain temperature and thus the reaction may require heating in some regions and/or seasons. Feedstock must be supplied periodically to maintain gas production. Water demand increases and consequently a good source of water should be available close to the digester. When a digester goes out of service due to problems with the reaction, it may take between one and two months to start normal operation again. Biogas production may be variable and thus the stove may turn off while cooking in winter. According to the users biogas is slower for cooking than firewood. Hydrogen sulphide should be filtered for the use of biodiesel in generators	Heat may be needed for maintaining bacterial activity (depending on climate). Minimum and maximum temperatures for reaction are 4ºC and 70ºC respectively but preferably above 18ºC. Daily feedstock input in warm regions: 30 kg of dung and 30 lt of water per day for a daily biogas production between 1 and 2m3. This amount of dung can be produced either with 2 to 3 large animals (cows, horses, etc.) or with 5 to 20 smaller animals (pigs, etc.)	$2900 for a domestic unit of 2m3 capacity (digester + gas storage)
	Landfill	Medium	Very low (3 cells)				
Biodiesel		Medium	Very low (>120 m3/day installed, >100 m3/day under construction)	High expectation, good R&D and demonstration capacity thanks to potential applications in agricultural sector as a substitute of diesel oil (very large market). High fossil fuels prices. Good resource availability. Some plants already in operation and many projects. Very good prospects for the commercialization of subproducts in industry (glycerine, high protein content flour). Smaller plants than for ethanol are available. No need for engine adaptation. Non-toxic and highly biodegradable. In general less polluting than diesel oil. Relatively simple conversion process from oil to biodiesel. Could be mixed with diesel oil in any proportion. Better engine lubrication. Local technology available.	Minimum scale is required in order to be cost effective. Recollection and transport can be costly and challenging. Long term fertility of the soil could be affected if not managed properly, particularly for annual crops. Competition with food/oil production (particularly with soybean due to high oil export price). Fuel storage will be required. Higher nitrogen oxides emissions than diesel oil. Biodiesel is biodegradable, and consequently the higher the amount of biodiesel in the fuel the higher the water absorption and decay rate. Storage tanks should be kept filled to prevent humidity. They also should be protected against extreme temperatures and long term storage should be avoided. The glycerol produced (20% of biodiesel volume) should be treated adequately	Artisanal plants have been built with capacities as low as 30 lts/hr of biodiesel produced. Commercial reactors are produced with 400 and 1600 lts/day capacity. Soybean would yield around 420 lt/ha, while coconut would yield 2500 lt/ha. Consequently the minimum land area to operate a 400 lt/day reactor at full capacity would be around 250 has of soybean. For the production of 1 ton of biodiesel 1tn of oil is needed, plus 0,1 to 0,2 ton of methyl alcohol and a small amount of sodium hydroxide. Silos for grain storage, and processing installations are also required (motors, compressors, electrical equipment). A small plant covers around 60m2.	USD 1000 / m3.day
Agricultural and agroindustrial wastes	Boiler	High	Medium (>100 MW of bagasse cogeneration + 10 MW mainly in agroindustrial sector)	Local technology available.	Mid to high power systems. Collection, transport and storage	Reliable source of residues	
Wood residues	Gasifier	High	Low	Local technology available.	Mid to high power systems. Collection, transport and storage	Reliable source of residues	
Bagasse / Ethanol	Still	High	None	Large national experience with "Alconafta" programme (no longer in operation). Good resources availability. Local technology available.	Only viable in mid to large scale in order to be cost effective. Recollection and transport can be costly and challenging. Long term fertility of the soil could be affected if not managed properly. Competition with food production. Fuel storage is required due to seasonal sugar cane availability.		
Geothermal		High	Very low (670 kWe power plant, out of service)	Cogeneration of heat and power. Suitable for communities or larger populations. Very low resource variability if well managed. Similar to conventional energy supply, could power all kind of electromechanical appliances and provide heat for processes and households. Local technology available	Not available for low power. Sometimes deep wells have to be bored. Some geothermal fluids can pose contamination risks (not in Argentina so far).	High enthalpy resource required for electricity generation	USD 600/kW for electricity generation (100 MW, local technology)

Heat							
Biomass stove	Traditional	High	High	Home made, inexpensive, easy to maintain	Very low efficiency resulting in high fuel input and time consuming gathering and transport. Some local deforestation and desertification problems. Indoor air pollution resulting in chronic respiratory problems. Risk of burns and fires.	Improvements in housing are recommended in association with this technology	
	Efficient	High	Low	Efficient burning resulting in high fuel and time savings compared to conventional. Exhaust for combustion fumes. Some models are inexpensive and may be built with materials available locally. Absence of smoke in the house and less time spent in cleaning the house, clothes and utensils. Safer. Easy O&M	Low R&D, no dissemination due to lack of commercial appeal, except for some expensive imported technologies oriented at high income population. Strong cultural barriers linked to the symbology of the traditional stove and the taste of the food. More time needed for cleaning the chimney		
Biomass kiln							
Solar stove/kiln		High	Low	Easy maintenance. Different pot sizes could be used. It reduces the rate of deforestation and increases the time available for other tasks.	Little dissemination due to lack of commercial appeal. Cultural barriers related with cooking practices and the taste of food. Requires adequate user capacitation. Cannot be used during the night or very cloudy days.	Cooking is performed outside the house. Temperature can be as high as 280 ºC (La Puna). Requires a mechanism to conserve heat. Manual orientation.	USD 200 per domestic unit, $2000 for a larger stove with a 60kg food capacity and 1,70m diameter
Solar Collector		High	Medium	Local technology available. Heats water between 40ºC and 90ºC depending on location (usually less than 60ºC). Could be used to complement other water heating systems and save fuel.	Direct systems without heat exchanger could be damaged by frosts.	Capacity between 50 and 600 lt.	USD 200 to 600 per collector depending on trademark and local or imported technology
Solar Drier		High	Low	Passive, very low maintenance requirements. Easy to design and build.			
Solar still			Very low				
Other passive solar		Medium	Low	Low cost and could be integrated to the house components as in solar architecture			
Geothermal well		High	Low (25,7 MWth)	Relatively simple technology. Versatile, many uses. Resource has low variability if well managed	Sometimes requires perforation of deep wells to tap the resource		
Mechanical power							
Wind mill		High	Medium (~400000 mills totalling around 200 MW all over the country)	Very good experience. Local technology available. Adequate O&M infrastructure in agricultural zones.	Some mills not in operation due to availability of cheap electricity and generating sets resulting in lack of proper maintenance.		USD 500 / kW
Mini Hydro mills					Only mechanical power for very specific applications (mills) and viewed as less versatile than a plant that generates electricity to power a set of appliances and machines.		
Animate		Medium	Limited to a portion of the low income population that have no access to machinery	Versatile, useful for performing many tasks. The fodder for the animals can be produced in situ or bought at a relatively low cost.	Limited power compared to agricultural machinery and trucks.	Good quality fodder with adequate nitrogen content.	

R&D Capacity

Category	Technology	BR	AR	PR	CM	TA	TT	O&M	HR	IC
Electricity / Shaft power										
Small - Mini - Micro Hydro	Pelton, Francis, Kaplan	L	M	M	L	M	M	L	M	L
Electricity										
Wind Turbine	Small Horizontal Axis	L	M	M	M	M	L	L	M	M
	Large Horizontal Axis	VL	N	N	N	N	N	L	M	N
	Vertical Axis									N
Photovoltaic	Monocrystalline, Policrystalline, Amorphous	L	VL	VL	N	VL	VL	L	M	L(*)
Heat - Electricity - Mechanical										
Biogas	Digester	VL	L	L	VL	M	L	VL	L	VL
	Landfill									
Biodiesel		VL	L	M	L	M	M	L	M	L
Agricultural and agroindustrial wastes	Boiler							M	L	M
Wood residues	Gasifier	VL	L	VL			L	L	L	L
Bagasse / Ethanol	Still	VL						L	L	L
Geothermal		VL					M	M	M	M
Heat										
Biomass stove	Efficient	N	L	L	N	L	VL	VL	L	N
Biomass kiln										
Solar stove/kiln		N	L	L	L	L	VL	L	L	VL
Solar Collector		L	M	M	M	M	L	L	M	L
Solar Drier		N	L	L	L	L	L	L	L	N
Solar still		N	VL	VL	VL			VL	L	VL
Other passive solar		L	M	M	L	M	L	L	M	VL
Geothermal well		VL					M	L	L	L
Mechanical power										
Wind mill		VL	L	M	M	M	L	M	M	M
Mini Hydro mills										

(*) only one plant that assembles modules, some BOS manufacturers

Labels	**Areas**
BR	Basic research
AR	Applied research
PR	Prototype
CM	Commercial model
TA	Technology adaptation
TT	Technology transfer
O&M	Operation and maintenance infrastructure
HR	Human resources
IC	Industrial capacity

