Urban and Peri-Urban Energy Access in Brazil II

FINAL VERSION

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Executive Summary

In spite of fuel wise issue this discussion will present national situation on energy access along with background, limitations recommendations and policy responses including the good and bad practices that may have been employed. Finally there will be some discussion of further areas for research and way forward.

The inexistence of disaggregated data per energy source or income level makes it impossible to establish a more precise picture of energy consumption patterns in the country, not only related to urban and peri-urban areas. In this way most of energy data is not specific for peri-urban population.

Peri urbans' types of fuel covers a very wide range of sources. Currently the types of fuel available and used by peri-urbans in Brazil can be categorized as: Natural gas, LPG, kerosene, fuelwood/solid residues, charcoal, electricity and diesel oil.

In 2006, about 41.1% of the primary energy supply was from renewable energy sources from which 14.8% came from hydroelectricity. The hydroelectricity has large participation in the Brazilian electric matrix: 74.1% (MME, 2007) and an annual growth rate of 5.7 % of the primary energy supply.

Given that, natural gas is not a source of energy that regularly reaches the peri-urban population: it only represents 8% of energy consumption in Brazilian residential sector. Being fuelwood and solid residues a larger portion with 37.8% of total residential sector energy consumption, charcoal represents only 2.4%. Kerosene has a marginal use typically, about 0.1% of energy consumption in residential sector (MME, 2007).

Concerning LPG, the Government intervention started on fifties via price control and cross-subsides, deregulation occurred from nineties until year 2002 when subsides were removed and an income transfer system was implemented via the decree 4102 (Costa *et al*, 2006).

Regarding to diesel, the energy consumption devoted to peri-urban consumers is concentrated in Amazon Region where most of electricity is generated by power plants running on diesel, it also can be found in isolated villages and farms far from the grid.

This report shows the variety of policies outlines and instruments promoting the use of those fuels. For instance, the Light for Everyone Program ("Luz Para Todos") and the Law 10 438/02 in Brazil are policies to achieve higher electrification levels. Further policies discussion and conclusion are presented in the topic "conclusion" in this document.

Table of Contents

List of Acronyms and Abbreviations

ANEEL – Agência Nacional de Energia Elétrica (Federal Electricity Regulatory Agency)

BNDES – Banco Nacional de Desenvolvimento Econômico e Social (National Social and Economic Development Bank)

CCC – Conta de Consumo de Combustíveis (Fuel Consumption Account)

CENBIO – National Centre of Biomass

CDE– Conta de Desenvolvimento Energético (Energy Development Account)

DIEESE – Departamento Intersindical de Estatística e Estudos Sócio Econômicos (Inter-Union Department of Statistics and Socioeconomic Studies)

Eletrobrás – Centrais Elétricas Brasileiras S.A. (Brazilian Electricity Generation Company)

MAE – Mercado Atacadista de Energia (Wholesale Energy Market)

IBGE – Instituto Brasileiro de Geografia e Estatística (Brazilian Geography and Statistics Institute)

IPCC – Intergovernmental Panel on Climate Change

LPG – Liquefied Petroleum Gas

MME – Ministério de Minas e Energia (Ministry of Mines and Energy)

NIPE – Núcleo Interdisciplinar de Planejamento Energético (The Interdisciplinary Center for Energy Resources Planning)

PRODEEM – Programa de Desenvolvimento Energético de Estados e Municípios (State and Municipal Energy Development Programme)

PNAD – Pesquisa Nacional por Amostra de Domicílio (National Household Sample Survey)

RET – Renewable Energy Technology

RGR – Reserva Global de Reversão (Global Reverse Fund)

UNDP – United Nations Development Programme

List of Tables

List of Figures

1 Introduction

In 1940 Brazilian rural areas had up to 69% of population density. At that time, total country population was only 41 million and the overall domestic energy supply was 24.3 M toe (million tonnes of oil equivalent) / year. From 1940 to 1990 there were an inversion on the urban/rural populate ratio, lead by accelerated economic growth was aware of 7 % per year, which was the result of import substitution drive where the industrialization had risen average GDP / capita to 2,536US$ 2003 / year in 1990). Industry had reached about 30 % of GDP, with services amounting to 60 % and agriculture barely 10 %.

Brazil does not have data specifically for the poor populations concentrated in the peri-urban area. This difficulty stresses the need to carry out studies that include field research, which means direct contact with the target population. The slum formation process undergone in large Brazilian cities has encouraged social exclusion. The concept of exclusion involves issues that are hard to quantify and are more complex than poverty or inequality. Exclusion is more comprehensive than living on the fringe, and does not necessarily coincide with poverty (SPOSATI, 1997).

Generally, it may be said that the regions inhabited by deprived populations in urban and peri-urban areas of Brazil have not been the main target of public policies (urban planning, for example). Housing, in these regions, has been basically a population's initiative, in low property value areas. Therefore, the lack of infrastructure and access to essential public services are the main factors that define the concept of energy exclusion in urban and peri-urban areas in Brazil.

Due to the country modernization occurred in the period of time between the end of Second World War until the eighties (that included industrialization and urbanization, as well as, the building of a highway infrastructure) Brazil have completely changed its energy demand and supply profiles. In 1940, firewood and charcoal supplied over 83 % of Brazil's energy needs, compared to 6 % oil, 6 % coal and only 1.5 % hydropower. In 1990, the two large centralized state-owned energy systems for oil and hydropower dominated about 60% of the energy supply, while the share of firewood was reduced to 12 % (see Table 1).

Table 1: Domestic Energy Supply in Brazil – 1940/1970/1980/1990/2000 and 2003

Source/Year	1940		1970		1990		2000		2003	
	Mtoe	%	Mtoe	%	Mtoe	%	Mtoe	%	Mtoe	%
Oil, NG and derivatives	1.522	6.4	25.420	38	62.085	43.7	96.999	50.9	10.0523	47.9
Coal and derivatives	1.520	6.4	2.437	3.6	9.615	5.1	13.571	7.1	13.145	6.5
Hydro and Electricity	0.352	1.5	3.420	5.1	20.051	14.1	29.980	15.7	29.494	14.6
Firewood and Charcoal	19.795	83.3	31.852	47.6	28.537	20.1	23.060	12.1	25.997	12.9
Sugar cane products	0.563	2.4	3.593	5.4	18.988	13.4	20.761	10.9	27.085	13.4
Other*	0	0.0	0.223	0.3	2.724	1.9	6.245	3.3	9.370	4.6
Total	23.752	100	66.945	100	142.000	100	190.615	100	201.704	100

Notes: *Include other renewable sources and uranium.
The Brazilian Energy Balance adopts a factor of 0.086 toe/MWh to convert hydro electricity.
Source: MME, 2004.

1.1 Background and rationale of the study

The previous study, prepared for GNESD Peri-urban Access I Working group has discussed the lack of energy access in Brazil.

That report pointed out that the difficulties related to data and terminology to define peri-urban population. By the report time, there was a lack of information. Particularly the absence of disaggregated data per energy source or income level turned impracticable to establish a more precise picture of energy consumption patterns in the country (not only concerning to urban and peri-urban areas).

In Brazil there is hardly any data and information available to distinguish urban and peri-urban areas. The concept of a peri-urban area[1] is defined more by its social aspects than by geographical boundaries leading to a mismatching. This concept, proposed by ZARÁTE (*apud* VALE, 1984), defines the peri-urban area as a physical area that is odd from the rest of the city and can also has a rural use. For this author, the peri-urban space is occupied by suburbs with houses and populations close to the city that usually belong to the same municipality as the main city. It is characterized by the proliferation of one-family properties and other urban uses (urban services that require extensive areas).

The peri-urban area is also considered a unique social area, due to the means of urban life; high mobility of its population; social variety, with predominance of different social strata. It also refers to the distinct residential areas; social behavior permeated by more intense social relations; and a greater contemplative value of nature, without however, integrating with the countryside. This area is also marked by its contrast to the city, given its tranquility and the greater contact to the environment (ZARÁTE *apud* VALE,

[1] It is also known as the urban fringe or shadow (ZARÁTE *apud* VALE, 1984).

1984).

According to (KAGEYAMA, 1998), peri-urbanization is a new conception of the workforce and it means reproduction, production and distribution activities. This area does not have boundaries specified by law as it does the concept of urban area. Thus, under the concepts of urban areas and rural areas used by the Brazilian Geographical and Statistics Institute (IBGE), are also found regions defined as peri-urban. So, in order to enhance the understanding and for the sake of consistency, IBGE terminology will be used, limited to the concepts of urban and rural areas and metropolitan regions.

Table 2 below shows that most of the Brazilian population (83.01%) lives in urban areas. The North and Northeast Regions have the highest number of people living in rural areas. In 2004, 26.48% of the population of the North Region lived in the countryside. For the Northeast Region, this figure was 28.5%.

Table 2: Distribution of Resident Population - Brazil, 2001-2004 (%)

Brazil and Geographical Region	Household Location	Year			
		2001	2002	2003	2004
Brazil	Urban	83.9	84.17	84.35	83.01
	Rural	16.1	15.83	15.65	16.99
North	Urban	100	100	100	73.52
	Rural*	n/a	n/a	n/a	26.48
Northeast	Urban	70.48	70.58	70.87	71.5
	Rural	29.52	29.42	29.13	28.5
Southeast	Urban	91.46	91.79	91.88	92.06
	Rural	8.54	8.21	8.12	7.94
South	Urban	81.44	81.45	82.16	82.05
	Rural	18.56	18.55	17.84	17.95
Mid-West	Urban	86.7	87.34	86.15	86.28
	Rural	13.3	12.66	13.85	13.72

*n/a = not available. IBGE did not carry out PNAD (National Household Sample Survey) in the rural area of the North from 1992 to 2003. Source: PNAD, 2004.

Brazil's population growth was relatively high during the 20th Century. Nevertheless it began to slow down in the 1980s. Until recently, the population was predominantly rural and agricultural. The latter half of the 20th Century brought rapid urbanization due to population growth and the migration of people from rural areas seeking employment in the expanding industries located in the cities.

