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Centro de Pesquisas de Energia Elétrica
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GLOBAL RENEWBLE ENERGY FORUM

Round Table 2:
Solar Energy - Potentials on Industrial Applications and Productive Uses (A small size application approach)

Foz do Iguaçu

May 2008

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Global Renewable Forum

The General objective of the Global Forum of Renewable Energies is to create an environment suitable for promoting a dynamic dialogue able to strength inter-regional connections and establish joint actions between countries and regions, driven in the direction of reduce poverty and increase the use of renewable sources of energy

I – Introduction

- RE in the framework of the Brazilian Energy Mix and concern with the global heating

II – Solar Energy: Characteristics and possible applications

- Solar Thermal (Low Temp. – Solar Heating and High Temp. - CSP)
- Solar Photovoltaic (PV)

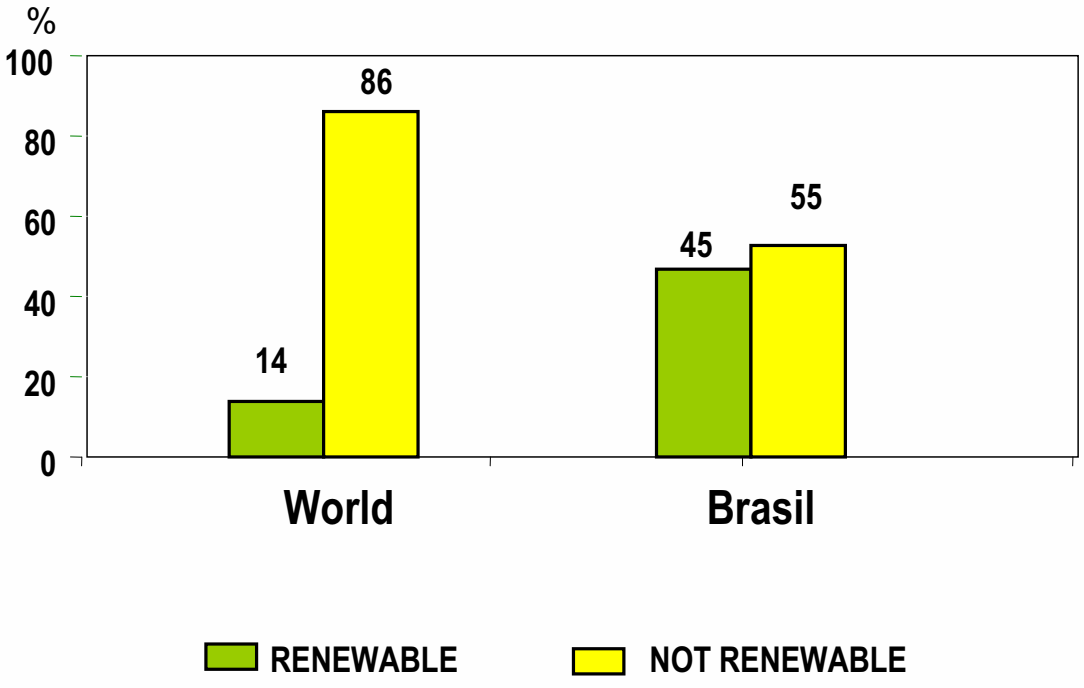
III – Conclusions

- From Brasil and South America to the World
- From the World to Brasil and South America
- World, South America and Brasil working together