Capacities that are more critical and need to be developed

Stakeholders

Sources	Group / Enterprise	Area	Type of Actor	Activities	Production site
Biomass	Fimaco S.A.	Biogas	Manufacturer		Córdoba
Biomass	BIO	Biodiesel	Manufacturer	Manufacture and export reactors for trans-estherification of vegetable oils in a simple way and at low cost. On the average they produce equipments range from 400 to 600 biodiesel liters/day	
Biomass	Fundacion Proteger	Family Biogas (up to 2m3 daily)	NGO	Production, sale and users training	
Biomass	Grupo de Energias no Convencionales, U.N. del Litoral	Biogas – Organic Wastes. Hydrate. Family scale, agricultural establishments and district	R&D	Research, technology development, prototypes and training	
Biomass	UNAM, Programa Universidad y Energía	Kitchen with oven	R&D		
Biomass	INCAPE - Area de Transf. de Tecnología	Biodiesel	R&D		
Biomass	UN del Litoral - INCAPE Instituto de investigaciones en catalisis y pretoquimica	Biogas, biodiesel	R&D	Advice in the production of fuels for anaerobic digestion organic solid wastes: modelling, design and evaluation of the bio-reactor. Studies on the obtaining of fuels for non conventional methods. (Technological transfer to BIOFE INC)	
Biomass	Grupo en Energias Renovables, UNNE	Biogas	R&D	Use of milking yard Effluents for Cogeneration	
Biomass	UBA	Gasification	R&D	Evaluation of the kinetic parameters that characterize the pyrolysis and biofuel gasification. Carbonization studies	
Biomass	UTN, CIELAC Villa Maria	Biodiesel	R&D	Development of an economic and transportable prototype, easy to manipulate (using canola)	
Biomass	UNLP, Facultad de Ingenieria	Gasification	R&D		
Biomass	Biofe S.A.	Biodiesel		Producer plant	
Biomass	Univ. Argentina de la Empresa	Biodiesel			
Geothermal	Segemar	Heat uses	R&D	Systematizes information. Databases and maps of thermal manifestations. Thermal projects. Starting from the evaluation of the geothermal potential of an area it is given to the users and producers the information and the technical know-how	
Minihydro	UN de La Plata, Departamento de Hidraúlica	Mini Hydro	R&D		
Minihydro	Microwatt	Mini Hydro	Manufacturer		
Minihydro	Universidad Nacional de Río Cuarto, Facultad de Ingeniería	Mini Hydro	R&D		
Minihydro	GERM-UNAM -Grupo de Energías Renovables de la Universidad Nacional de Misiones	Mini Hydro	R&D		
Minihydro	CNEA - CAB	Mini Hydro	R&D		
Minihydro	Investigador	Mini Hydro	R&D		
Minihydro	EOLUX - Empresa Giacobone – División energía	Mini Hydro			
Solar	Numericon	PV and wind turbine	Dealer		
Solar	Aldar S.A.	Solar water heater	Dealer		Córdoba
Solar	Miracuyá SRL.	Solar pumps	Dealer		Imported
Solar	Dalbuz SRL	PV	Dealer		Imported
Solar	Ecosolar SA	PV	Dealer		Imported
Solar	José E. Calvaresi	Submergible pumps	Dealer		Imported
Solar	Solo sol	PV	Dealer		Imported
Solar	BP	PV	Dealer		
Solar	Sansolar	PV	Dealer		Regulator, luminary
Solar	Kalorinti	Water heaters	Manufacturer		Catamarca
Solar	Solar Pirca	Solar collectors, kitchens and ovens	Manufacturer		Tilcara, Jujuy
Solar	Natural Power	Water purifiers	Manufacturer		Córdoba
Solar	Vademarco SA	Solar collectors	Manufacturer		Lanús
Solar	Empresa vinculada a J. Follari (U.N. de San	Solar water heater	Manufacturer	Development, sales and maintenance. Since 1998	

	Luis)				
Solar	Solartec (Kyocera Solar Argentina)	PV	Manufacturer	Assembles panels and manufactures electronic components	La Rioja (module)
Solar	Energia Natural	Solar drier and air collectors	Manufacturer	Designs, manufactures and markets solar dryers for grains and vegetables and air collectors. Markets wind turbines, hydro systems, Biomass gasificators, collectors of hot water and photovoltaic modules.	
Solar	Dirección de Asuntos Municipales de Chubut	Solar public baths and installation of three solar ovens and a parabolic solar kitchen	Government	Chubut	
Solar	Subsecretaría de Ciencia y Tecnología	Pumping	Government		
Solar	Fundacion EcoAndina / ITAGH Consulting Group (vinculada a Instituciones y proveedores alemanes)	Solar pumping, communal solar kitchens and solar water heaters	NGO	Promotes to take conscience about low impact technologies, and easy access technologies for small communities. It developed technologies of alternative energy (solar and wind), projects of drinking water and of watering by means of pumping	Solar Thermal produced in place (Jujuy). Other technologies from Germany
Solar	Laboratorio de Energia Solar, U.N. de San Luis,	Solar water heaters and solar collector accumulator	R&D	Research, adaptation. Appropriate low cost prototype development	
Solar	Laboratorio de Ambiente Humano y Vivienda, Instituto de Ciencias Humanas, Sociales y Ambientales, CRIC YT, Mendoza.	Passive solar	R&D	research, development, and experimental application	
Solar	UN de Salta, INENCI.	Passive solar	R&D	research, development, and experimental application	
Solar	UN Noreste	Heater, solar drier and PV	R&D	research, advice, transfer and training	
Solar	Fac. de Arquitectura - UN La Plata	Water heaters	R&D		
Solar	UN de Rosario Fac. de Ci. Ex.	Swimming-pool heaters, solar drier	R&D	Development of applications	
Solar	INENCO - Univ. Nac. Salta	Water heaters	R&D		
Solar	INENCO - Univ. Nac. Salta	Steam production	R&D		
Solar	Universidad Tecnológica Nacional - Facultad Regional Buenos Aires, Grupo de Estudios Sobre Energía	Useful life of PV	R&D		
Solar	Fac. de Ciencias Agrarias - U.N.Ca	Pumping	R&D		
Solar	INENCO - Catamarca		R&D		
Solar	Centro de Investigación Hábitat y Energía, CIHE, FADU, UBA	Hot water installations	R&D		
Solar	Universidad Nacional de San Luis	Solar distiller	R&D		
Solar	Universidad Nacional de Salta	Thermal solar	R&D		
Solar	UN del Litoral	Fluid heater and PV	R&D	Technical-economic evaluation of systems for use of solar energy Calculation and design of solar facilities for heating fluids Design, projection, consultancy and technical conduction for uses of the photovoltaic solar energy	
Solar	IDEHAB- Instituto de Estudios del Hábitat. Facultad de Arquitectura y Urbanismo, Universidad Nacional de La Plata.	Bio-climatic architecture	R&D	Bio-climatic architectural. Research and training	
Solar	Tandar, CNEA Constituyentes	PV and solar collector - Spatial and terrestrial applications	R&D		
Solar	UN de Lujan	Solar resource	R&D	Assessment of the solar resource	
Solar	UN de Lujan	Solar drier	R&D	Drying of aromatic grasses in Buenos Aires. Assessment of the solar resource	
Solar	UN de Rosario Fac. de Ci. Ex.	Solar architecture	R&D		
Solar	CIUNSA	PV and thermal solar	R&D		
Solar	Sursolar SA	Flat solar collectors. Solar architecture			
Wind	Bornay Inclin	Wind turbine	Dealer		Imported
Wind	Neg Micon	Wind turbine	Dealer		Imported
Wind	Servicios Electromecánicos	Wind turbine	Manufacturer		Buenos Aires
Wind	Natural Power	Wind turbine	Manufacturer		Manufacture
Wind	Vademarco SA	Wind turbine	Manufacturer		Lanús
Wind	Eólica Salez	Wind turbine	Manufacturer		
Wind	Giacobone	Wind turbine	Manufacturer		Córdoba
Wind	Ingeniería Argentina	Wind turbine	Manufacturer		

Wind	Elio Armando Mantovani	Wind turbine	Manufacturer		Santa Fe
Wind	Molinos El Lucero	Wind turbine	Manufacturer		Bs. As.
Wind	Fábrica de Impl. Agrícolas	Wind turbine	Manufacturer		Bs. As.
Wind	M.A. Seery & Cía.	Wind turbine	Manufacturer		Bs. As.
Wind	Indelmec	Wind turbine	Manufacturer		Bs. As.
Wind	Natural Power	Wind turbine	Manufacturer		Córdoba
Wind	Universidad Tecnológica Nacional, Confluencia	Wind turbine	R&D		
Wind	Grupo de Estudios Sobre Energía y Ambiente		R&D	Design and construction of wind turbines for dispersed rural and peri-urban inhabitants	
Wind	Centro Regional de Estudios Eólicos-CREE	Wind turbine	R&D		
General	UN de Salta / UN de Catamarca	Renewables	Training	Training. Post-grade, Master degree, and Specialist in renewable energy. Application courses to the engineering, Architecture and agriculture	
General	BID		Loan	Program of Sustainable Markets of Sustainable Energy (SMSE) of the Division of the Environment of the Department of Sustainable Development	
General	Red Iberoamericana para la Electrificacion rural con Energias Renovables	Electricity generation with renewables	Government	Latin American experts' and projects registration. Training promotion, evaluation and diffusion. Nexus with suppliers. Support to norms development.	