Spatial distribution of the poor population is still occurring through a significant movement of population to the periphery of large and medium-sized cities. One of the reasons for this process is the hard access to urban land for low income families. This resulted in a proliferation of informal human settlements (slums, shanty-towns, illegal land parceling), in the peri-urban areas of metropolitan regions. Often, problems are related to the duo use of land and to poverty. The alternative of land parceling became low income population housing way. It is mostly found in areas where legislation forbids occupation (environment permanent protection areas, such as spring water areas) and building.

Table 3 displays the average monthly income of the regions of Brazil. There is a large difference between family income in the North Region (US$232.10), which has the highest rate of people living in households without electricity (81.55%), and that of the Southeast Region (US$345.9), which has one of the highest rates of people in households with electricity (98.77%).

The lowest electricity access occurs in rural zones. These are the ones with the lowest monthly incomes, as well. Normally, the household average monthly income of urban areas is greater than the rural ones.

Table 3, below, shows the average monthly income of Brazilian households in urban areas to be US$321.70. In the rural area, this income drops to US$152.90.

Table 3: Average Monthly Household Income, Brazil, 2001-2004 (US$)

Brazil and Geographical Region	Household Location	Household Monthly Income			
		2001	2002	2003	2004
Brazil	Total	232.6	254.2	274.5	295.5
	Urban	255.1	278.0	297.7	321.7
	Rural	103.9	113.6	136.5	152.9
North	Total	198.0	215.9	223.3	232.1
	Urban	198.0		0.0	252.7
	Rural	0.0	0.0	0.0	170.5
Northeast	Total	139.3	155.8	165.7	185.8
	Urban	164.7	184.3	193.6	216.7
	Rural	72.2	79.0	90.2	100.0
Southeast	Total	281.3	304.4	326.7	345.9
	Urban	294.4	318.2	339.6	359.1
	Rural	129.6	135.9	165.5	183.9
South	Total	252.2	271.3	311.3	341.8
	Urban	275.2	293.8	331.0	365.6
	Rural	145.4	164.7	214.0	223.9
Mid-West	Total	247.5	282.7	294.2	330.6
	Urban	266.7	304.0	316.7	354.1
	Rural	122.7	142.1	153.6	183.0

*n/a = not available. IBGE did not carry out PNAD (National Household Sample Survey) in the rural area of the North from 1992 to 2003. Source: PNAD, 2004.

In April 2002 Brazilian Congress passed Law 10438, with provisions for the reduction of tariffs to low-income consumers, the establishment of targets for concessionaires and 'permissionaires' to provide full energy coverage, and the creation of a national fund CDE (Energy Development Account) to promote universal access to electricity and the use of innovative sources of energy. ANEEL (Federal Electricity Regulatory Agency) is expected to pass regulations implementing that Law, whereby concessionaires must provide full coverage under a target timetable plan.

Present situation of energy services to the poor in Brazil

Brazil is a country of huge inequalities, shown by the concentration of income. Table 4 data confirms that in recent years there was no substantial drop in income concentration in Brazil. Despite an increased share of total income by the poorest. The poor people income grew from 12.7%, in 1999, to 13.85%, in 2004, however the number of poor people also increased from 56.18 million to 59.43 million in the same period (IPEA, 2006).

Table 4: Evolution of GDP per capita and Poverty - Brazil, 1999-2004

	1999	**2000**	**2001**	**2002**	**2003**	**2004**
Household income - share of the 50% poorest	12.69 %	-	12.58 %	12.98%	13.36%	13.85%
GDP per capita (R$, 2005)	9,873	10,152	10,134	10,179	10,087	10,433
Number of people in households with per capita income below the poverty line (million)	56.18	-	58.34	57.48	-	59.43

Source: IPEADATA, 2006.

Although income distribution indicators show favorable results over the last five years, in the urban area income concentration still drives poverty and influences the organization of the social space. The process of slum formation, experienced by most large Brazilian cities, has been increasing substantially over the past few years.

Most of the growth of large urban agglomerations is happening without any kind of planning. According to Rocha (1997), the slum formation phenomenon is clearly an urban process that is most evident in metropolitan regions. In 1991, there was a concentration of about 43 million people or 38% of the Brazilian urban population. Hence, in that year 70% of the slum households in Brazil were in this urban category. In terms of population, this means approximately 5 million people living in slums or about 12% of the metropolitan population.

The 2000 Census, carried out by IBGE, registered 1,650,548 households in 3,905 sub-normal groupings (slums, shanty-towns or slum-tenements) throughout the country, representing 6,550,634 of people. The Southeast Region concentrates more than 60% of its houses in slums, that is, 1,038,068 houses. The Census also registers that the number of slums in Brazil enhanced fivefold from 1991 to 2002, going from 717 to 3,905.

The scenario of poverty and social exclusion becomes intertwined with intra-urban

growth dynamics in Brazil.

This context reveals that urban planning approaches that are detached from the socio-economic framework, excessively static and restrictive to be able to follow urban dynamics are insufficient to meet essential urban demands. Currently the sources of energy in Brazil relay strongly in hydropower (electricity), biomass and oil.

Fuelwood

Together with growing rates of urbanization, industrialization and concentration of economic activities over Brazil, one can observe an increase in urban poverty, both in relative and absolute terms, as well as the proliferation of slums "*favelas*" and illegal settlements, either in central cities or in the outskirts of the metropolitan areas.

Increased urban poverty, crime, social discrimination and spatial segregation within the cities adversely affect the environmental quality and living conditions of the urban population, especially the poor, increase the need for adequate shelter and urban infrastructure services and call for more efficient and better-targeted urban development and social policies. Homes for the poor are shacks of cardboard and corrugated iron, furnished with the barest essentials and mostly without water, light or sanitation.

The practice of cooking using solid fuel derived from biomass in traditional cook stoves is the most important issue in health-energy access field in Brazil. Poor urban and peri-urban continue to depend on solid fuel derived from biomass like; wood fuel, charcoal and many types of waste materials, such as construction debris, (Jannuzzi *apud* Lucon, Coelho, Goldemberg, 2004).

Charcoal

Residential cooking and hot water in rural areas of Brazil are supplied primarily by direct combustion of biomass-in the form of wood, crop wastes and charcoal. In recent decades, the decline in forest resources in many countries directed attention to more efficient household use of biomass, as well as solar cookers. Regarding to domestic use by peri-urban population it has bad practices issues like indoor pollution deforestation and risk of unsustainable exploration.

LPG – Liquefied Petroleum Gas

Among usual ways of energy consumption for cooking, poor urban or peri-urban population in Brazil rely upon bottled LPG and solid fuel firewood. The 13kg bottle is available in several specialized stores or distributed by trucks. LPG delivery infrastructure is highly developed in all regions, including rural zones.

Natural gas

Natural gas is an expanding marketing with low availability. So far, it is concentrated on the Centre South part of the country. It is used as vehicle fuel, source for thermo electricity generation, industries and urban domestic use. The domestic use is characterized by pipeline distribution in some distribution areas. Due to the installation costs and the low income of peri-urban population (table 3) this type of fuel is unbearable. Hence, peri-urban population normally do not use natural as fuel.

Electricity

The majority of Brazilian population lives in urban areas where the higher rates of electricity coverage are found for the residential sector, representing 31.6% of energy consumption. Urban areas have electricity access nearly to 100%. In the rural areas the access is distinct, being the availability in the rural areas in general medium, except for the South region where the access level is high.

Due to the low affordability, peri-urban and urban population's electricity consumption have many times irregularities such as unauthorized consumption (informal access to the utility), which is unmetered and can lead to losses due not rational use of electricity ,as well as, lack of security, risk of firing. This situation is a result of the lack of infrastructure and urban planning.

Kerosene and diesel

For low income population these fuels use is restricted to isolated areas like in Amazon Region to produce electricity (via diesel motors receiving CCC help to afford the fuel costs) and kerosene is used for lightning.

1.2 Objective of the Research

The main objective of this study under the theme "Energy Access" will be to carry out an assessment of fuel use diversity in peri-urban population in Brazil, identifying existing barriers and current policies aiming the enhancement of clean fuel use in such areas, as well.

These policies can assist to provide cleaner and more sustainable energy services to the rapidly growing urban and peri-urban population in and around the mega-cities in the world with a fast reforming on energy sector. This includes assessing previous energy policies and instruments. It will confront the addressed policies to the results achieved. To find out if they actually contributed to minimize growing problem of improper energy services in urban and peri-urban areas.

Building on this assessment focus will be on ongoing and planned energy policy reforms and address the questions of what steps have been taken to reach a cleaner and more sustainable energy services for the poor in these areas.

Furthermore it discusses how the processes can be improved to promote better access to cleaner energy services and for poverty alleviation compromising with environmental sustainability and energy efficiency issues.

1.3 Limitations of the study

For the fuel sources cited in item 1.2 above, the real potential of each of them might be limited by hurdles. One of those is the fact that there is a lack of information about peri-urban areas (Brazilian National Statistics distinguish population only as urban and rural ones). It also can be cited the lack of information on productive uses (domestic business) of energy in the residential sector, for peri-urban areas.

Therefore it is prudent to consider lack of information as a strong limitation.

1.4 Organization of the report

The report is organized as following:

Chapter One gives an overview of the theme: this topic presents Brazilian population changes from rural to urban and the energy demand's change that followed it, explaining the changing process. This first chapter also presents the current situation of energy services to the poor in Brazil, based on census data. The objective of the research is to investigate fuel use diversity in peri-urban, as well as, laws and barriers related to them. Limitations of the study discuss the barries to evelop this study.

The Second Chapter updates national situation on energy access along with policy responses. The type of fuels, one by one, are described taking into account related policies. The types of fuel are: natural gas, fuelwood and solid residues, liquefied petroleum gas, kerosene, electricity, charcoal and diesel.

In the Third Chapter the methodology applied is described.

Chapter Four describes the Scoping phase of the study its findings, and the transition from scoping to thematic phase.

The Fifth Chapter can be defined as an resume of Thematic Phase Findings.

Chapter 6 presents conclusion and study recommendations, including the recommended policies' changing.

The last chapter discusses further areas for research and the way forward.

2. Update of the national situation on energy access along with policy responses

Peri urbans' types of fuel covers a very wide range of sources. Currently the types of fuel available and used by peri-urbans in Brazil can be categorized as: natural gas, LPG, kerosene, fuelwood/solid residues, charcoal, electricity and diesel oil. Further explanation of the situation for each of them will be described in the coming topics below.