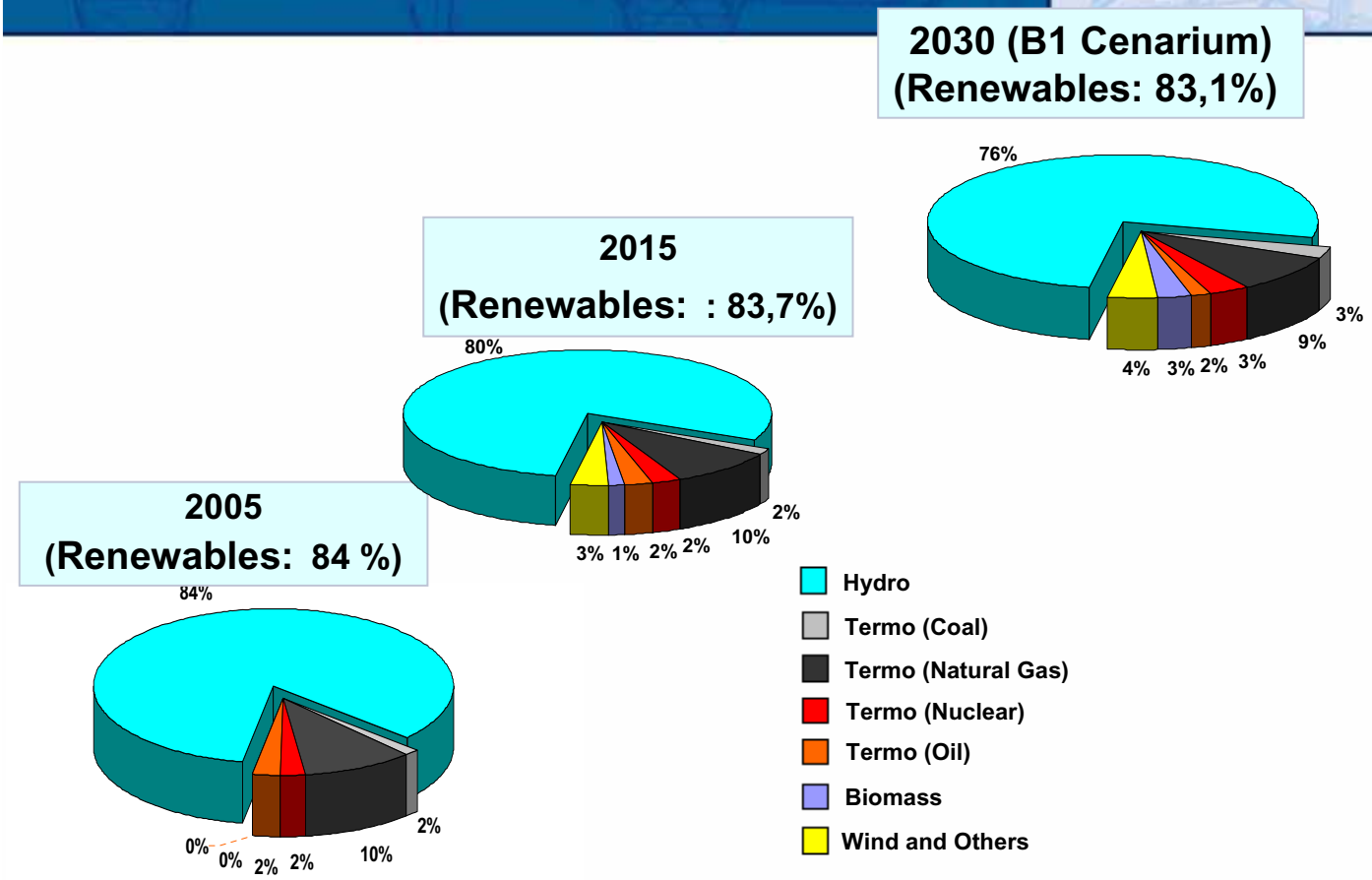
I – Introduction

Ministério de Minas e Energia

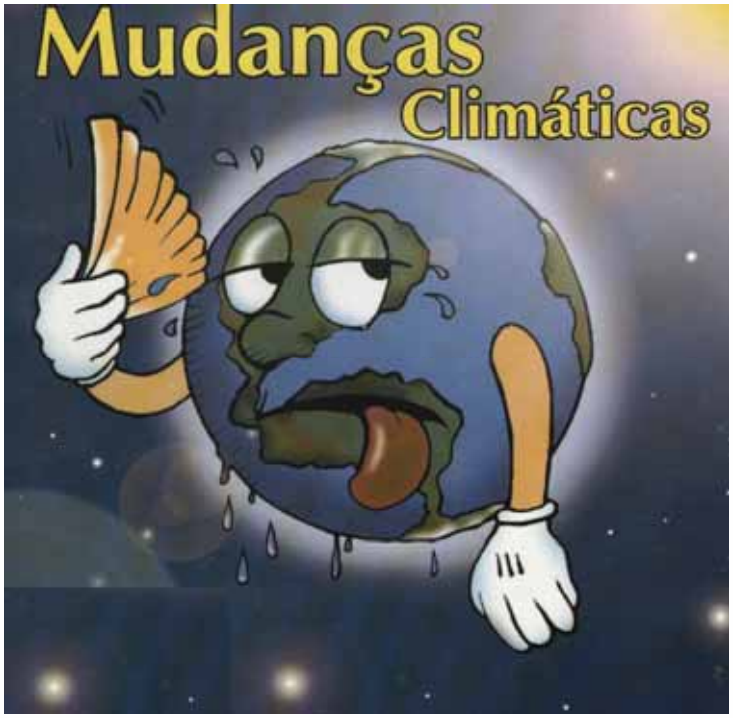
BRASIL- ENERGY MIX



Electrical Mix



Global Heating



Source: Instituto de Pesquisa Ambiental da Amazônia