General	SECYT - Programa Rec. Renovables y No Renovables		Government	Energy programme	
General	SECYT - Progr. De Proyectos Especiales		Government	National Direction of PyPEs	
General	FONCYT Áreas de vacancia - Red de institutos y laboratorios – Reuniones nacionales		Government	Vacancy areas - Network of institutes and laboratories -National Meetings	
General	Agencia Nacional de Promoción Científica y Tecnológica		Government	Special Programs of Quality of Life and Social Development. Programs and Special Projects of Renewable, Non-renewable Resources and Prevention of Natural disasters and Quality of Life. Economic and Social Development	
General	Programa Crédito Riojano		Government	Provincial Programs of Rural electrification for basic used, based on Solar energy (2000)	
General	SAGPyA		Government	National Programme of Biofuels	
General	FIO-UNaM -Facultad de Ingeniería de Oberá, Universidad de Misiones). Y el Ministerio de Obras y Servicios Públicos del Gobierno provincial		Government	Programme of Hydro-electricity Micro-enterprises	
General	UN del Litoral	Renewables	R&D	Studies on integration of non conventional energy sources in agricultural and agroindustrial establishments	
General	Univ. Nac. De Bs. As. - C. Inv. Hábitat y Energía		R&D		
General	UBA - Instituto de Geografía		R&D		
General	Grupo Energía Solar - Departamento de Física Centro Atómico Constituyentes CNEA		R&D		
General	Asociación Civil ESTUDIOS POPULARES		NGO		
General	ASADES		NGO	It contains actors in all the areas of the renewable energy	
General	UTN Com. Evaluadora RR, NR y PCN - Energía				
General	FOPAR - Fondo Participativo de Inversión Social				
General	AVE - CEVE (CONICET) – SEHAS				
General	Ministerio de Educ. Dir. de Infraestructura				
General	Min. De Desarrollo Social - PROMEBA				
General	Univ. Nac. Del Comahue Gcia. de Gestión Ambiental				
General	INTA - Catamarca				
General	Univ. Nac. de Pat. Austral Unidad Académica				
General	INTI – CIPURE				
General	Universidad Nac. de Salta				
General	Secretaria de Energia			National Direction of Promotion	
General	SECYT - Coord. Del Progr. De Competitivada Productiva			Link Area with PyPEs	
General	SECYT			Dirección Nacional de Planificación y Evaluación	

General	Gendarmería Nacional a través de la Patrulla Ecológica				
General	Dirección General de Recursos Naturales Renovables				
General	Universidades de Jujuy, de Buenos Aires y de Salta, Escuelas de la región Puna				
General	Centro Nacional Patagónico (CENPAT),				
General	Electricidad de Misiones SA (EMSA)			U.E.C.	
General	EPEN (Empresa Provincial de Electricidad de Neuquen)			U.E.C.	
General	Instituto de Ingeniería Rural - INTA			Research and Development Area	
General	Secretaría de Recursos Naturales y Ambiente Humano				
General	Dirección de Recursos Forestales Nativos			Department of Forest Statistic of the Argentine Republic	
General	Secretaría de Agricultura, Ganadería, Pesca y Alimentación			Dirección de Producción Forestal	
General	Secretaría de Energía			Undersecretary of Fuels	
General	Agencia Nacional de Promoción Científica y Tecnológica			Programme of Action of Fight against the Desertificación with the National Policies of Sustainable Development.	
General	IADIZA-GTZ e INTA			Programs of Permanent Training	
General	IADIZA - Inst. Arg. de Investig.de las Zonas Áridas				

APPENDIX 3.5
CASE STUDIES

Case Studies Selection Matrix

Case studies / **Criteria**	**Case study 1**	**Case study 2**	**Case study 3**	**Case study 4**	**Case study 5**	**Case study 6**	**Case study 7**
Representativeness							
Replicability within the zone	VH	M	M	H	L	M	H
Potential population benefited (million inhabitants)	~15	~1,5	~0,45	~0,33	<0,20	~0,17	~0.000826
Complexity	L	M	H	M	H	H	M

VH Very high
H High
M Medium
L Low
VL Very low

Data Case Study Nº1						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	2.6	electricity network		Urban	Temperate Zone
	heating	24.3	GLP / biomass stove	0-100%		
	air conditioning	3.2	electricity network			
	cooking	56.0	GLP / biomass stove	0-100%		
	hot water	32.8	GLP / solar collector	> 50 %*		
	food refrigeration	25.6	electricity network			
	Radio	2.3	electricity network			
	TV	11.3	electricity network			
	Washing machine	1.7	electricity network			
	Ironing	5.0	electricity network			
Total		**164.8**				

Data Case Study Nº8						
Category	**Use**	**Useful Energy requirement per micro-enterprise (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Productive (bakery)	lightning	2.9	electricity network		Urban	Temperate Zone
	oven	118.8	GLP			

	oven	356.4	GLP			
	hot water	53.5	GLP / Solar Collector	25%		
	food refrigeration	56.8	electricity network			
	human energy	33.9				
Total		**622.3**				
* A. Fasulo						

Data Case Study Nº2						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	4.7	PV / GLP	100%	Rural dispersed	Warm
	heating	0.0	-	-		
	air conditioning	0.0	-	-		
	cooking	49.2	Biomass stove / Biogas	100%		
	hot water	27.3	Biomass stove / Biogas	100%		
	water pumping	10.7	PV / GS	100%		
	food refrigeration	19.2	PV / GLP	100% (*)		
	Radio	2.3	PV / Dry cell	100%		
	TV	11.3	PV / Battery			
	Washing machine	1.7	PV / GS	100% (*)		
	Ironing	5.0	GLP	0%		
Total		113.5				

Data Case Study Nº3						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	5.0	WG / GLP	100%	Rural dispersed	Temperate
	heating	24.2	Biomass stove / Biogas	100%		
	air conditioning	0.0	-	-		
	cooking	54.5	Biomass stove / Biogas	100%		
	hot water	43.8	Biomass stove / Biogas	100%		
	water pumping	10.7	Wind pump / GS	100%		
	food refrigeration	18.0	WG / GLP			
	Radio	2.3	WG / Dry cell	100%		
	TV	11.3	WG / Battery	100%		
	Washing machine	1.7	WG / GS			
	Ironing	5.0	GLP	0%		
Total		158.5				

Data Case Study Nº4						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	6.3	WG / GLP		Rural dispersed	Arid
	heating	96.9	Biomass stove	100%		
	air conditioning	0.0	-	-		
	cooking	74.7	Biomass stove / Solar stove	100%		
	hot water	70.0	Biomass stove / Solar collector	100%		
	water pumping	10.7	WG / GS			
	food refrigeration	15.6	WG / GLP			
	Radio	2.3	WG / Dry cell	100%		
	TV	11.3	WG / Battery			
	Washing machine	1.7	WG / GS			
	Ironing	5.0	GLP	0%		
Total		276.4				

Data Case Study Nº9						
Category	**Use**	**Useful Energy requirement per micro-enterprise (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Productive (Workshop)	lightning	2.9	MCH / Diesel / GS	100%	Rural community	Warm
	soldering	174.4	MCH / Diesel / GS	100%		
	drill	18.4	MCH / Diesel / GS	100%		
	electric motors	86.8	MCH / Diesel / GS	100%		
	electric gun	47.7	MCH / Diesel / GS	100%		
	human energy	33.9				
Total		364.1				

Data Case Study Nº5						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	4.7	MCH / GLP	100%	Rural grouped	Warm
	heating	0.0	-	-		
	air conditioning	0.0	-	-		
	cooking	49.2	Biomass stove / Biogas	100%		
	hot water	27.3	Biomass stove / Biogas	100%		
	water pumping	10.7	MCH / GS	100%		
	food refrigeration	19.2	MCH / GLP	100%		
	Radio	2.3	MCH / Dry cell	100%		
	TV	11.3	MCH / Battery	100%		
	Washing machine	1.7	MCH / GS	100%		
	Ironing	5.0	GLP	0%		
Total		113.5				

Data Case Study Nº6						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	5.0	WG / GLP	100%	Rural grouped	Temperate
	heating	24.2	Biomass stove / Biogas	100%		
	air conditioning	0.0	-	-		
	cooking	54.5	Biomass stove / Biogas	100%		
	hot water	43.8	Biomass stove / Biogas	100%		
	water pumping	10.7	Wind pump / GS	100%		
	food refrigeration	18.0	WG / GLP			
	Radio	2.3	WG / Dry cell	100%		
	TV	11.3	WG / Battery			
	Washing machine	1.7	WG / GS			
	Ironing	5.0	GLP	0%		
Total		158.5				

Data Case Study Nº7						
Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Target population**	**Case study context**
Residential	lighting	6.3	WG / GLP	100%	Rural scattered	Arid/cold
	heating	33.1	Biomass stove	100%		
	air conditioning	0.0	-	-		
	cooking	74.7	Biomass stove	100%		
	hot water	70.0	Biomass stove	100%		
	water pumping	10.7	Wind pump / GS	100%		
	food refrigeration	15.6	WG / GLP			
	Radio	2.3	WG / Dry cell	100%		
	TV	11.3	WG / Battery			
	Washing machine	1.7	WG / GS			
	Ironing	5.0	GLP	0%		
Total		212.6				

(*) Technically feasible but not advisable from the point of view of PV system power and cost.