2.1 Natural Gas

It can be cited as currently domestic use of the natural gas as fuel cooking and heating practices. However, the availability is restricted to big cities like São Paulo and Rio de Janeiro where the pipelines for natural gas distribution have already been installed in new residential flats.

In this way, a strong barrier to the enhancement of natural gas participation in the energy matrix is the price, which is highly dependent on international market. Once it is imported from Bolivia[2] (Leite, 2007) that leads Brazil into the energy security field, unless the recently natural gas reserves discover announced by Petrobras (419 billion m^3 in Santos basin 2003) starts its production in order to cover the growing demand (Costa et al, 2006). Other barrier is the lack of pipeline distribution for the final consumers.

On the other hand, natural gas represents a good practice replacing electricity for heating purposes using efficient appliances (good option especially in peak hours).

As policy recommendations aiming at natural gas use incensement it can be cited the enlargement of the distribution network.

2.2 Fuelwood, solid residues and charcoal

Fuelwood and solid residues represent 37.8% of energy consumption in the overall residential sector. In Brazil it is used mostly by low income peri-urban, rural and isolated areas populations for cooking and heating purposes. Even though their high availability, these fuels exploration by low income population is unsustainable.

According to MME, in 2006, wood fuel percentage in the residential sector accounted for about 37.8% of its production. Wood fuel and charcoal represent 13.2% of Brazilian Energy Matrix this result is 0.3 % above 2003 result.

Wood fuel and charcoal represent 13.2% of Brazilian Energy Matrix this result is 0.3 % above 2003 result.

Brazil produces large amounts of charcoal that was initially from forests residues, but nowadays most of it comes from reforestation. It represents 2.4% of energy

[2] The pipeline built to transport natural gas from Bolívia to Bazil is 3150 km long. In May, 2006, the Bolivian President Ivo Morales, nationalized the oil and gas reserves via decree, through with Petrobras and others oil companies were affected.

consumption in residential sector.

Used mainly for cook purposes in peri-urban area, most commonly in North and Northeast regions. About 25.4 million m^3 of charcoal were used in steel, metallurgy and cement production in 2001 (Rosillo and Moreira, 2006).

Although forest resources are important for national energy matrix, there is not a coordinated system that regulates and up date the information.

Even though effort made by some institutions, the information related to the production and use of the forest resources for domestic, agricultural or industrial sectors remains not precise. It is partly explained by taking in account the high level of scattered forest products' users, low level of official trade, specially the wood fuel required for energy supply such as charcoal production.

The Brazilian Reference Centre on Biomass (CENBIO) is preparing a new methodology, which will point out inter alia the personal consumption for wood fuel in domestic sector (EPE, project)

Concerning to health, air pollutant emissions from those types of fuel cause indoor pollution that can affect human health specially children and women.

Biomass combustion releases high levels of known indoor air pollution, which can be increased if the fuel burned, come from waste materials. Carbon monoxide is just one part of this pollution. It also presents small particles and volatile organic compounds (VOCs), when the fuel that is burned come from waste materials. These materials composition may have been affected by: paints, wood stains, sealants, adhesives, and sealers. In this way indoors pollution from cooking in urban Brazilian areas can represent even more health risks.

According to WHO (2006), "This killer in the kitchen can double a child's risk of contracting pneumonia and is responsible for nearly half of the more than two million annual deaths from acute respiratory infections in children aged under five years". The statistics from Brazilian Health Ministry for acute respiratory death of children under five years old per year is displayed on table 5. However it displays only a general data. As it was said before wood fuel data still presents shortcomings that need to overcome.

Table 5: Respiratory acute death children under 5 years.

Year	North Region	Northeast Region	Southeast Region	South Region	Middle west Region	Total
1990	821	2.662	5.983	1.747	526	11.739
1991	561	2.181	4.473	1.357	450	9.022
1992	674	2.354	4.814	1.374	485	9.701
1993	705	2.545	4.936	1.447	549	10.182
1994	634	2.788	4.566	1.347	541	9.876
1995	647	2.486	4.134	1.241	486	8.994
1996	520	1.733	3.311	1.028	420	7.012
1997	435	1.475	2.670	748	401	5.729
1998	474	1.789	2.524	838	341	5.966

1999	575	1.620	2.114	599	313	5.221
2000	557	1.523	1.823	531	285	4.719
2001	530	1.411	1.523	416	214	4.094
2002	509	1.281	1.342	349	244	3.725
2003	569	1.340	1.340	391	238	3.878

Source: Health Ministry /SVS and MME (2005)

Table 6: Standardized mortality rates by selected cause of death (all ages), 2004 per 100,000 inhabitants.

Brazil										
Causes per group	**bellow 01**	**01 to 04**	**05 to 09**	**10 to 14**	**15 to 19**	**20 to 49**	**50 to 64**	**65 and over**	**60 and over**	**Total**
I. Some infectious and parasite diseases	7,5	17,0	8,9	6,1	2,5	8,6	4,9	3,4	3,5	5,1
II. Malignant neoplasm	0,3	8,2	14,7	12,4	5,1	12,0	23,3	16,7	17,6	15,7
IX. Diseases of the circulatory system	0,9	2,9	4,0	5,7	3,9	16,2	36,1	42,6	42,1	31,8
X. Diseases of the respiratory system	6,7	20,3	8,8	6,7	3,2	5,1	8,2	16,1	15,3	11,4
XVI. Some diseases from pre-natal period	61,2	0,6	0,2	0,1	0,1	0,0	0,0	0,0	0,0	3,5
XX. External causes	2,2	22,6	40,4	49,7	75,5	41,3	8,1	3,0	3,3	14,2
Other causes	21,2	28,4	23,0	19,2	9,8	16,7	19,3	18,4	18,4	18,3
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: SIM/SINASC

Policy recommendations

To establish monitoring and surveillance systems in order to collect information along the whole production chain of forestry origin biomass that can be transformed in charcoal or fuelwood. As the illegal charcoal producer plants are not officially registered, the conduction of a field survey to create a database is needed to support the monitoring system.

Charcoal producer plants are usually small units spread all over the country and its known that Minas Gerais state is one of the places where this practice is very common. Most of the native forest in this state has already been vanished. According to information from Minas Gerais Government it can be concluded, via the overall state charcoal balance, that illegal production is a reality.

Strengthen the institutional framework, which forbids illegal fuelwood and charcoal production, is necessary.

2.3 LPG – Liquefied Petroleum Gas

In 2004, 98.48% of urban population owned cook stoves and 7.61% of rural one did not

owned any stove (PNAD, 2004). Even though this high rate for poor population urban or rural LPG cook stove is not the only means of cooking. They keep wood fueled stove as a back up in case they can not afford LPG (Lucon, Coelho, Goldemberg 2004). So that the biggest energy access problem faced by poor urban is related to biomass burning most of the time for cooking activities. Table 7 shows the domestic energy consumption evolution by source of energy.

Table 7: Residential sector's energy consumption distribution (%).

Source	**2000**	**2001**	**2002**	**2003**	**2004**
natural gas	0	1	1	1	1
firewood	32	34	37	38	38
LPG	31	31	30	27	27
kerosene	0	0	0	0	0
gasworks gas	0	0	0	0	0
electricity	35	31	30	31	32
charcoal	2	2	2	2	2
total	**100**	**100**	**100**	**100**	**100**

Source: MME, (2005)

According to Costa (2006), the Brazilian Government have intervened on LPG for domestic use prices based on price controls and cross-subsidies through an additional tax on other fuels such as gasoline.

LPG performance have been rising from fifties until 2002 when the subsidy "Gas Allowance" was removed from this point its consumption decreased at same period wood fuel consumption started to rise (Figure 1). The other way around, was the performance of traditional wood fuel use in the same period. The residential use of traditional biomass has declined significantly over the last decades because it was substituted by more efficient fuels and end-use technologies.

This inversion happened because the residential use of firewood for cooking in traditional wood stoves has dwindled over the years. With the growing urbanization (currently less than 20 per cent of the Brazilian population lives in rural areas), to the rise of population's income, to the large level of deforestation in some regions of the country and mainly the availability of liquefied petroleum gas. Turned out that, residential consumption of firewood has declined from 53.5 percent of total biomass consumption in 1970 to just 13.8 per cent in 2002. In Industrial sector the use of firewood is stable due to the sustainable use of wood.

Policy recommendations

To expand the already existing distribution network to remote areas where the transportation can increase the final price of LPG. In this way, even consumers with higher power purchase may choose forest products as fuel.

Reintroduce the previous subsidies: despite the fact that subsidies nowadays are included in "Bolsa Família", the previous policy appears to be more adequate to stimulate LPG consumption since it reached all LPG consumers

Both policies could induce reduction of fuelwood and charcoal.

2.4 Kerosene

Even though this fuel has high affordability, it represents 0.1% of the total energy consumption in residential sector (MME, 2007), which is limited to marginal use, concentrated in isolated villages for lighting purposes.

Reasons for not using

Since households' access to electricity services in the country is high there is no reason to stimulate the use of kerosene.

2.5 Electricity

In 1950, Brazil's electricity installed power was only 1.9 million kilowatts, and most of the required petroleum products had to be imported. An adequate supply of electric energy became critical, both for production and for a rapidly growing urban population. Petroleum requirements expanded quickly because of the decision to make the automobile industry the mainstay of import-substitution industrialization and because of the heavy reliance on trucks for short- and long-distance transportation. Ambitious road-building programs were implemented, and the domestic automobile industry quickly expanded the number of motor vehicles, reaching 1.05 million units in 1960, 3.1 million units in 1970, and 10.8 million units in 1980.

The unfolding of Brazil's current difficulties in the energy arena constitutes a classic example of distortions arising from misdirected regulation combined with the action of interest groups. When import-substitution industrialization, the country's main sources of energy were firewood and charcoal. Because modern industrial expansion could not be based on these, a decision had to be made regarding the sources of energy to be used. Not surprisingly, electricity and petroleum products received special attention.

Low electricity prices stemmed from the substitution policy and from the attempt to control inflation by restraining the increase in public-sector prices in nominal terms. Thus, the capacity of the electricity sector to generate resources for investment was considerably affected. As a result of federally induced borrowing in the late seventies and early eighties, the sector was also heavily indebted. Intermittent adjustments in electricity prices allowed the sector to generate profits and thus some resources for investment. However, on occasion, the government returned to the practice of manipulating consumer final prices to fight inflation.