CO2 Emission of Diverse Technologies (ton/GWh)

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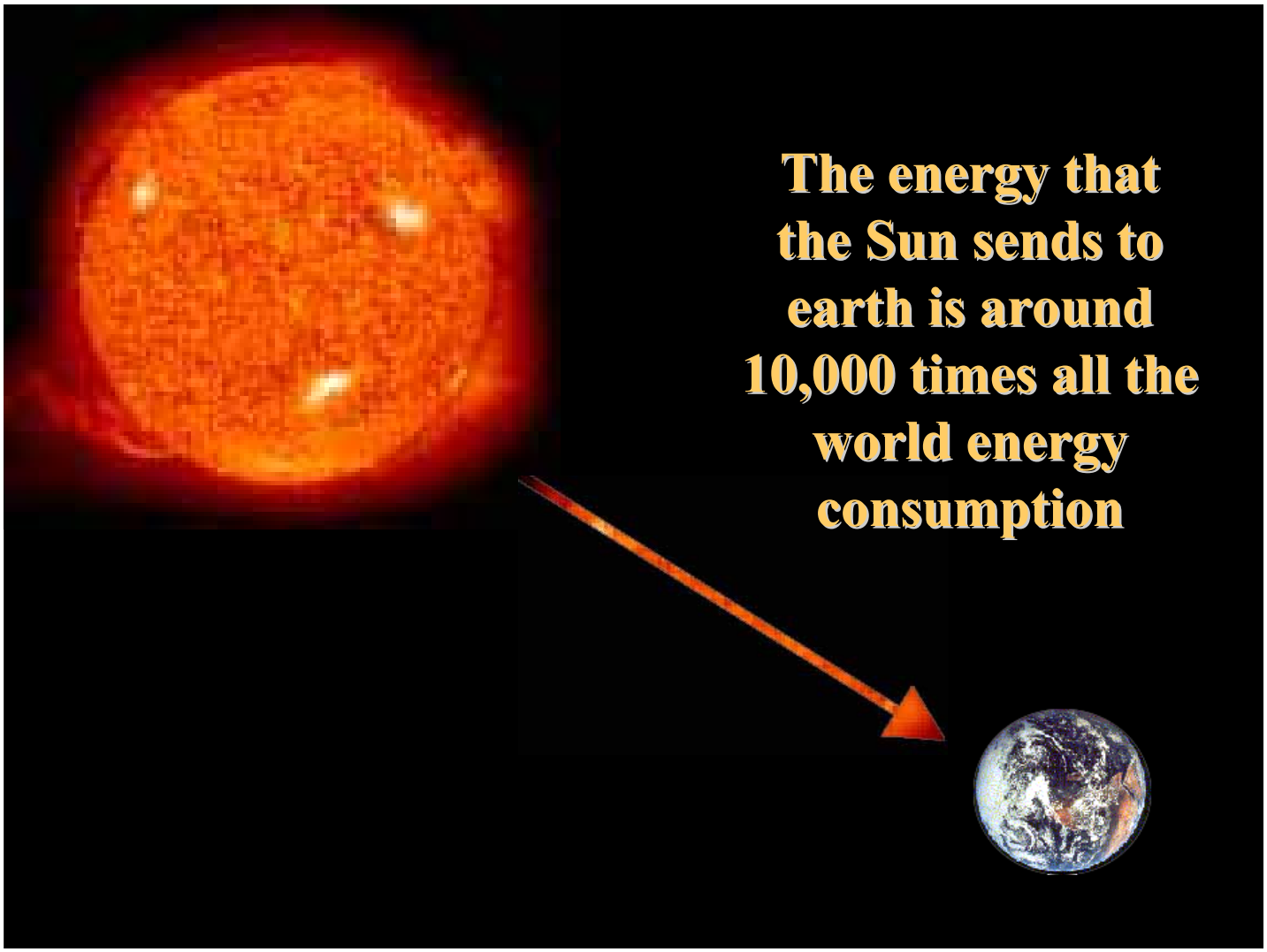
Coal (conventional plant)	1000
Gas	500
Wind	7
PV (Photovoltaic)	5
Large Hydro	4
Solar Thermal	3
Biomass	-160