APPENDIX 3.6
RENEWABLE ENERGIES CAPACITIES

Stakeholder	Function/Activities	Capacity status / problems	Capacity development measures	Magnitude of CD needs / Priority
1. Legislative authorities, elected officials	Set national political priorities; social, economic, and environmental goals; legal framework conditions.	Lack of knowledge about RE. Perception as unreliable and not ripe in relation to conventional energies. Not prioritaire or even in agenda in general. Sensitive to lobby groups pro conventional energy and to media. Sporadic interest tied to conventional energies problems or pressure from important stakeholders (biodiesel, agriculture)	Provision of outstanding information by means of, for example, the presentation of successful projects, information trustworthy, possible niches for RETs, and stressing the importance of the RE appropriately.	**VH**
2. Government macroeconomic and development planners	Define development goals and macro policy; general economic policies; cross-cutting issues; subsidies and trade policy; sustainable development goals, and frameworks	Lack of knowledge about RE potential. Lack of integration of RE into Development Policies	Capacity development in policy formulation, regulatory frameworks and incentives. Strengthening of the technical staff in the role of the RE and their characteristics. To prepare technical staff as well as decision makers in the analysis on how the RE could be included into those policies addressed to the development as well as into the promotion mechanisms.	**VH**
3. Government energy authority or ministry	Set sectoral goals; technological priorities; policymaking and standard-setting functions; legal and regulatory framework; incentive systems; federal, state, and local level jurisdiction.	Lack of coordination capacity and centralized control of RE information. Access to detailed information is not straightforward for stakeholders. Lack of coherent energy and RE policies	Capacity development in policy formulation, regulatory frameworks and RE promotion. Strengthening of the technical staff. Establishment of a public information system, appropriate and integrated..	**VH**
4. Energy regulatory bodies	Have monitoring and oversight functions; implement the regulatory framework; administer fees and incentives.	Lack of adequate regulatory frameworks for the promotion of RE. Lack of power for ensuring compliance. Lack of consistent regulation for small decentralized RE generators, forbidden in some cases. Lack of experience in dealing with RE	Training in: incentive mechanisms for the RE and their particularities; in regulations related to interconnection aspects with the electricity grid and in isolated and decentralized systems management. Training to achieve a better fulfillment of the regulations.	**VH**
5. Market coordination agencies	Dispatch entities; have operational coordination functions; interface with industry investors; information brokers.	Lack of interest in most RE due to financial constraints, small market, perception as risky and not ripe, unstable political and taxes frame	Training for the integrated information management, in order to reach a greater linking between actors and a greater knowledge of the area of the renewable energy and their possibilities on the part of the potentials interested.	**H**
6. Non-energy governmental authorities/ministries	Sector policies; cross-cutting issues; inter-relation with energy policies; public sector energy consumers; require energy inputs for social services provision.	Lack of knowledge about RE and coordination with other development areas	Knowledge of the potential of application of the renewable energy in each sector and the needs that can be covered with each technology.	VH

7. Energy supply industry	Private companies and public utilities; manage energy supply, electricity generation; fuels management and transport; finance some R&D.	Lack of interest in dispersed and low income users due to low profitability. Financing problems. Perception as risky business and not ripe, unstable political and taxes frames. Regulatory framework not adequate. Some stakeholders opposing decentralized generation due to fear of increased competition and reduced share of market.	Knowledge of the particularities of the O&M of the renewable energy and their specific requirements beyond the purely technical aspects. Outlines of supply in low density rural areas. Knowledge about potential market niches and comparative advantages confronting the conventional systems in certain applications.	H
8. Entrepeneurs and productive industry	Business development; economic value added; employment generation; private sector energy consumers.	Still perceived as incipient market and risky.	Knowledge of the potential application of renewable energy and their limitations. Knowledge about potential market niches and comparative advantages confronting the conventional systems in certain applications. Interaction with other actors.	H
9. Energy equipment and end-use equipment manufacturers	Supply equipment for the energy industry and other industries, including vehicles and appliances; impact energy end-use efficiency; adapt/disseminate technology; finance some R&D.	Still perceived as incipient market and risky. Enterprises created by individuals with personal interest in RE that profit on small niche markets and the increase in competitiveness in relation to foreign technology thanks to currency devaluation. Equipment quality is highly variable and no quality standards are in place for manufacturing. Manufacturer sometimes does not share the responsibility for an adequate maintenance.	Knowledge of the users´ requirements. Training for the financing obtaining; for the technology improvement and entail areas of technological transfer of universities and investigation institutes. Training to adapt to standard of quality and alternatives for reach a cost reduction in devices, without detriment of their quality. Training to improve the post sale service; how to set a commercial strategy and the diffusion of the products among the potentials interested. Development of strategies to put the issue in the political agenda and lobby capacity for the implementation of measures addressed to promotion.	M
10. Energy equipment O&M services	Provide O&M. Feedback on performance and feasibility	Difficult, costly and time consuming O&M for dispersed users. In fee per service schemes fee collection is perceived as problematic.	Training in the particular requirements of the RE and their users. Standard of quality for facilities. Logistics optimization.	VH
11.Credit institutions	Financing options for large- and small-scale energy generation; capital provision for energy using enterprises; financing options for household energy consumers.	Difficulties associated with the large administrative costs compared with low amount of money involved in loans for individual projects. Lack of rules and knowledge about RE projects and technologies, and interest in low income users. No specific credit lines for RE projects.	Training in the special characteristics of the renewable systems, especially of small power, and on modality and capacity of payment of their users. Development of mechanisms of soft credits for RE projects.	VH
12. Civil society / NGOs	Consumer participation and awareness; oversight and monitoring; environmental and social advocacy; equity considerations	Strong pro RE attitude, sometimes leading to lack of objectivity and holistic view of problems. Strong lobby potential but some groups perceived as "fundamentalist" and consequently considered little serious and their proposals not feasible. A certain degree of lack of information and subjectivity, or managing partial information. Good link to some communities. Dispersed.	Capacity development for the design and administration of RE projects in a sustainable way along the time and their monitoring. Capacity to capture the users needs and their cultural particularities. Development of strategies to put the issue in the political agenda and lobby capacity for the implementation of promotion measures.	M

13. Users	Users of renewable energy systems. Providers of feedback and knowledge about resources, cultural traits, technology performance, friendliness and suitability.	Demand for increasing amounts of power resulting in misuse of systems. Lack of acceptance due to cultural traits and lack of knowledge. Lack of knowledge in community system self-management and the potential of renewable energy to increase the productivity and to generate revenues. Lack of knowledge to carry out a productive project. Lack of knowledge for an appropriate O&M of the systems.	Training for the appropriate use of renewable systems and the understanding of their limitations. Training in self-management and design of community projects.	H
14. Energy specialists and consultant firms	Strategic advice, problem definition and analysis; systems development; specialist services delivery; options analysis; information sharing.	Underestimate non-technical problems leading to lack of sustainability of projects. Deficiencies in the post sale service, training of users and maintenance.	Training for the monitoring and the design and project monitoring to achieve the sustainability along the time.	M
15. Academia and research organizations	R&D, knowledge generation, and sharing; formal and informal education; technical training; technology adaptation, application, and innovation.	Lack of adequate links with industry, sometimes due to inadequate regulations and incentives in these institutions. Superposition of efforts and lack of coordination into national promotion and development policies and strategies. In some cases, approach too academic and not oriented towards results of concrete applicability. Lack of information about national priorities.	Training to achieve a more fluent transfer medium and small enterprises and industries associated with the production of prototypes and devices. To achieve more dialogues among institutions and perception of the high-priority needs of the potential users of renewable systems. To implement programs specifically for the formation of human resources in RE. Development of strategies to put the issue in the political agenda and of lobby capacity for the implementation of promotion measures.	H
16. Media	Awareness raising, advocacy; information sharing; journalistic inquiry, watchdog functions; monitoring, public transparency.	Sporadic interest and diffusion. No long term information and education efforts. Lack of accurate information and reliable and deep analysis.	Knowledge of the qualified sources of information in RE topics.	M

APPENDIX 3.7
RENEWABLE ENERGIES NICHES

NICHES SELECTION MATRIX

Niche	**Biogas in mild and warm areas, both rural grouped and rural scattered**
Representativeness	
Replicability	Medium to high in rural areas, in accordance with the availability of the resource, which is associated to the existence of animals in a relatively concentrated way, and close to the consumer
Population benefited	Corresponds in a potential way to the poor population in mild and warm areas. In warm areas: rural scattered 1 million; rural grouped 0.2 million. In mild areas: rural scattered 0.45 million; rural grouped 0.17 million.
Complexity	Medium, as it may meet heat requirements. High when combined with a generator to produce electricity and motive power.
Sustainability/Viability/Suitability	
Affordability	Medium to high. Good potential for low cost technology, as it is relatively simple and can be built with standard off-the-shelf materials. Electricity generation involves the use of more expensive equipment (generator), and is more suitable for rural communities than for scattered settlements.
Effectiveness	Medium. Low O&M expenses, while raw materials have low or zero opportunity cost. Adding this to the low investment and the long lifetime, we have a low cost per energy unit produced.
Risk of obsolescence	The technology in itself has been widely tested in many parts of the world, reaching a relatively stable degree of development. The risk of obsolescence may come more from the side of substitution with LPG, or, eventually, NG. Substitution with LPG faces high costs and a difficult supply to the scattered rural dweller, due to which only certain social sectors will have adequate access to it to meet their energy requirements. With respect to NG, the extension of the system will mainly favor urban and peri-urban consumers.
Flexibility	High, as it has the potential to meet both heat & lighting and electricity requirements in two stages. Being a gaseous fuel, it may be stored. Some equipment is of the modular type, which allows expanding the generation in accordance with rising requirements both for household and production uses. It may be powered with a variety of organic waste.
Technological capability	Medium to low. Although it is a relatively simple and low-cost technology, Argentina lacks much practical experience in it. Trained human resources are related to national universities (Littoral, Northeast) and to INTA. So far, there is no adequate O&M infrastructure, except in the areas surrounding these establishments, as commercialization is incipient. The training of technicians would be required for their design, construction, and mainly O&M, in those areas with the highest potential for their application.
Suitability and urgency	Very high. This is a technology that may help meet a large portion of household heat requirements - in many case the most essential ones - at a low cost, and, eventually, it may also help meet requirements as to electricity and certain production uses.
Resilience	This technology requires three significant resources to function, namely: organic waste (preferably manure), contaminant-free water (not necessarily drinking water), and workforce to operate the biodigester. In the case of the organic waste, no competition is generated with the use of manure as agricultural fertilizer, and its quality is improved during biodigestion. Water availability, instead, may represent a restricting factor in certain regions, especially when lacking an adequate pumping and storage system. With reference to human resources, gathering, transportation, biodigester supply, and effluent removal tasks call for almost daily attention, with the consequent demand of workforce that will not be available for other tasks.
Adaptability	
Environmental impacts	Positive. Reduces firewood demand and yields an organic change that improves the soil, reincorporating nutrients.
Social acceptance	Low. Certain experiences have encountered cultural problems associated with the handling of manure. This could improve through adequate training and demonstration of its usefulness.
CD requirements	Medium to high. Promotion and education towards better acceptance. Strengthening of local manufacturers. Adequate O&M infrastructure. Quality standards for design and construction. R&D in different organic waste to obtain better prototypes for commercial purposes and to couple, to a generator.
Income generation	Has the potential to meet production requirements.