Although the federal treasury initially assumed many of the cost distortions of the energy policy, by the end of the 1980s the virtual bankruptcy of the public sector precluded this approach. In the early 1990s, the government implemented a series of measures to reduce its role. It introduced deregulation, market reforms, and privatization, but these reforms did not change the essence of the energy policy. Interest groups prevented the adoption of measures that would drastically alter the liquid fuel policy, and the agency controlling electric energy continued to lack resources for investments. Thus, the energy price structure was only marginally altered.

Low electricity prices induced a considerable substitution of electricity for other sources of energy and the expansion of electricity-intensive production, such as aluminium. The

heavy investments in hydroelectricity of the 1970s and 1980s matured, creating a considerable generating capacity. Brazil is the third largest producer and consumer of electricity in the Western Hemisphere, behind the United States and Canada. As of December 2002, Brazil had an installed generation capacity of 76.2 GW, a 3.6% increase year-on-year. Hydroelectricity accounted for 83% of Brazil's installed capacity in 2002, with an absolute year-on-year increase of 1.48 GW (EIA, 2004). One of the world's leading producers of hydroelectric power, Brazil has a potential of 106,500 to 127,868 megawatts, or, according to the World Factbook 1996, 55,130,000 kilowatts. The country's two largest operating hydroelectric power stations are the 12,600-megawatt Itaipu Dam, the world's largest dam, on the Paraná River in the South, and the Tucuruí Dam in Pará, in the North Region.

In principle, an increase in the electricity generating capacity should have been easy to achieve. Brazil has enormous hydroelectric potential, and investments in the sector were forthcoming, although with an initial delay. However, until 1995 nationalistic considerations excluded foreign capital from the electric energy sector, and regulatory obstacles prevented domestic private investment. After 1995, this situation underwent changes with regard to the privatization program.

It normally takes place in isolated areas in Amazon and urban area outskirts. It is clearly necessary to give attention to these communities' needs and renewable energy can collaborate to achieve this goal (Goldemberg et al, 2003).

Another issue that represents a barrier for major accessibility is the need of valid address proof from consumers and in some regions the distance is a strong barrier to grid connection.

Social tariffs to low income dwellers

In Brazil, the use of subsidies to benefit low income population, so they can afford energy power, started on seventies, law No. 10.438 with the inclusion of in the low income tariff. All residential consumers with single phase connections and an average monthly consumption less than 80 kWh automatically benefit from the subsidies. Consumers in the 80 to 220 kWh per month range must be registered at the utility and in the Federal Government's Single Social Programs Register. The low income tariff was financed by resources from the Energy Development Account (CDE)[3]. There are currently some 18 million households that benefit from the low income tariff, 14 million of which have a monthly consumption of less than 80 kWh, and 4 million in the range of 80 - 220 kWh/month (ANEEL, 2006);

Policy recommendations

Extension of the legal connection, free of charging, to the needier population that is now using unauthorized and dangerous connections, in order to prevent the lack of security and risk of firing

On the other hand, this could enhance the electricity demand. Hence, a complementary policy on energy efficiency and the strengthen of existing programs should be coupled with the aforementioned policy proposal.

[3] The CDE is a sectoral tax and is part of the cost of the electricity tariffs. It is paid by all Brazilian consumers.

2.6 Diesel

Diesel oil consumption (37 million cubic meter in 2007) in Brazil is mainly in the transportation sector (buses and trucks), but there is also a high consumption (up to 809 thousand cubic meter per year) in diesel generators for isolated communities mainly in the Amazon Region. Aiming to keep inflation rates at low levels, special subsidies for diesel were introduced in the past and still exist, based on price structure of gasoline for final consumers (ANP, 2002). Because of this price structure, light vehicles using diesel oil are forbidden in the country.

Diesel consumption in the country is high and, even considering the refining profile established by Petrobras to produce mainly diesel oil, it is necessary to import pure diesel oil (6.5 million cubic meter in 2001, corresponding to 1.2 billion US$, from ANP).

Another factor responsible for the high diesel consumption in the country is the diesel supply in Amazon for the isolated communities. With high transportation costs for isolated villages this supply was stimulated mainly by the CCC, which was introduced in 1993 as a special policy to foster diesel generation in isolated systems. This law establishes an additional payment for the diesel oil used by utilities and communities.

3. Methodology, approach and research framework

Data information available to differentiate urban and peri-urban areas is hard to find in Brazil. So that, in order to standard the information IBGE (Brazilian Institute of Geography and Statistics) terminology was used in the present UPEA II Brazilian Report. This limits to the concepts of urban and rural areas and metropolitan regions.

In some specific cases, very soon, it will be possible to overcome this barrier – especially when peri-urban practically mean rural areas and when fuel wood is thoroughly used. In fact, Brazil needs a more consistent and organized a national wood energy information system, with consistent methodology and resources to survey watch and inform wood use, preparing an annual wood balance, if possible in regional terms. This action will identify the “hot spots” that deserves more attention.

Considering the methodology adopted in the present UPEA II Brazilian Report, it is relevant to mention that the present work will rely mainly on secondary data. This decision was based on two aspects: (1) the absence of appropriate data that focuses the energy sources used in urban and peri-urban areas, and (2) the time for report elaboration. The selected sources of data include national energy statistics annual reports, census and socio-economic survey in sources like IBGE (Brazilian Statistics Bureau), BEN (Brazilian Energy Balance), ANEEL (Brazilian Energy Agency), ANP (National Petroleum Agency), MME (Ministry of Mines and Energy), MCT (Ministry of Science and Technology), Eletrobrás (the federal holding company in the power sector) and Petrobras (the national oil and gas company).

To overcome partially the eventual troubles caused by the use of secondary data, interviews with Brazilian stakeholders in the area of energy access were made.

4. Scoping phase

4.1 Description

The scoping phase analyzed the access of poor populations living in urban and peri-urban areas of Brazil to modern energy sources.

This phase showed that, in the urban areas, access to more modern energy sources has singular aspects. The main energy utility of the State of Rio de Janeiro — Light SA Formerly known as light – Serviços de Eletricidade SA — has a electricity access coverage rate of 99.86%, one of the highest in the country. Nevertheless, the rate of commercial losses[4] in the area covered by Light is 18% (MP, 2006). The large number of households existing in unregulated lands, such as slums, shanty-towns or slum-tenements, contributes to these informal losses. But the factor that most contributes to this enduring scenario is found in the country's socioeconomic conditions.

In fact, the scoping phase confirmed that poverty, inequality and social exclusion have a high influence on the energy consumption patterns of low income populations. In addition, this phase showed that those populations whose are characterized by lack basic services could allow efficient energy consumption. Contradictorily, they are excluded from a decent quality of life, facing several problems to change their socioeconomic condition.

Lastly, the scoping phase showed that the issue of energy insertion in Brazil is complex. It does not only involve factors that are essential for development, but it also involves delicate social questions, which influence the daily life of the population.

To achieve a broad understanding of the economic and energy scenario of urban and peri-urban areas in Brazil nowadays, a range of factors linked to energy access and consumption was analyzed in the scoping phase. These factors include the type of sources used, the quality of the energy, and the structure of the energy industry and the impact of recent policy reforms. To do so, the IPEA[5] (Institute for Applied Economic Research) database was used together with the following surveys: the National Household Sample Survey (PNAD, 2004), the Family Budget Survey (POF) and the 2000 Census, all carried out by the Brazilian Geography and Statistics Institute – IBGE[6].

Difficulties are found in gathering information to build a profile of poorer populations per geographical area. In Brazil, there are hardly any data and information available to differentiate between urban and peri-urban areas[7]. The difficulty remain in the concept

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[4] Commercial losses arise from the theft of energy straight from the electricity grid. These losses are also known as theft losses.

[5] The Institute for Applied Economic Research – IPEA promotes dissemination of information and knowledge on economic issues in Brazil. IPEA, linked to the Ministry of Planning, Budget and Management, produces research, projections and macroeconomic, sectoral and thematic studies to provide input to government *in the production, analysis and dissemination of information* for policy formulation and planning (IPEA, 2006).

[6] The National Household Sample Survey, PNAD and the Family Budget Survey, POF are carried out every year by IBGE. PNAD provides information on the general characteristics of the Brazilian population such as migration, education, work, families and households for the entire country and large regions. POF, in turn, has information on per capita household expenses, income and food purchases, and also provides a subjective evaluation of living conditions, per geographical strata and monthly income level for the entire country and large regions (IBGE 2006).

[7] In its surveys, IBGE only uses the concept of urban and rural areas and metropolitan region. Urban area is defined by an urban perimeter established by municipal law. Rural area, in turn, is defined as the area outside the urban perimeter. Metropolitan regions are groups of municipalities within the same state brought together under state law, according to criteria established by the state. The 1988 Brazilian Federal Constitution granted states the right to alter the then existing metropolitan regions and to create new ones. Up until the reference date for the 2000 Census - August 1, 2000

of a peri-urban area[8] is defined far more by its social aspects than by geographical boundaries.

4.2 Main findings

The main findings observed during the elaboration of the section "Urban, Peri-Urban and Rural Environments" are:

- Most of the Brazilian population (83.01%) lives in urban areas. The North and Northeast Regions have the highest number of people living in rural areas. In 2004, 26.48% of the population of the North Region lived in the countryside. For the Northeast Region, this figure was 28.5% (PNAD, 2004);
- The areas with the lowest levels of access to electricity are in the rural zone, which, in turn, are also the ones with the lowest monthly incomes. Generally, the average monthly household income of urban areas is higher than the average monthly income of households in the rural area. The average monthly income of Brazilian households in urban areas is US $321.70 and that of households in rural areas is US $152.90 (PNAD, 2004);
- Access to new, cleaner and more versatile kinds of energy, such as electricity, can contribute to the modernization of the rural area. Modernization of the rural area is a core element in the development of these regions. Thus, it is clear that access to electricity is more than necessary for the rural development of the country (RIBEIRO, 2002);
- Considering the total Brazilian population, in 1999, 15.03% of Brazilian households had a per capita income below the destitution line. In 2004 this percentage[9] dropped to 13.13%, as shown by Figure 1.