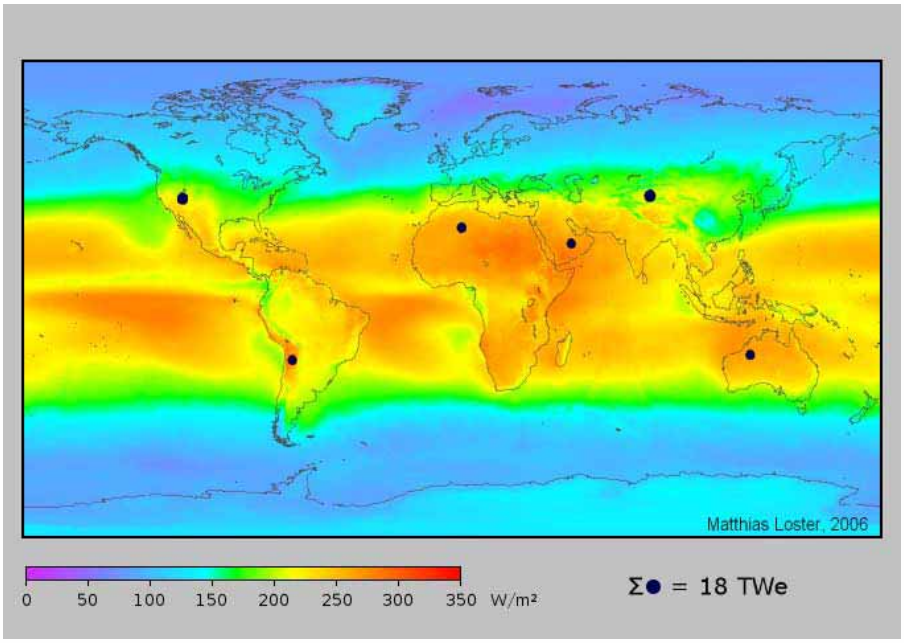


Global Solar Radiation

40 N

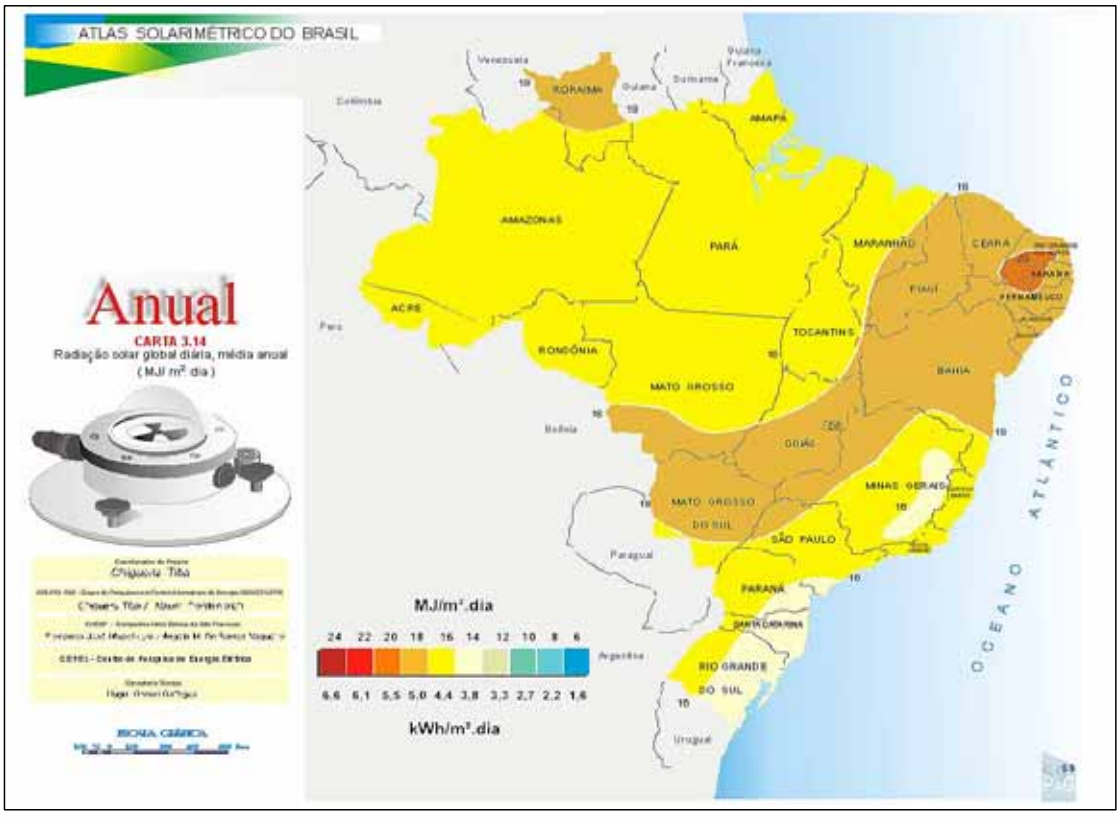
The Sun Belt

35 S

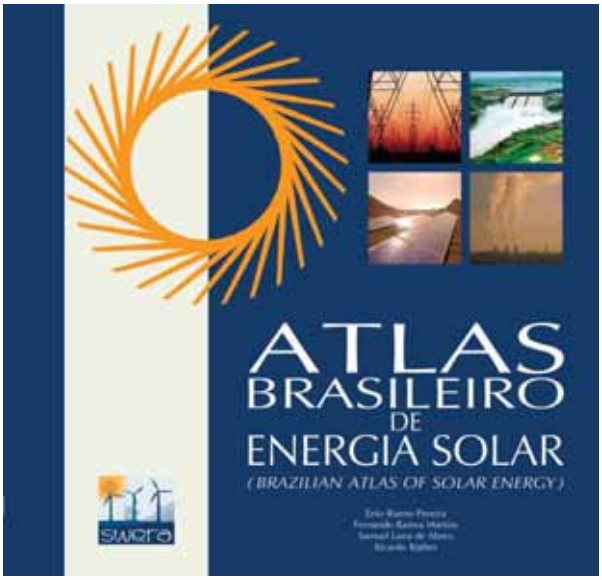


Fonte: Wikipedia

Average Annual Solar Radiation (UFPE – CEPEL)