Niche	**Wind Mill**
Criteria Representativeness	
Replicability	High. Restrictions may arise as from the overexploitation of water resources, a situation that is not frequent in the case of scattered rural dwellers or small rural communities.
Population benefited	
Complexity	Low. Only water pumping, and, eventually, some motive power.
Sustainability/Viability/Suitability	
Affordability	Medium to high
Effectiveness	High
Risk of obsolescence	Medium to low. Mainly associated to the potential substitution with the expansion of the electricity system, the use of motor generators, and the supply of water through a system. The use of motor generators proves to be more expensive, and depends on the adequate supply of fuel.
Flexibility	Medium, with relation to water pumping. As long as the resource so allows it, the water volume stored may be increased, or consecutive mills may be installed to meet a demand that exceeds the original flow.
Technological capability	Medium. This is a relatively simple technology, and there is adequate experience on its use at national level. There are several manufacturers, and any mechanical workshop may deal with simple repair works.
Suitability and urgency	Very high. It represents the adequate supply of a critical resource for subsistence, standard of living, and different agricultural/livestock and production activities.
Resilience	High. Water availability restrictions may arise from the overexploitation of water resources, a situation that is not frequent in the case of scattered rural dwellers or small rural communities.
Adaptability	Very high. The supply of drinking water may improve the capacity to adjust to seasonal changes, as it represents one of the key aspects to achieve higher productivity in agricultural/livestock activities.
Environmental impacts	Low. Risk of water resource overexploitation and contamination due to drilling and pumping mismanagement.
Social acceptance	High. This technology has been widely promoted and accepted within rural areas in Argentina.
CD requirements	Medium. Higher O&M infrastructure, strengthening of local manufacture.
Income generation	High. Supplies water for agricultural/livestock and production activities in general.

Niche	**Solar Water Heater**
Criteria Representativeness	
Replicability	High. Applicable both to rural and urban areas.
Population benefited	
Complexity	Low. Only hot water close to 40ºC.
Sustainability/Viability/Suitability	
Affordability	Medium to high
Effectiveness	High. Allows large savings in conventional fuels.
Risk of obsolescence	Low. This is a technology on which much research has been done, and which has reached an adequate level of maturity and demonstration.
Flexibility	In general, it must be used in cascade with other systems, running both with firewood and conventional fuels. However, this restriction gives the energy system a good margin to adapt to a changing demand. Its modular structure allows expansions with relative ease.
Technological capability	There are local manufacturers and associated maintenance infrastructure. Nevertheless, higher O&M coverage would be probably necessary in the event of the higher promotion of the systems.
Suitability and urgency	Medium to high. It allows meeting a large portion of the hot water requirements for personal hygiene and as an intermediate step to cooking, with the resulting savings in firewood or conventional fuels.
Resilience	
Adaptability	
Environmental impacts	
Social acceptance	
CD requirements	
Income generation	

Niche	**Improved Cookstove**
Criteria Representativeness	
Replicability	High
Population benefited	
Complexity	Medium to high. Hot water, cooking, and heating.
Sustainability/Viability/Suitability	
Affordability	Very high
Effectiveness	High. Contributes to significant savings in the consumption of firewood and other conventional fuels.
Risk of obsolescence	Medium. It is a simple and efficient technology that may be further improved. There are highly efficient but still too costly biomass cookers. There is a risk of substitution with natural gas or LPG in urban and peri-urban areas. In the first case, natural gas could wholly replace firewood, while in the second one there will probably be a complementation on account of the high cost of LPG.
Flexibility	Medium. Generally used only to meet household needs. A rise beyond this level would require the construction of a new installation, as well as an adequate supply of firewood. Certain models accept a range of biomass fuels.
Technological capability	
Suitability and urgency	Very high. It may meet some of the most essential household requirements, such as cooking, home heating, and water heating.
Resilience	
Adaptability	
Environmental impacts	Medium. It requires an adequate management of the biomass resource to prevent deforestation, desertification, and loss of habitat for animal species.
Social acceptance	High. It requires training and demonstration to accustom the palate to the new taste. A reduction in firewood consumption and gathering time is quite welcome.
CD requirements	
Income generation	Low. Not used for production purposes, although the more time available may indirectly contribute to such use.

Niche	**Solar Cookers**
Criteria Representativeness	
Replicability	Medium
Population benefited	
Complexity	Medium. Cooking and, eventually, water heating.
Sustainability/Viability/Suitability	
Affordability	High
Effectiveness	
Risk of obsolescence	Low
Flexibility	
Technological capability	
Suitability and urgency	High
Resilience	Very high. Releases pressure from the biomass resource.
Adaptability	
Environmental impacts	Zero negative impact. Indirect positive impacts on the effects of firewood overconsumption in certain regions.
Social acceptance	Medium to low. This system is viewed as quite odd with respect to the traditional way of cooking, in light of which its incorporation is not an easy task, and cultural aspects must be considered.
CD requirements	
Income generation	Low. In general, it is a technology aimed at meeting household or community requirements, although it could be used to provide some food service.

Niche	**Mini Hydro Power**
Criteria Representativeness	
Replicability	Medium to low
Population benefited	
Complexity	Medium to high. It is one of the few systems that allows meeting all electricity needs, as well as certain marginal heat requirements. It also meets other non-energy needs.
Sustainability/Viability/Suitability	
Affordability	Medium
Effectiveness	High. It is one of the cheapest electricity generation systems per power unit. Low O&M cost.
Risk of obsolescence	Low. Well-proven technology. Possible improvement in regulation mechanisms.
Flexibility	Medium. As long as the resource is not a limiting factor, the system is designed in accordance with the load. An unexpected increase in requirements will generally presuppose the change of the system, and perhaps of the civil works.
Technological capability	
Suitability and urgency	Medium to high. It allows the adequate meeting of all household and production electricity requirements.
Resilience	Medium to high. The use of the hydro resource for electricity generation purposes does not rule out other uses. The construction of a dam may allow some control over swellings and floods. On the other hand, it is necessary to evaluate the impact of the installation on the fishing resource.
Adaptability	Very high. The installation may favour other complementary uses, such as irrigation and fish farms, which may contribute to the diversification of the activities of the community.
Environmental impacts	Medium. They depend on the type of civil works made and on the management of the dam (sediments, fish circulation, stratification, alteration of water biophysical parameters).
Social acceptance	High. It is a well-proven and accepted system that renders good power and reliability.
CD requirements	
Income generation	Medium to high. All electricity uses and certain marginal heat use. Other non-energy uses.

Niche	**Wind Turbine**
Criteria Representativeness	
Replicability	High
Population benefited	
Complexity	Medium. Low and medium voltage electricity uses.
Sustainability/Viability/Suitability	
Affordability	Medium to low
Effectiveness	Medium
Risk of obsolescence	Low to medium
Flexibility	Medium to high. It requires a certain management of the demand to accommodate a higher requirement. Furthermore, another generator must be installed, and the battery set and BOS must be resized.
Technological capability	
Suitability and urgency	Medium to high
Resilience	High
Adaptability	
Environmental impacts	Low negative impact. Noise, electromagnetic interference.
Social acceptance	High
CD requirements	
Income generation	Medium. It allows certain medium voltage electricity uses.

Niche	**PV for community services**
Criteria Representativeness	
Replicability	High
Population benefited	
Complexity	Medium. Allows meeting multiple medium and low voltage electricity requirements.
Sustainability/Viability/Suitability	
Affordability	Low
Effectiveness	Medium. Limited by the high cost and low voltage of the systems. In turn, in certain places it represents the only option to provide electricity.
Risk of obsolescence	Low to medium. The efficiency of the systems is still quite low. Much research is being carried out on this.
Flexibility	Low to medium. The modules yield low power and may only supply electricity to low and medium voltage applications. The technology is modular, except for some BOS components. Expansions are restricted by cost considerations. They may be transferred without much effort, if required.
Technological capability	Still deficient and costly O&M infrastructure for the supplier and the consumer.
Suitability and urgency	Very high for certain uses and places lacking other reliable options for electricity generation. The most critical uses are related to community services, as follows: drug and vaccine cooling, water pumping, communications, battery charging, and lighting.
Resilience	Medium to low. The procurement, O&M of the system may capture the scarce economic resources of the community.
Adaptability	Medium. Improvement of the standard of living in isolated areas (communications, health, drinking water, lighting)
Environmental impacts	Medium to low. Mainly related to the operation of the batteries and the manufacture of the photovoltaic cells.
Social acceptance	Medium. Some rejection associated to its limited power, which prevents meeting a rising demand, and is worsened by troubles due to misuse and lack of adequate maintenance.
CD requirements	
Income generation	In general, brought forward here for social purposes, although water pumping, communications, and lighting uses also have repercussions on production activities and, thus, on income generation. Nevertheless, the high cost per power unit results in the installation of low-power systems with limitations for production applications.