– there were 22 Metropolitan Regions in 15 States: Belém, Grande São Luís, Fortaleza, Natal, Recife, Maceió, Salvador, Belo Horizonte, Vale do Aço, Grande Vitória, Rio de Janeiro, São Paulo, Baixada Santista, Campinas, Curitiba, Londrina, Maringá, Vale do Itajaí, Norte/Nordeste Catarinense, Florianópolis, Porto Alegre, Goiânia (IBGE, 2000).

[8] It is also known as urban fringe or shadow (ZARÁTE *apud* VALE, 1984).

[9] Last available Brazilian consolidated data.

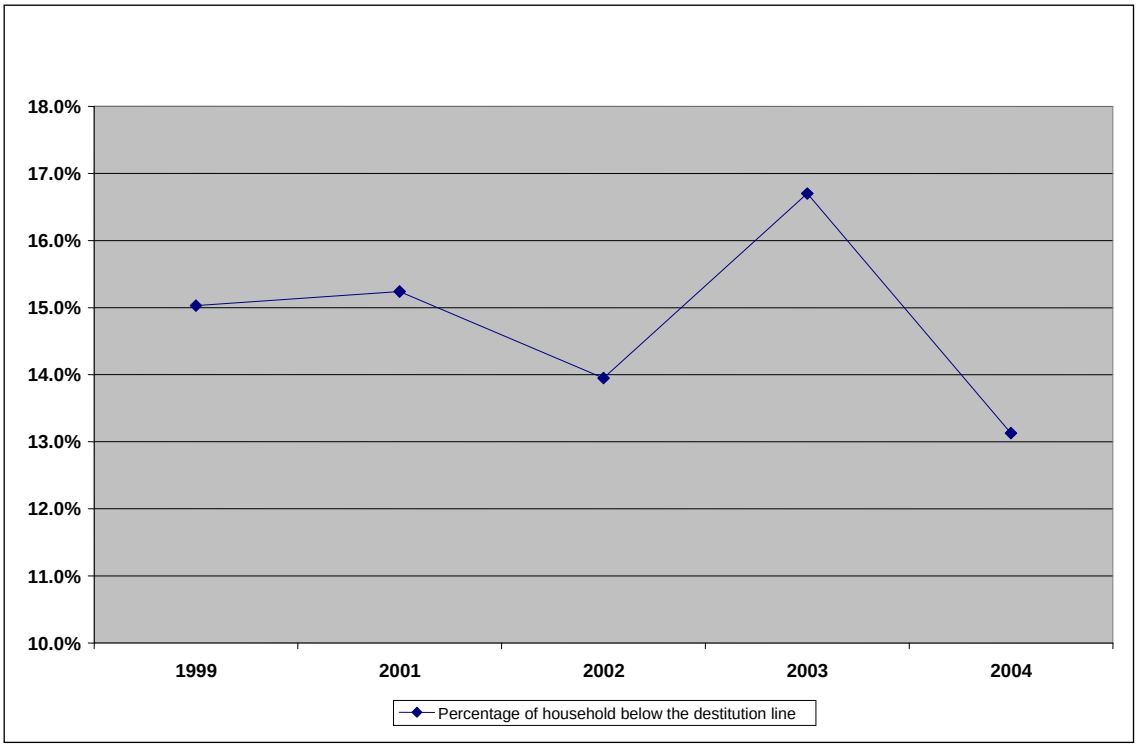

Figure 1: Percentage of people with per capita household income below the destitution line
Note: Data for the year 2000 are unavailable. Source: IPEADATA, 2006.

- The share of income of the poorest grows from 12.7%, in 1999, to 13.85%, in 2004. The number of poor people also increased from 56.18 million to 59.43 million in the same period (IPEA, 2006);
- Although income distribution indicators show favorable results over the last five years, in the urban area income concentration still drives poverty and influences the organization of the social space, giving rise to the process known as "*favelização"* (slum formation);
- The process of slum formation, experienced by most large Brazilian cities, has been increasing substantially over the past few years. The year 2000 Census data indicate that the Rio de Janeiro Municipality is second place in the number of slums in Brazil – 513 slums, with an accumulated growth rate of 11% between 1991 and 2000. In fact, there was a significant increase of populations in slums from 1996 to 2000. In 1996 there were 952,429 slum residents; in 2000, this number had gone up to 1,092,476, that is, 1/5 of the population of Rio de Janeiro is concentrated in slums (IPP, 2006);
- Most of the growth of large urban agglomerations is happening without the necessary planning. According to ROCHA (1997), the phenomenon of slum formation is clearly an urban process that is most evident in metropolitan regions, which, in 1991, concentrated circa 43 million people or 38% of the Brazilian urban population. In that year, about 70% of the slum households in Brazil fell into this urban category. In population terms, this means approximately 5 million people living in slums or about 12% of the metropolitan population;
- Poverty in urban areas is not necessarily found in low income. It manifests itself most strongly in social exclusion. The slum formation process undergone by large Brazilian cities has encouraged the process of social exclusion. The concept of exclusion involves issues that are hard to quantify and are more

complex than poverty or inequality. Exclusion has a broader scope than living on the fringe, and does not, necessarily coincide with poverty (SPOSATI, 1997);

- The scenario of poverty and social exclusion existing today in large cities is becoming intertwined with intra-urban growth dynamics in Brazil. Spatial distribution of the poor population is still occurring through a significant movement of population to the outskirts of large and medium-sized cities. One of the reasons for this process is the difficulty low income families have in access to urban land;
- Urban planning approaches are isolated from the socio-economic framework and are excessively static and restrictive to be able to follow urban dynamics are inadequate to meet essential urban demands, such as the adequate supply of electricity.

The main findings observed during the elaboration of the section "Main Sources of Energy Used in Brazil" are:

- In the urban environment, the poorer populations have access to electricity, but often informally, through unauthorized connections, being another problem of urban planning;
- Unauthorized access to energy services occurs because the population has access to housing through self-management of popular housing. Many of the houses for poor population are of low quality and cost, with an irregular electricity supply. Self-management contributed to the lack of infrastructure and planning in construction, which excluded a big part of low income from having access to basic services like running water, sewage systems or piped gas;
- In the urban and peri-urban areas, families whose income are below or close to the poverty line, which live in slums, shanty-towns or slum-tenements, have access to electricity, authorized or unauthorized. The social organization existing in these communities, which deals with specific social codes and rules, limits the action of the State. In these communities the State influence is different than in other places, which partly contributes to the continued informal losses of electricity. According to Light Electricity Company, the rate of commercial losses in the slums within its area, in 2004, was 64% (Light, 2004).
- The research on use and habits of the urban and peri-urban Brazilian population carried out by SILVA (2003) finds that the main causes of high electricity consumption are electric showers (the share of electric showers in total electricity consumption is around 24%) and fans. There is also a significant use of energy to water heating and space cooling devices. The significant share of these end uses in the total energy consumption suggests that new and more efficient technologies for heating and cooling could be implemented;
- In Rio de Janeiro, access to gas bottles, LPG, is more difficult because of the social risk situation existing in communities. People who live in these areas must pay a kind of security tax to groups known as "militia" who charge inhabitants and traders for security, use of alternative means of transport (vans, mototaxis), and also per gas bottle;
- There was a reduction in the share of LPG in total energy consumption. In 2000, this share was 4.6%; and in 2005, 3.6% (BEN, 2005). This reduction coincides with the year 2003, period in which the government removed the gas allowance social program[10], which was incorporated to the *Bolsa Família* (Family Allowance), a cash transfer program;

[10] The aim of the program was to compensate poor families for the elimination of LPG subsidies in 2000. The program transferred some US$ 6.97 every two months to 8.5 million people.

- Regarding residential sector, it is important to notice the use of wood fuels in Brazil has changed notably over the past several decades. Fuelwood use for cooking and heating fell from 19.0 Mtoe in 1970 to 8.2 Mtoe in 2005, though there are some indications that high oil prices have recently reversed this trend. In Seventies almost 60% of fuelwood demand was traditional use for cooking and heating in the residential sector. In 2005, fuelwood still is an important source of energy for preparing food, but its use declined to 30%. Many poor households still rely mainly on fuelwood to meet their cooking and heating needs. However there are important uncertainties about the actual consumption of fuelwood in residential use, mainly due to the lack of information and the effect of prices of possible replacement, especially electricity and liquefied petroleum gas – LPG (IBGE, 2006);
- The current fuelwood demand could be lower than indicated by official figures, estimated with rough methods based on evolution of LPG demand, affected by other factors, as stoves efficiency, population cooking practice, etc. Household with only fuelwood represents in Brazil 3.7% of total primary energy supply (BRASIL, 2005), especially in rural areas, around 23 million people rely on fuelwood, 13% of total population (IEA, 2006). The fuelwood used in Brazil comes from native forests and forestation. According to IBGE (2005b), 58% comes from native forests in 2004, for all uses;
- Some signals of difficulties to supply the wood demand in Brazil can be observed in the reduction of wood production and export, prices escalation and recognition of Government of urgent need to promote reforestation. The native forests are losing fast importance in this context, as shown by some numbers: in 1990 the whole round wood production from Brazilian forests was 308.2 million cubic meters, with a 26.8% contribution planted forests, but in 2004 the round wood produced reached 218,2 million cubic meters, with a 62.6% participation from planted forests. In other terms, along fifteen years, the total round wood production and the production just from native forests have been decreasing respectively at annual rates of 2.36% and 7.27%. Even though an annual growth rate of 3.39%, planted forests is not able to cope with wood demand at forthcoming years, taking into account industrial and energy needs (BACHA et al, 2006);
- In Brazil, according to the Ministry of Mines and Energy (BRASIL, 2006), 13% of TPES (Total Primary Energy Supply) is met by woodfuels, especially by fuelwood and charcoal. It totaled 28.4 Mtoe in 2005, almost the same energy supplied by hydropower generation;
- Although forest resources are important for national energetic matrix, there is not a coordinated system that regulates and updates the information. Even though effort made by some institutions, the information related to the production and use of the forest resources for domestic, agricultural or industrial sectors remains not defined. It is partly explained taking in account the high level of scattered forest products' users, low level of official trade, specially the wood fuel required for energy supply such as charcoal production;
- In Brazil, first, second and third place of charcoal quantity use is industry, residential and commercial sector respectively. In the last six years, the charcoal demand has remained constant in residential sector, and represents 8.3% of total consumption. It is estimated that in the residential sector, 635.8 thousand houses, 1.3% of national total, consume charcoal for coking in 2003, at practically equal levels in urban and rural area, as indicated in Table 1 (IBGE, 2004). Although, in percentage, such value could be considered small, this means that in Brazil currently 2.4 million people rely on charcoal for cooking;
- The charcoal consumption in residential sector occurs mainly in Northeast States, chiefly in Maranhão and Piaui States where in some municipalities by 20% of the houses use this fuel for cooking. Due to its location, the source of charcoal for those houses probably is the excess of production of charcoal kilns that supply

such product to pig iron production at Carajás Region in Pará and Maranhão States (IBGE, 2004d);

- The expressive number of residences that uses simultaneously charcoal and Liquefied Petroleum Gas - LPG, mainly on the urban area can be attributed to an important cultural aspect spreading diffused over the country and in all income levels: the habit of Brazilian families to prepare barbecue. In fact, charcoal bags are sold in every Brazilian supermarket and in most gas station, basically to be used in grills (IBGE, 2004);
- The cleaner energies access problem - such as electricity, liquefied petroleum gas (LPG) or natural gas - by some of the urban and peri-urban populations is different to the one faced by the populations living in Brazilian rural areas. The use of stoves in Brazilian households illustrates this well. As it can be seen, in 2004, about 98% of the population living in urban areas had stoves[11] in their homes. But, in rural areas, 8% of households do not have stoves (PNAD, 2004). In absolute numbers, there are 608,785 households without stoves belonging to the income class of up to one minimum wage. Although there is no data on how many wood stoves exist in rural and urban areas, it is known that the residential sector has the second largest energy consumption of biomass;
- The lack of data on consumption and other energy uses really makes the analysis of the profile of the energy consumption of the Brazilian population very difficult. As a rule of thumb, the databases existing in Brazil do not delve deeply into the issue and not all information is subdivided by income level or region. Nevertheless, the difficulty does not invalidate the drawing of inferences from previously produced studies. To better illustrate the use of energy in the rural environment, results were used from *ex-ante*, intermediary and *ex-post*[12] field research on access to electricity for the *Luz no Campo* program (Light in the Countryside)[13]:

> - In the State of Mato Grosso do Sul, in which the first stage of the survey was carried out and concluded in December 2000 and the last in October 2003, 437 rural properties were electrified. The results of the field research for the *Luz no Campo* program provide important information on the energy profile in the rural environment. In the rural areas of Mato Grosso do Sul, before electrification, firewood, charcoal and coal were widely used for cooking. Other sources, like LPG, kerosene, gasoline and diesel oil were used for lighting. CEPEL undertook a survey to verify the acceptance of electricity in the universe of rural properties in Mato Grosso do Sul that were to be electrified. The percentage of the population unhappy with the type of energy used in their properties was quite high up to 70% of residents were not satisfied with the energy they used, the most common reason being "lack of comfort". Only 4% of owners mentioned “harmful to health” (CEPEL, 2004).

The main findings observed during the elaboration of the section “Recent Reform in the Brazilian Energy Industry” are:

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[11] PNAD (2004) recorded the existence of stoves with two or more plates, even if they were portable or made out of masonry. The fuel used for cooking was not identified.

[12] *Ex-ante* – before electrification of properties; intermediary – one year after electrification; *ex-post* – two years after electrification.

[13] *Luz no Campo* was a program for providing universal access to electricity. It was established by the Federal Government and intended to increase access to electricity by expanding the grid. Its aim was to electrify one million properties. In fact, it provided access to 600 thousand properties throughout Brazil, from 2000 to 2003, period in which it was implemented. It was then replaced by the current universal access program called *Luz para Todos* (Light for All) of the current federal administration.

- The new regulatory framework for the Brazilian energy industry was established by the 2004 Federal Law No. 10.848 and is based on the following pillars: stable rules, security and reasonable tariffs. The current model emphasizes universal access, reasonable tariffs and security of supply. The changes, written into law, will affect, as a whole, both the consumers connected to the power grid, through reasonable tariffs and security of supply, as well as those who do not yet have access to electricity, through the federal universal access program *Luz para Todos* (Light for Everyone);
- The main features of the current model includes the following directives: Reasonable Tariffs, Security of Energy Supply and Universal Access Program;
- The main mechanism for ensuring reasonable tariffs is the use by distributors of competitive bidding for contracting energy, using lowest tariff criteria. This mechanism stimulates the use of more competitive energy sources, seeking to ensure security of energy supply and the quality of services rendered;
- The new model re-establishes the role of energy planning, which has a direct influence in ensuring the quality and the security of energy supply to consumers. Renewable sources of energy like ethanol can contribute to the security of energy supply, complementing the water regime;
- It is expected that the Universal Access Program have a great impact on poor consumers. Nevertheless, rural consumers located in areas that allow the grid to be expanded will be the ones who benefit the most. Brazil has approximately 180 million inhabitants, with 31 million living in the rural area and 137 million in major cities (Census 2000). Altogether, there are some 11 million inhabitants (or 2.5 million households) that do not have access to electricity (IBGE, 2005). In Brazil, 94.53% of the population has access to electricity. Regionally, the lowest rate is seen in the North, 81.55% (ANEEL, 2004). In order to revert this situation, in 2002 the program *Luz para Todos* was launched to provide universal access. Law No.10.438 establishes that ANEEL has the responsibility for determining the deadline for universal access to energy[14]. There are projections that state that in 2007, 43% of municipalities that did not previously have energy, will have achieved access (ANEEL, 2005);
- In Brazil, the use of subsidies as a mechanism for price discrimination in order to allow the inclusion of the poorer segment of the consumer market goes back to the seventies. Law No. 10.438 changed the parameters for inclusion in the low income tariff. All residential consumers with single phase connections and an average monthly consumption less than 80 kWh automatically benefit from the subsidies. Consumers in the 80 to 220 kWh/range must be registered at the utility and in the Federal Government's Single Social Programs Register. The low income tariff is financed by resources from the Energy Development Account (CDE)[15]. There are currently some 18 million households that benefit from the low income tariff, 14 million of which have a monthly consumption of less than 80 kWh, and 4 million in the range of 80 - 220 kWh/month (ANEEL, 2006);
- Gas Allowance, regulated through Decree No. 4.102, dated January 24, 2002,[16] was a cash transfer program created by the government in 2001. The aim was to compensate poor families for the elimination of LPG subsidies in 2000.

[14] Law 10.762, from 2003, establishes that ANEEL will set goals and deadlines for universal access for each energy utility.
[15] The CDE is a sectoral tax and is part of the cost of the electricity tariffs. It is paid by all Brazilian consumers.
[16] The resources for financing the program came from taxes gathered from imports and commercialization of oil and derivatives, natural gas and its derivatives and ethyl alcohol fuel.

The main findings observed during the elaboration of the sections “More Appropriate Technologies and Sources for end Energy Consumption by Populations Below the Poverty Line” and “Conclusions” are:

- Populations living in urban and peri-urban areas are connected to the electricity grid and most have access to LPG for cooking, and firewood is only widely used in rural areas. The arrival of electricity for poor families in rural areas does not mean the end of traditional sources of energy (firewood and coal);
- In general, low income families tend to use electricity selectively, especially for lighting and communications. They continue to use firewood, coal and other fossil fuels, such as LPG, for cooking, and kerosene for lighting. The transition to more modern energy sources is mainly based on the availability of the resource, in the capacity for payment and also on cultural preferences (OLIVEIRA, 2005);
- The mere access to new energy sources does not significantly contribute to changing the way of life of poor populations located in the urban and peri-urban areas. The direct benefits arising from electrification are improved well-being and increased access to information. These are, without a doubt, very important benefits to create the minimum and essential conditions for development. Access to energy creates conditions to induce development. This is not, however, enough to promote equitable and sustainable socioeconomic transformation (Rodrigues, 2006);
- The mere access to new energy sources does not significantly contribute to changing the way of life of poor populations located in the urban and peri-urban areas. The direct benefits arising from electrification are improved well-being and increased access to information. These are, without a doubt, very important benefits to create the minimum and essential conditions for development. Access to energy creates conditions to induce development. This is not, however, enough to promote equitable and sustainable socioeconomic transformation (Rodrigues, 2006);
- It is fact that the low income tariff used by the government to allow lower income classes to pay for electricity usage has progressed in the last year. In the previous legislation, the consumption range that was entitled to a discount was limited to 120 kWh, and it was necessary for the family to live in slums, shanty-towns or slum-tenements, that is, there was a spatial-geographical condition to receive the discount. With the recent Law No. 10.438, the main requirement for getting a discount is to be registered in one of the government's cash transfer programs – Schooling Allowance, Family Allowance – or to be registered in the Federal Government's Single Social Actions Register, which means having an average per capita income of up to half the minimum wage. Nevertheless, the tariff discount percentages and the consumption ranges need to be adjusted to take into account the real energy consumption needs of families;
- In fact, other cross cutting actions, like access to credit, education and health services, are also required. These actions, associated to the continuous supply of energy, are essential for encouraging new productive structures and relationships in the rural, urban and peri-urban environments;
- In the rural environment, the main challenge is to provide modern clean energy sources in order to provide rural communities with their own effective means to achieve sustainable development. Solar or wind energy applications have been successful when used in lighting, communications or water heating, that is, the end uses related to community well-being. It is necessary spread the use of new technologies for productive applications. According to Anhalt, (2006) several devices for productive purposes are already ready to be disseminated.

- The challenge is not in the effective implementation of these technologies or in the use of modern energy sources, but in overcoming underdevelopment and old problems associated to economic, social and environmental contexts. Initiatives must be comprehensive, with true efforts by government and societies, along with a real desire to contribute to improving the quality of life of the many poor communities of Brazil, no matter if they are urban, rural or peri-urban.
- Related to the Case Study presented in the Section "More Appropriate Technologies and Sources for End Energy Consumption by Populations Below the Poverty Line" it was showed that expanding the use of solar heaters in low purchasing power communities is an strategy to save energy to the consumer, however the investment is high. Since the shower is one of the appliances that most consume energy in Brazilian households. Another benefit is macro, i.e., is related with the Brazilian energy security: this benefit is energy savings for the electricity system, which usually becomes overloaded in the early evening, at the time when a large number of Brazilians turn on their showers[17]. Energy specialists believe that the electrical shower is responsible for 7% of the entire national electricity consumption (CPFL, 2006). The third advantage is for the environment, which will be spared the impact arising from the construction of another hydropower plant.