Niche	**Solar Driers**
Criteria Representativeness	
Replicability	High. Quite simple technology that only involves the use of easily available low-cost materials. It may function adequately in a large part of Argentina.
Population benefited	
Complexity	Low to medium. Only drying, and, eventually, hot water and air supply.
Sustainability/Viability/Suitability	
Affordability	High. Adaptable low-cost technology.
Effectiveness	Very high. Through low investment and O&M expenditure, it brings down foodstuff losses due to putrefaction, while expanding commercialization possibilities both as to time and distance.
Risk of obsolescence	Low
Flexibility	It may be used to dry a wide variety of products. Its processing capacity may be expanded with relative ease. Limitations arise on the side of the operation being restricted to periods with sun resource availability, which may restrict the processing speed when processing large volumes in a seasonal way.
Technological capability	High
Suitability and urgency	Medium to high for rural producers far from the place where their products are commercialized, and who produce foodstuff that putrefy easily. Low with respect to the meeting of household energy requirements.
Resilience	High. No critical resource is affected.
Adaptability	High, as it allows the storage of products to be commercialized at a better price or to consume in times of higher need.
Environmental impacts	Null or low. Risk of fire during the drying of wood and other combustible products.
Social acceptance	Medium to high. There is not much experience on its use, but there are no signs of rejection either.
CD requirements	Promotion of its potential. Development of local manufacture. R&D and demonstration for different products.
Income generation	High. It allows storage and access to somewhat distant markets for the commercialization of foodstuff with short lifetime when fresh. Drying results in the better quality of the product that reaches the market and, hence, in a better price.

Niche	**Biodiesel for mechanical power**
Criteria Representativeness	
Replicability	Medium. It requires a wide area and adequate agricultural infrastructure for the sowing, harvest, transportation, and storage of the biomass.
Population benefited	
Complexity	High. As it is a liquid fuel, it could meet both heating and electricity requirements. Nonetheless, its niche is the use for transportation, agricultural machinery, and motive power, as it is the only renewable fuel that may be used in conventional diesel engines without need of adaptation works.
Sustainability/Viability/Suitability	
Affordability	Medium to low
Effectiveness	Medium to low
Risk of obsolescence	Medium. Relatively simple technology that is still evolving.
Flexibility	High. As it is a liquid fuel, it could meet both heating and electricity requirements. Nonetheless, its niche is the use for transportation, agricultural machinery, and motive power, as it is the only renewable fuel that may be used in conventional diesel
Technological capability	Medium
Suitability and urgency	Medium
Resilience	Medium. Biodiesel production competes against the generation of oils and foodstuff, some of which is exported, its price being set by the international market.
Adaptability	Very high. It may allow carrying out many activities that require motive power.
Environmental impacts	Medium to high. It requires an adequate management of the energy crop to prevent soil depletion. An adequate market must be found for glycerol.
Social acceptance	High. Similar to a traditional fuel such as diesel.
CD requirements	
Income generation	Very high. It may have great impact on the yield of agricultural and production activities in general (should there be no restrictions as to other resources).

Data Niche Nº1

Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs (*)**	**Zones of application**	**Target population**	**Equipment demand (**)**
Residential	lighting	5,0	Domestic Biodigester (1 to 2 m3 of biogas/day)	30% to 60% (100%)	Warm and temperate	Rural	
	cooking	49 to 54					
	hot water	27.3 to 43.8					
	electrical uses	45.2 to 52.5		0% (100%)			
Subtotal		126.5 to 155.3		16% to 49% (100%)		1,883,645 hab.	400.000

Data Niche Nº2

Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Zones of application**	**Target population**	**Equipment demand**
Residential	water pumping	10,7	Wind pump	100%	Temperate and arid/cold	Rural	
Subtotal		10,7		100%		1,044,353 hab.	220.000

Data Niche Nº3

Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Zones of application**	**Target population**	**Equipment demand**
Residential	hot water	32.8 to 58.4	Solar collector (100lt/day)	50%	Arid and temperate (north of Colorado river)	Urban - Rural	
Subtotal		32.8 to 58.5		50%		13,975,687 hab	2.974.000

Data Niche Nº4

Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Zones of application**	**Target population**	**Equipment demand**
Residential	heating	0 to 96.9	Efficient biomass stove	100%	All	Peri Urban - Rural	
	cooking	49.2 to 74.7		100%			
	hot water	27.3 to 70		100%			
Subtotal		76.5 to 241.6		100%		>2,301,031 hab.	>490,000

Data Niche Nº5

Category	**Use**	**Useful Energy requirement per household (kep/yr)**	**Technology / Source**	**% covered with RETs**	**Zones of application**	**Target population**	**Equipment demand**
Residential	cooking	49.2 to 74.7	Domestic Solar stove	30-70%	Arid and warm	Rural - Peri urban	
	hot water	27.3 to 70		low			
Subtotal		76.5 to 144.7		10% to 68%		>1,672,916 hab	>356,000

Data Niche Nº6

Category	Use	Useful Energy requirement per household (kep/yr)	Technology / Source	% covered with RETs	Zones of application	Target population	Equipment demand
Residential	Lightning	2,5	Wind turbine (1,5 kW per household)		Temperate and arid-cold	Rural	
	Water pumping	1,3					
	Air conditioning	0 to 2.6					
	Food refrigeration	22.2 to 25.5					
	Other appliances	15.8 to 19.1					
Subtotal		41.8 to 51		55% to 100% (100%)		<1,044,353 hab.	<222,000

Data Niche Nº7

Category	Use	Useful Energy requirement per household (kep/yr)	Technology / Source	% covered with RETs	Zones of application	Target population	Equipment demand
Residential	Lightning	2 to 2.5	Mini-hydro turbine (3 kW per household)	100%	All	Rural	
	Water pumping	1,3		100%			
	Air conditioning	0 to 8		100%			
	Food refrigeration	22.2 to 27.3		100%			
	Other appliances	15.8 to 19.1		100%			
Subtotal		41.3 to 58.2		100%		84,648 hab.	18.000

Data Niche Nº8

Category	Use	Useful Energy requirement per household (kep/yr)	Technology / Source	% covered with RETs	Zones of application	Target population	Equipment demand
Productive	Crop drying		Solar drying	50 to 100%	Warm, arid and temperate	Rural	
Subtotal				50 to 100%		<2,300,000 hab.	<489,000

Data Niche Nº9

Category	Use	Useful Energy requirement per household (kep/yr)	Technology / Source	% covered with RETs	Zones of application	Target population	Equipment demand
Community services	Lightning		Photovoltaic (1.5 kWp)	100%	Warm, arid (north of Colorado river) and temperate	Rural	
	Water pumping			100%			
	Communications			100%			
	Vaccine refrigeration			100%			
Subtotal				100%			

Data Niche Nº10

Category	Use	Useful Energy requirement per household (kep/yr)	Technology / Source	% covered with RETs	Zones of application	Target population	Equipment demand
Residential	Lightning	4.7 to 5	Biodiesel (400lt/day plant supplies 241 households with 130 to 250 has cultivated)	100%	Warm and temperate	Rural Community	
	Water pumping	10,7		100%			
	Food refrigeration	18 to 19.2		100%			
	Other appliances	4.2 to 5.1		100%			
Subtotal		37.6 to 40		100%		<1,883,645 hab.	<1,663

Notes:

(*) The technically achievable potential is stated between brackets
(**) It refers to the equivalent number of systems specified under the Technology/Source column
All the data corresponds to basic energy requirements
In order to estimate the fraction of the requirements that could be covered with RETs, both the power of the equipment in relation to that of the energy system and the energy produced and demanded were taken into account

APPENDIX 3.8
ASSESSMENT OF OTHER EXPERIENCES

Source/Technology7 Installation cost	Destination/Use/Device/ Cost	Applicable Area	Degree of penetration (1)	Quantification detected
		Hydro		
Large stations	Electricity, irrigation, flood control, recreation, etc.	All sectors linked to the grid	M	Total Installed: 9500 MW
Small stations (USD 1000/3000 /kW)	Electricity, irrigation, flood control, recreation, etc.	Isolated rural and households	B	Projects detected: (5) 150 kW (Jujuy) (7) 150 kW (Neuquén) (9) 240 kW (Misiones) (2) 145 kW (Santa Cruz) 40 MW (Total estimated in the country – SEE)
		Geothermal		
Generation	Electricity	All sectors	+B	Total: 0.6 MW station (Neuquén), out of service
Water/steam gathering	Hot water	 Tourism and health Household use Greenhouses Hatcheries Industry Snow melting	 M B B B B +B	Projects detected in different provinces: (112) 13.6 MW (13) 7.5 MW (4) 1.1 MW (2) 0.4 MW (2) 1.7 MW (1) 1.4 MW
		Sustainable dendroenergy		
Firewood and wastes Firewood (Cost 1500 U$S/kW)	Cooking (efficient cookers), Heating, Steam and Heat Self Electricity Generation	Rural households and agricultural Interconnected or not	B-M B B	Firewood 870000TN 2350 kTEP Charcoal 250000TN 8 MW