4.3 Areas identified for thematic phase

The scoping phase reveals aspects that need improvement; analysis of available variables allows an enlightening description of the intrinsic relationship between energy and development. This relationship makes it possible to understand why some 38% of Brazilian households still use traditional energy sources like firewood (MME, 2005). One of the reasons is that in Brazil, 33.5% of the population lives with about US$2.00 a day (IPEADATA, 2006).

Access to more modern energy sources, such as electricity, liquefied petroleum gas (LPG), natural gas and kerosene is virtually only found in urban areas. According to NERI (2001), in the rural area of the Brazilian Northeast, about 53.5% of the population uses electric energy for lighting, but in the urban area of this same region, this percentage rises to about 98%.

In fact, the scoping phase showed the need of a deep and more consistent analysis about the relationship between the main sources of energy used by the urban and peri-urban and the level of social and economic development observed. So, that subject was chosen as a preferential area to be analyzed in the thematic phase.

The scoping phase also showed that it is necessary to understand and identify how electricity is being consumed by urban and peri-urban Brazilian populations and what is

[17] Because of its high wattage (in Brazil, usually between 2,500 and 6,500 watts), the electrical shower overloads the electrical system, particularly in the most critical consumption hours, such as from 17:30 to 20:30, known in Brazil as the peak hours.

the purpose of this consumption. Therefore, this would be an area identified to be discussed in the thematic phase.

4.4 Transition from scoping to thematic phase

The transition from scoping to thematic phase was based on deep analysis of each probing of issues identified in scoping phase and understanding reasons behind them, identification of positive initiatives.

In fact, the transition from scoping to thematic phase mainly considered the identification of positive initiatives. This strategy aimed the elaboration of recommended policies to improve energy access, quality of energy accessed, social and economical conditions of the urban and peri-urban Brazilian population. The realization of interviews improved the sense of viability and feasibility of such policies.

5. Thematic phase

5.1 Description

This report describes the types of energy that regularly can be reached by low income population, being firewood an old but still used for cooking and LPG widely used all over the country thanks to Governmental actions to incentive this type of energy for cooking. There are others sources explained in his report; however they are not so representative.

5.2 Findings of the thematic phase

- It can be cited as currently domestic fuel use of the natural gas for cooking and heating practices. However, the availability is restricted to big cities like São Paulo and Rio de Janeiro where the pipe lines for natural gas distribution have already been installed in new residential apartment houses.

As policy recommendations aiming at natural gas use increase can be cited the enlargement of the distribution network.

- Fuelwood and solid residues represent 37.8% of energy consumption in the overall residential sector. In Brazil it is used mostly by low income peri-urban, rural and isolated areas populations for cooking and heating purposes. Even though, their high availability these fuels exploration by low income population is unsustainable. Even though effort made by some institutions, the information related to the production and use of the forest resources for domestic, agricultural or industrial sectors remains not precise. It is partly explained taking in account the high level of scattered forest products' users, low level of official trade, specially the wood fuel required for energy supply such as charcoal production.

As policy recommendations can be cited, to expand even more distribution network

- Even though this fuel has high affordability, it represents 0.1% of the total energy consumption in residential sector (MME, 2007), which is limited to marginal use, concentrated in isolated villages for lighting purposes.
- In Brazil, there is the use of subsidies to benefit low income population, so they can afford energy power.

6. Conclusion and study recommendations

This document used the low income urban population data due the inexistence of disaggregated data for urban and peri-urban areas. In this way most of energy data is not specific for peri-urban population.

Peri-urbans' types of fuel covers a very wide range of sources. Currently the types of fuel available and used by peri-urbans in Brazil

6.1 Fuels description

Natural gas due its affordability does not reach the peri-urban population with 8% of energy consumption in Brazilian residential sector. Fuelwood and solid residues represent a larger portion with 37.8% of total residential sector energy consumption. Mainly for cooking issues using solid fuel derived from several types of biomass. Poor urban and peri-urban continue depending fuel derived from biomass, which is the most important issue in health-energy access field in Brazil. The charcoal consumption in residential sector happens mainly in Northeast States, chiefly in Maranhão and Piaui States for cooking. Due to its localization, probably is the excess of production of charcoal kilns that supply such product to pig iron production at Carajás Region in Pará and Maranhão States (IBGE, 2004). Although forest resources are important for national energetic matrix, there is not a coordinated system that regulates and up date the information.

Despite LPG, Government intervention started on fifties via price control and cross-subsides. There was a reduction in the share of LPG in total energy consumption. In 2000, this share was 4.6%; and in 2005, 3.6% (BEN, 2005). This reduction matches with the period in which the government removed the gas allowance social program[18].It was incorporated to the *Bolsa Família* (Family Allowance), intending to reduce distortions so that, only low income population is benefited. The income transfer system was implemented via the decree 4102.

In 2006, about 41.1% of the primary energy supply was from renewable energy sources from which 14.8% came from hydroelectricity. The hydroelectricity has large participation in the Brazilian electric matrix 74.1% (MME, 2007). However after the interconnected system the electricity that reaches peri-urban population can also come from thermoelectric power plant or nuclear. The majority of Brazilian population lives in urban areas where the higher rates of electricity coverage are found for the residential sector representing 31.6% of energy consumption. Urban areas have electricity access near to 100%. Due the low affordability, peri-urban and urban population's electricity consumption has many times irregularities such as unauthorized consumption (informal

[18] The aim of the program was to compensate poor families for the elimination of LPG subsidies in 2000. The program transferred some US$ 6.97 every two months to 8.5 million people.

access to the utility). This situation is a result of the lack of infrastructure and urban planning. In Brazil, the use of subsidies to benefit low income population, so they can afford energy power. Started on seventies, there is the law No. 10.438 inclusion in the low income tariff.

Kerosene has low consumption by low income population. Its use is restricted to isolated areas like in Amazon Region for lighting together with diesel to produce electricity (via diesel motors receiving CCC help for afford the fuel).

The scenario described above shows the need to carry out studies that include field research, that is, make direct contact with the target population. Also those policies have been done without a centralized action except for gas incentive that is now connected to the Family Allowance.

6.2 Policy pointers

The Brazilian Constitution (1988) considers the distribution of energy to be an essential public service for which the Federal Government assumes full responsibility, either directly or through designated concessionaires or "permissionaires". The Constitution further states that these public services can only be granted through public bidding.

The next topics give an overview of existing legal instruments and laws that support peri-urban population in achieving electrical energy.

6.2.1 Instruments

The instruments that make possible funds for policies implementation are; CCC, Fuel Consumption Account; RGR, Reversion Global Reserve; and CDE, Energy Development Account. They further explained in following topics bellow.

6.2.1.1 CCC, Fuel Consumption Account

As mentioned before diesel fuel is not a fuel used by peri-urbans by themselves, except if they are located in isolated areas where the electricity generation is based in this type of fuel. Diesel's price in Brazil is lower than the others petroleum derivates (special taxes). In order to support the electricity generation in isolated areas of Brazil, especially in *the* North region (basically Amazon region), where the generation is pretty much based on diesel oil CCC instrument is used. CCC is an instrument that subsidizes Diesel oil consumed for this purpose through a fund called Fuel Consumption Account (Conta de Consumo de Combustíveis – CCC) with resources collected from electricity consumers.

This account is funded by energy utilities, from special taxes on electricity bills for households all over the interconnected system. ANEEL Resolution 245/99 determined conditions and timeframes for sharing of projects in isolated electric systems that substitute totally or partially oil fired thermoelectric generation (diesel generators). This scheme is applicable by May 2013.

The bases of CCC creation is displayed in the Law Nº 5899/73, of July 5 in its article 13, item III that says: "The onus and advantages resulting of fossil fuel consumption, for interconnected system or due national imposition interests, will be shared by all companies of the system…"

The Decree Nº 73102/73, of November 7, regulated the articles 12 and 13 of law Nº

5899, establishing in its article 29 that “CCC will be a financial reserve for fossil fuels costs coverage, working as a compensation account, through the share of onus and advantages of fuel consumption in thermo electric generators that belong to companies being connected total or partially to the interlinked system, South / South-East.

Portaria MME (Ministry of Mines and Energy Brazil) No. 360/77, of March 17, article 4 determined the extension of CCC to North-East.

Decree No. 774/96, of March 18, article 22 extended to all concessionaries and Distributors. CCC was divided in 3 sub-accounts.

- CCC South/South-East/Centre-East
- CCC North/North-East
- CCC Isolated Systems (CCC – ISOL)

At this time the tariff for the whole country was the same.

After tariffs equality being extinguished due the restructuring of the power sector was necessary strict rules and CCC extinguish chronogram.

6.2.1.2 RGR, Reversion Global Reserve

Law 8631/93 and subsequently Decree 774, assure financing for grid expansion and rural electrification programs through the Reversion Global Reserve - RGR[19], a fund managed by Eletrobras (Holding of the Brazilian Power System), with compulsory contributions by all concessionaires. These contributions are included in the tariffs imposed by concessionaires. In 1996, Law 9427, which created ANEEL, also decreed that 50% of the resources of RGR should be directed to the North, Northeast, and Mid-West regions and that 50% of such resources should be allocated to programs for rural electrification, energy efficiency, and electrical power for low-income users. Such an initiative reflected the concern with the supply of electricity to the rural and **low-income populations**, plus the concentration of investments to provide funds to minimize potential future problems.

An extension of RGR until the end of 2010 will insure resources for the continuation of the Luz no Campo Program. State and Municipal Governments, concessionaires and “permissionaires”, rural electrification cooperatives and infrastructure cooperatives for land reform projects and inter-municipal consortia are now allowed to borrow resources from RGR. These resources can be used for the expansion of distribution services, particularly on **low-income urban** and rural areas, and specific promotion program to the individual or collective use of solar energy conversion to electricity.

6.2.1.3 CDE, (Energy Development Account)

Law 10438/02, of April, passed by Brazilian Congress.

It created a national fund CDE (Energy Development Account) to promote universal access to electricity and the use of innovative sources of energy. It stipulates that resources from, RGR resources can be used for the expansion of distribution services, particularly on low-income urban and rural areas, and specific promotion program to

[19] Reversion Global Reserve is a yearly reversion quota (up to 2.5%, limited to 3% of annual income) to be levied on concessionaires and “permissionaires” investments, and transferred to electricity tariffs.

the individual or collective use of solar energy conversion to electricity.

6.2.1.4 Subsidies

Electricity

In Brazil, the use of subsidies as a mechanism for price discrimination in order to allow the inclusion of the poorer segment of the consumer market goes back to the seventies. Law No. 10.438 changed the parameters for inclusion in the low income tariff. All residential consumers with single phase connections and an average monthly consumption less than 80 kWh automatically benefit from the subsidies. Consumers in the 80 to 220 kWh range must be registered at the utility and in the Federal Government's Single Social Programs Register. The low income tariff is financed by resources from the Energy Development Account (CDE)[20]. About 18 million households that benefit from the low income tariff, 14 million of which have a monthly consumption of less than 80 kWh, and 4 million in the range of 80 - 220 kWh/month (ANEEL, 2006);

Governmental subsidies to reforesting have benefited 5.5 millions hectares in 2001 (compared to 3.3 million hectares in the 1965-1980 period), to produce charcoal; wood fuel, pulp, and paper. Charcoal and firewood were the predominant fuels in Brazil until 1954. About 40% of Brazil's steel production made use of charcoal (now from sustainable forests) instead of imported coke.

LPG

Despite to LPG subsidy "Gas Allowance", from fifties there were a Government intervention process via price control and cross-subsides. The deregulation process started in the nineties until year 2002 when subsides were removed. Other decree (4102) about the regulation/legal[21] structure was made to minimize distortions by income transfers from the Brazilian Government help for LPG purchase (Costa et al 2006).

Gas Allowance, regulated through Decree No. 4.102, dated January 24, 2002,[22] was a cash transfer program created by the government in 2001. The aim was to compensate poor families for the elimination of LPG subsidies in 2000. The program transferred US$ 6.97 every two months to 8.5 million people. Beneficiaries were those families whose monthly per capita income was below half a minimum wage, (U$ 81.40). To benefit from the subsidy, the family had to be registered for another cash transfer program, such as the Food Allowance[23] or Schooling Assistance[24];

In 2004, the Federal Government launched the Family Allowance program, through Law No. 10,836, which united all the cash transfer programs (gas allowance, schooling

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[20] The CDE is a sectoral tax and is part of the cost of the electricity tariffs. It is paid by all Brazilian consumers.
[21] Removal of subsidies (end-2002), followed by the creation of a Federal "gas assistance" program, in order to transfer to low-income families subsidies for residential LPG.
[22] The resources for financing the program came from taxes gathered from imports and commercialization of oil and derivatives, natural gas and its derivatives and ethyl alcohol fuel.
23 The Food Allowance program ensures a monthly aid of US$ 6.97 to US$ 20.93 per family. It benefited at most 3 family members (children up to 6 years of age at nutritional risk, pregnant and nursing women) and the family per capita income had to be less than half the minimum wage. The Food Allowance program lasted for six months and was renewable for equal periods if the family continued to remain in poverty and if they met a set of commitments related to health.
[24] Schooling Assistance ensured a monthly aid of US$ 6.97 for children from 6 to 15 years of age who went to school. The program benefited at most 3 children per family and the family per capita income could not be higher than US$ 41.86.

assistance and food allowance) because of the difficulties in administering the programs and the low impact they had on the poor population;

Uniting the programs initially reduced the number of beneficiaries of government cash transfer programs, since according to the new rules, families with a per capita income from US$ 23.25 to US$ 46.51 and without children are excluded from the benefit. The idea was to give the benefit to poor families with children and also to the very poor families without children;

In 2004, the government expanded the benefit, which increased the inclusion of the needier population. The Family Allowance Program and PETI transfers[25] went from less than US$ 930.23 million to more than US$ 1 billion a year. In this same year, the Gini[26] index dropped about 4%. Furthermore, according to the simulations done by Rocha (2004), the percentage of poor people in Brazil dropped from 34% to 32% after the implementation of the Family Allowance Program;

Criticisms related to cash transfer programs, like the Family Allowance, have to do with the concept of citizenship. Is this kind of program a distributive or welfare program? Critics believed that implementation of the Family Allowance were disguising a situation of structural unemployment. They also stated that only growth together with sustainable development can provide needy populations with true alternatives for social transformation (JUSTO, 2004).

6.2.2 Laws and decrees

Brazilian policies supporting low income population are:

6.2.2.1 Light for Everyone Program ("Luz Para Todos")

This program means access to everyone so that, peri-urban ones are included.

It was conducted by the Federal Government, intends to provide energy access to **all households in Brazil** up to 2008. This program will have priority alternative energy sources, particularly in the case of North region where are located the most of remote villages in the country that not have energy access from grid.

6.2.2.2 Law 10438/02

In April 2002, Brazilian Congress passed Law 10438. The law provisions the reduction of tariffs to **low-income consumers,** the establishment of targets for concessionaires and 'permissionaires' to provide full energy coverage, and the creation of a national fund CDE (Energy Development Account) to promote universal access to electricity and the use of innovative sources of energy. Among the innovations specify that RGR resources can be used for the expansion of distribution services, particularly on **low-income urban** and rural areas, and specific promotion program to the individual or collective use of solar energy conversion to electricity. It creates Incentive Program for Alternative Electric Generation Sources (PROINFA - Programa de Incentivo as Fontes

[25] Program to Eradicate Child Labor
[26] The Gini Index measures income inequality. The closer to zero, the better the distribution.

Alternativas de Energia).

ANEEL (Federal Electricity Regulatory Agency) regulates that Law, whereby utilities must provide full coverage under a target timetable plan. On parallel lines, MME (Ministry of Mines and Energy Brazil) is preparing a program to accelerate universal access to electricity by ensuring additional resources, and particularly by creating rules for the use of CDE resources.

Cide - Contribution of Intervention in the Economical Domain

Law N 10.336, of December 19, 2001, instituted Cide (Contribution of Intervention in the Economical Domain) on the import and the commercialization of gasoline its alike products, *diesel* its alike products, aviation *kerosene* and other kerosene oils, fuel oils (fuel-oil), *liquefied gas of petroleum* (GLP), besides derived him/it of natural gas and of naphtha, and combustible ethyl alcohol. There are differences on Brazilian taxes for fuels, related either to diesel or kerosene.

The Cide is paid by the producer, blender, or importer of fuels. The taxpayer is allowed to deduct the Cide from the Program for Social Integration (PIS) and Contribution for the Financing of Social Security (COFINS).

The tax rates[27] vary from product to product:

- Gasoline: R$ 501.10 per m^3;
- Diesel: R$ 157.80 per m^3;
- Kerosene: R$ 25.90 per m^3;
- Aviation Kerosene: R$ 21.40 per m^3;
- Fuel oil: R$ 11.40 per t;
- Liquefied Petroleum Gas (LPG): R$ 104.60 per t;
- Liquid Fuel Ethanol: R$ 22.54 per m^3.

7. Further areas for research and way forward

As discussed in the Brazilian UPEA I Report, the country lives a paradox at the forest sector. This country has one of the biggest native forests of the planet (416 millions of hectares, corresponding to 31% of the native forest covertures of the planet) and has the fifth biggest reforested area of the world. However, there is scarcity of wood in Brazil, for all uses – including energy. In order to change this panorama, is opportune to develop researches focused mainly in the following issues:

- Implementing of some policy guidelines;
- Expanding sustainable woodfuel production;
- Increasing efficiency in the process of conversion and final use (of the wood). Considering the growing importance of the issue “reduction of the deforestation of tropical forests, especially, the Amazonian forest” in the context of mitigation of the global climate change, this issue is absolutely fundamental.

[27] The average rate is 1.8 per Reais per Dollar.

The analysis of primary data (and also secondary data) related to the Brazilian forest sector tend to be a key point for the methodology to be adopted. This kind of data it is not so easy to obtain in Brazil, especially considering forest regions. In such context, the relationship between the GNESD Brazilian Team with researchers and scientists that are now working in researches centers or universities located close to forest will be valuable.

In great Brazilian cities, like Rio de Janeiro, São Paulo and Belo Horizonte the concept of energy exclusion are strongly related to the absence of infrastructure and access to essential public services, allied to the socioeconomic conditions of the people who live in the peripheries or slums (case of Rio de Janeiro, especially). As observed during the development of the Brazilian UPEA I Report, there is a historical lack of urban planning policies in such regions. In fact, housing was basically an initiative of self-enterprise, in areas of low real estate value, usually in the outskirts of the city. In this context, it is necessary to study alternatives for local and integrated development, which will have an impact on energy, since the latter is present in all aspects of individual and collective consumption.

Once again, stressed that energy exclusion does not just mean not having energy supplied by the utility company. It involves social and economic issues that prevent access to energy (not just electricity), which, in turn, deny the individual the right to education, health and leisure, thus denying the right to citizenship. In the city of Rio de Janeiro, for example, energy exclusion is seen particularly in the hills and slums, places where access to electricity is mostly through unauthorized connections.

To provide modern clean energy sources in order to supply rural communities with their own effective means to achieve sustainable development is a great Brazilian challenge (in urban, rural and peri-urban context). In such context, the expansion of the use of some technologies (like solar or win energy or efficient stoves) could help.

However, to overcome this challenge it is necessary to implement strategies really focused in the effective income distribution and in the job generation. Probably, there are good practices in such context – and related with the expansion of the energy access – occurring in small Brazilian cities. This kind of initiatives must be known in order to a possible replication.

The Federal Government has a fundamental role in the context of reducing the historical inequalities in Brazil – also, NGOs, local civil associations, municipal and state government can help a lot. To detect, map and analyze good practices focused in income distribution and in the job generation through energy access implemented in small Brazilian cities could help all this actors to promote replication. Hence, there is a possibility for further research area in the future GNESD studies (in the Brazilian context).

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