Sustainable bioenergy				
Agricultural fuels				
Biodiesel	Electricity generation	Rural households		Research Projects
Gasohol	Fuel	Transport	-	-
Biodiesel (1000 USD/m^3day)	Fuel	Agricultural machinery	+B	>120 m^3/day installed >100 m^3/day under construction
Bagasse	Fuel (co-generation)	Agricultural industry. Interconnected or not	M	>100MW 884 kTEP
Agricultural wastes	Electricity generation (Steam Turbine)	Industry and other sectors Interconnected or not	B	More than 10 MW
Biogas	Fuel, Cooking-Heating	Rural households	B	No data
Biogas	Electricity Generation	Rural households		Research Projects
Others Biogas				
Urban waste	Heat/Steam	Urban households, Health	+B	3 cells (Catamarca, Tucumán, Entre Ríos)
Swamps	Heat	Rural households	+B	No data

References:
(1) Degree of penetration. This index is of a qualitative nature, and gives an idea of the relation existing between the utilization of the resource and known reserves. The index also somehow shows the degree of development of the technology available to make use of it. It is important to note that, as there are no centralized statistics or inventories on this type of projects, it is highly likely that the index may be underestimating the real picture.
A: High, M: Medium, B: Low, +B: Very Low
RETs were sorted according to the categories proposed in (Coviello, 2003)

Main sources of information:
Hydro: www.cammesa.com.ar ; http://cab.cnea.gov.ar/ieds/ ; Erico Barney (UNAM); EJSEDSA; SEE; http://www.orsep.gov.ar/
Geothermal: http://www.segemar.gov.ar/geotermia/neuquen/campos.htm#copahue and http://www.segemar.gov.ar/geotermia/pagina/sintesis.htm
Firewood and charcoal: Anuario Estadístico Forestal; (Bravo,2003)
Biodiesel: (Corradini, 2004)
Alconafta: (IDEE/FB, 1986)
Urban waste biogas cell: http://www.medioambiente.gov.ar/calidad/programas/asentamientos/pnvr/villadominguez/default.htm
Photovoltaic Energy: (Durán, 2004); EJSEDA (Jujuy); equipment suppliers.
Solar Pumping: (Herrera, 1999)
Solar, Thermal Energy: Science and Technology Secretariat and different suppliers.
Wind chargers: (Spinadel, 2004); Sociedad Cooperativa Popular Limitada de Comodoro Rivadavia; different suppliers.
Wind pumping: (Urribarri, 1999); equipment suppliers.
Fuel cells: (Corti, 2004)

Assessment of previous experiences

Experience (E) / Criteria	PERMER- Jujuy (Present)	PV pumping – Catamarca (Present)	Gasohol Plan (1980s)	Geothermal energy Project under implementation
Description 1. Objectives	1. Isolated rural electricity supply	1. Drinking water supply (for human beings and animals)	1. Substitution of 15% of gasoline with anhydrous alcohol from sugar cane	1. Balneology, heating, greenhouses, fish farms, industries, snow melting, and, to a much lesser extent, electricity generation
2. Goals	2. 1720 households and 34 services	2. 460 inhabitants – 138 m^3	2. 450000 m^3 of alcohol	2. Development of 25 new geothermal areas
3. Results obtained	3. Approximately 1400 households with PV equipment	3. Approximately 460 inhabitants, 1900 goats, 1700 cows, and other 600 animals served	3. 250000m^3 of alcohol, significant impact on employment and income generation	3. 134 ventures with an annual installed capacity of 25.7 MWt
4. Population target	4. Rural dwellers. Subsistence economy	4. Rural dwellers. Subsistence economy	4. Population owner of the gasoline-run vehicles	4. Population close to the developments and associated to health tourism
5. Population benefited	5. Rural dwellers. Subsistence economy, without being sized	5. Rural dwellers. Subsistence economy, without being sized	5. Inhabitants of 12 provinces in the nation's hinterland	5. Not sized
6. Weak points	6. Electricity not used for production. Institutional conflict associated to the management of the funds	6. The efficiency levels promised by the manufacturers of the technology could not be achieved	6. Project outside a strategic national plan to substitute fossil fuels. Lack of signals towards the sugar production sector. Fiscal subsidy. These factors led to its disappearance	6. Obtainment of prospecting funds
7. Capacity status assessment of project stakeholders (agents in charge)	7. Moderate. The service company continued operating and maintaining the installations	7. Moderate. Difficulties among the receiving population and the participating organizations	7. High local training and active participation of the different agents	7. Active participation of the different agents involved, especially municipalities that have the resource and private agents that supply exploitation technology
8. Zones	8. Locations scattered within the province of Jujuy	8. Locations scattered within the province of Catamarca	8. Regions: Northeast and Northwest (producer of sugar for the alcohol)	8. Locations scattered throughout the nation
Representativeness 1. Replicability	1. High replicability potential if the main problems are solved	1. High replicability potential if the main problems are solved	1. High replicability at the time of its implementation (12 provinces). Should the Plan be once again part of a government initiative, it may be replicable, although CNG may make it less attractive	1. There is high replicability in the development of this type of projects
2. Potential population benefited	2. 6500 people	2. 481 inhabitants	2. Quite estimated: 600000 owners +200000 employees=800000	2. Approximately 500000 beneficiary inhabitants (direct and indirect)

1. Complexity	1. Cultural, geographical, climate, institutional, bureaucracy	1. Cultural, geographical, climate, institutional, bureaucracy, poverty	1. Project highly dependant on the national energy policy and the fiscal sacrifice capacity (subsidy)	1. High costs (although swift recovery)
Suitability/Viability/ Sustainability				
1. Affordability	1. Low (subsidized by 90%)	1. Low (subsidized by 90%)	1. Low. The existence of State subsidies is necessary	1. As the prospecting investment is made by the State, it is easier for the municipalities/consumers to meet the exploitation costs, especially when tourism represents a source of income
2. Effectiveness	2. Medium. These are not high costs	2. Low, high replacement and maintenance costs	2. Low. The existence of State subsidies is necessary	2. High effectiveness when the exploitation of the resource follows production purposes
3. Risk of obsolescence	3. High	3. High, and depending on the continuity of the relation with the supplier	3. No risk of obsolescence	3. Some of the technologies to make use of geothermal energy may pose this risk, e.g. electricity generation
4. Flexibility	4. Medium, with quite high additional investment	4. Medium, with not quite high additional	4. High, although with strong fiscal subsidies and	4. This technology is flexible as long as the

		investment	investment	resource is available
5. Technological capability	5. Medium. The service company continued operating and maintaining the installations	5. Significant advantage of partial automation. The continuity of the technical follow-up of the equipments must be guaranteed	5. High	5. Due to its simplicity, the exploitation of the resource does not demand high technological training. Corrosion and incrustation processes demand certain technical expertise
6. Suitability and urgency	6. Basic urgencies associated to caloric and/or production uses rather than the lighting use provided by the PV units	6. This technology provides tools to meet basic energy needs	6. This technology is not aimed at meeting basic energy needs	6. The low temperature levels obtained do not allow the direct use of this technology to meet other basic energy needs
7. Resilience	7. The resources allocated to PV units do not affect the resilience of the population on account of the high subsidy level	7. The resources allocated to PV units do not affect the resilience of the population on account of the high subsidy level	7. The resources allocated to this fuel do not affect the resilience of the population on account of the subsidy	7. The income that the production activities associated to the exploitation of this resource may generate increase the resilience capacity of the population
8. Adaptability	8. The PV units partly expand the capacity to adapt to long-term changes	8. Although with certain technical deficiencies, this technology provides high adaptation possibilities	8. These fuels provide relief as to dependence on hydrocarbons	8. This technology allows increasing the degree of adaptability to long-term changes
9. Environmental impacts	9. Positive: Reduction of smoke and fire risks in the household, as well as emission. Negative: accumulation of spent batteries	9. Positive: Reduction in emission corresponding to the displaced diesel pumping units.	9. Positive: Reduction in CO_2 emission, although with negative impacts by the black liquor	9. The substitution of fuels for heat use has positive impacts
10. Social acceptance	10. Only 12% of the population did not accept the service	10. The lack of observance of the PV efficiency technical specifications, added to the technical troubles of the equipments, has brought about adverse opinions or the request of dual equipments.	10. No trouble as to the acceptance of the fuel while the program lasted	10. There is wide acceptance towards the implementation of this type of projects
11. CD requirements	11. Although the service company continued operating and maintaining the installations, it would seem necessary to transfer the technology expertise to all agents involved	11. More significant achievements reached as to project results in those places where efforts were made towards technology transfer. Nevertheless, a permanent follow-up by experts is required to prevent the “fall” of the technology.	11. There is at local level the necessary capacity to implement this technology	11. There is at local level the necessary capacity to implement this technology
12. Income generation	12. The low levels of power supplied do not allow considering substantial changes in the activities carried out	12. It is assumed that the rise in production uses brings the possibility of additional income generation	12. The possibility of obtaining additional income by direct consumers is not expected, as gasohol costs the same as gasoline. However, past experience indicates a rise in production, employment, and indirect income from the production chain	12. The production and services activities implemented in the country have generated significant income, thus guaranteeing the sustainability of the projects, as long as the resource is rationally exploited.

APPENDIX 3.9
OVERALL ASSESSMENT AND IDENTIFICATION OF PROBLEMS

A - General issues

Elements of the problem	Problem definition	Problem manifestation	Causes	Stakeholders involved
General context	1-Macroeconomic crisis-Lack of basic consensus on the country model Convertibility allows internalizing international prices for the energy sector through an unsustainable external debt scheme, as a consequence of the logical devaluation. The internalization of international prices has a high political, economic, and social cost.	The renegotiation of contracts is quite complex. Companies demand "the reliable application of laws". There is a mix of deregulated (oil by-products) and regulated prices. Frozen rates in regulated segments (transport and distribution of electricity and natural gas). Lack of investment. Companies with financial rather than energy strategies.	Failure of the models applied in the 1980s and further correction through structural reforms. Overvaluation during the convertibility period. Wrongly-defined energy reforms and further devaluation.	Pension funds from developed nations. International financial system. Multinational technical operators (Repsol-YPF; Total; Petrobras; British Gas; Sempra Energy; etc,)- Ministry of Economy-Ministry of Federal Planning, Public Investment and Services (Energy Secretariat, Regulating Bodies)
	2-Lack of State control over strategic energy resources and lack of comprehensive planning for the energy sector. In light of the lack of basic consensus, the political power is weakened and disjointed. When private agents rule over decisions, results are random in terms of necessary political objectives.	Lack of an infrastructure expansion plan. Lack of actual capacity and supply restrictions due to price signals. Trouble to access energy, or else lack of payment capacity on the part of the poor sectors.	Reduced staff. Lack of training; clash of interests with the private sector; lack of clear guidelines and political will.	Ditto above.
	3-Interest on the fossil fuels sector. The high rent of the sector guides the resources towards an intensive natural gas use policy, both for final and intermediate consumption. Export orientation when the domestic market shrinks.	Energy crisis, non-renewal-resource depletion due to lack of prospecting, and possibility to invest in nations with better geological prospects. High rates for the poor sectors.	High rent within the hydrocarbon sector as a result of the legislation in force and the low access costs during the privatizations.	Ditto above.
	4-High fossil fuel dependence. Resource availability-Inherited policies-Inertia of the demand and supply structure-based on large-scale centralized generation with conventional energies. Relative prices.	The substitution policy has been aimed at the use of natural gas in nearly all sectors on account of its alleged abundance and the past and present price policy.	Lack of access to natural gas through a system in poor neighbourhoods; LPG at international prices inaccessible to the poor sectors; high degree of non-payment as to electricity bills; increase of irregular consumers.	Pension funds from developed nations. International financial system. Multinational technical operators (Repsol-YPF; Total; Petrobras; British Gas; Sempra Energy; etc,)- Ministry of Economy-Ministry of Federal Planning, Public Investment and Services (Energy Secretariat, Regulating Bodies)
	5-Insufficient public resources. Structural macroeconomic crisis going back to over three decades.	The public expenditure reduction policies imposed by the credit organizations restrict expenditure freedom. These affects in particular the renewable energy sector since it is seen as lacking priority when contrasted to other issues	Constant tug-of-war on scarce public funds. Insufficient public investment. Highly-restricted subsidy policies, unless expressly authorized by the multilateral credit organizations.	Ministry of Economy. IMF-WB-IDB.

	6 -High influence of energy on imports. Effects of the devaluation.	During the convertibility period, the nation relied on a high external financing scheme. The overvaluation of the currency encouraged imports and discouraged the local industry. This undermined the possibilities of local renewable energies manufacturers. Few of them survived this period taking advantage of some niches and face better prospects after the devaluation of the currency.	Difficulty to import, rising investment costs. There is still insufficient reaction by local producers to replace imported equipments.	Ministry of Economy.
	7-Local government. Overlapping of jurisdictions and scattering of legal frameworks.	Conflict of powers - Internal divisions within the political structure. Contributes to the risk, uncertainty and excessive bureaucracy	Blocked projects-Misinformation.	Municipal governments, provincial governments, national government, NGOs.
	8-Lack of definition as to the legal framework for the promotion of renewable energies. Lack of conceptual clarity within the State working teams.	Lack of adequate policies and technical working teams in the public sector. Lack of long term stability	Ineffective promotion systems - Bureaucracies - Poor policy definition.	Energy Secretariat-RETs Programme. WB-IDB.
	9-Short-term approach to energy system development. Crises and country model changes.	Resistance to the proposal of long-term views.	Isolated actions not properly framed within a consistent non-energy production view.	Ministry of Economy-Ministry of Federal Planning, Public Investment and Services, Energy Secretariat.

B – Specific issues

Elements of the problem	**Problem definition**	**Problem manifestation**	**Causes**	**Stakeholders involved**
Dimension				
I-Policy/Institutional	I.1-Lack of a strong public institutional entity that coordinates activities, formulates policies and objectives.	Isolated RE projects. Superposition and duplication of efforts. Inefficient use of scarce resources.		Ministry of Energy
	I.2-Lack of incentives to promote the development of renewable energies projects. Lack of a comprehensive policy as proper framework for the role of renewable sources within the context of the nation's social and energy needs.	Lack of access to modern energy sources in isolated rural areas at reasonable costs and for production development. In urban areas, lack of an adequate price policy to make sustainable the energy consumption of the poor sectors, especially as to LPG, electricity, and natural gas.	Policies mainly aimed at conventional sources and large projects.	Private agents. World Bank-IDB-Ministry of Economy-Ministry of Federal Planning, Public Investment and Services (Energy Secretariat, Regulating Bodies)
	I.3- Existing regulations do not favour the development of renewable energies	Difficulties for the development of RE projects.	The implemented reforms have not taken into account the potentialities of RE, focusing on hydro and fossil resources.	Ministry of Economy; Ministry of Federal Planning, Public Investment and Services (ES; ENRE; ENARGAS), political parties, legislators.

	I.4-Lack of incentives, stability of rules, and coherent promotion at national level in the field of R&D, demonstration, technological transfer, and local manufacture of renewable technologies. Lack of comprehensive planning and long-term view of links between the energy and the production sectors.	Lack of connection between the S&T- R&D body and industry.	Scarce development of the equipment industry.	Private producers. Energy Secretariat.
II-Economy	II.1-High investment cost and risk. Market size; high relative cost of the investment; lack of subsidy policies; lack of sufficient payment capacity on the part of consumers.	The cost of the RETs is high and non-competitive with respect to the traditional options. The payment capacity for potential market segments is insufficient, and there are no consistent subsidy policies.	Low RETS penetration. Insufficient coverage of the basic needs of the poor sectors.	Science, Technology, and Production Innovation Under-secretariat. Private and public banks. World Bank. Inter-American Development Bank. Other organizations related to the promotion of RETs.
	II.2-High cost of credit.. Inefficient banking system. High country risk. Loss of financial autonomy due to the foreign debt and trans-nationalization of the local financial system. Bureaucracy in promotional credits from multilateral organizations.	Difficulty to access credits at reasonable rates. Bureaucratic problems with respect to promotional credits. Credit is even more difficult for renewable energies projects due to: high risk and uncertainty aggravated by bad past experiences and inadequacy of insurance to cover losses; small scale of individual projects; very small payment capacity by poor and indigent population.	Small and medium-sized ventures lack access to bank credit. Access difficulty to innovators due to an excess of requirements as to collateral, prior experience, etc.	Science, Technology, and Production Innovation Under-secretariat. Private and public banks. World Bank. Inter-American Development Bank. Other organizations related to the promotion of RETs.
III-Social	III.1-Lack of knowledge from the rural population on renewable energy alternatives. Lack of sufficient promotion. Deeply-rooted cultural problem.	Lack of non-conventional-source-use habit, as these sources are seen as costly and with maintenance trouble.	Maintenance and use continuity trouble. Restricted access.	Energy Secretariat-RETS Program.
	III.2-Inadequate meeting of basic energy requirements in rural areas. The power supplied through the existing programs allows limited uses.	Lack of an adequate definition of the type of equipment, training programs, and maintenance to meet basic and production requirements.	Lack of adequate energy for production tasks and the obtainment of products that could be commercialized. Insufficient power for modern uses at the proper scale.	Ditto above..
	III.3- Exclusion of the modernization processes of poor and indigent population. Conflict politization. Lack of adequate perception of poor and indigent needs and the role of renewables	Lack of social and cultural integration. Extreme needs only mitigated by limited social assistance policy without incurring in deep changes in the main areas (e.g. employment)	Unsatisfied demand, blocked projects, cultural consensus on modern production processes and lifestyles.	Groups representing aborigines-NGOs-Church
IV-Energy	IV.1-Lack of an adequate O&M infrastructure. Scarce local development of the equipment-production industry.	Lack of an adequate production scale that allows maintaining a sufficient and territorially-extended O&M infrastructure.	Scarce acceptance of RETs, mistrust as to their usefulness.	Private producers. Energy Secretariat.
	IV.2-Lack of application of quality standards in the manufacture of equipments. Lack of a large-scale industry and of a framework for renewable energies within an integrated energy & industrial policy context.	Failure in the application of regulations that guarantee the quality of renewable energy equipments in accordance with defined standards. Sometimes standards are still lacking	Quality diversity, lack of product and quality continuity, maintenance failure.	Private producers. Energy Secretariat.
V-Environmental	V.1-Some projects may have adverse effects on the ecosystems. Lack of an energy policy integrated to social and environmental aspects.	Lack of a consistent and well-defined environmental policy.	Use of polluting technologies; ignorance of the actual scope of the RETs.	Ministry of the Environment; Energy Secretariat; NGOs