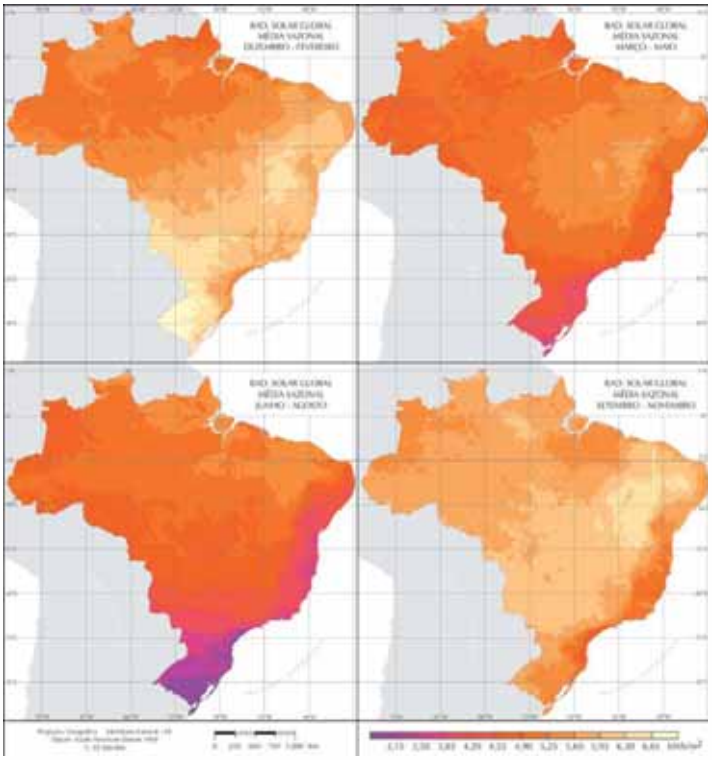
Newest Atlas: The Swera Project



SWERA:
Solar and Wind Energy Resource Assessment

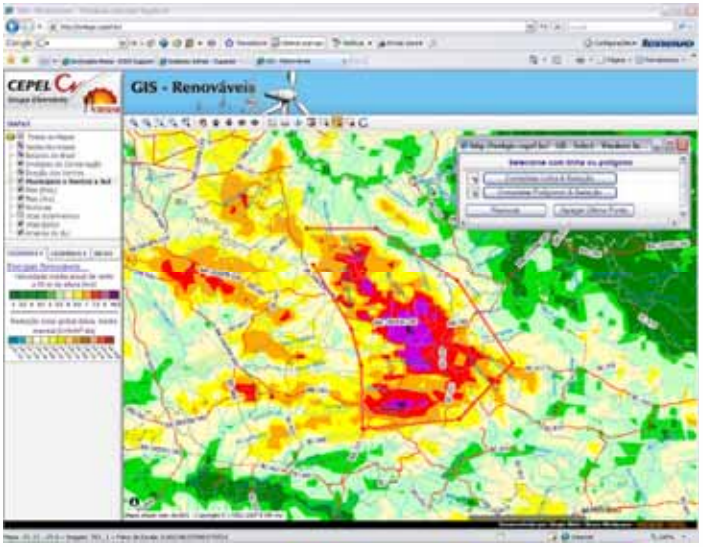
A project sponsored by the United Nations Environment Program (UNEP) and Global Environmental Facility (GEF)

Newest Atlas: The Swera Project



Renewable WEB GIS

A new tool for Web resource assessment



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II – Characteristics and Possible Applications

Main Solar Applications (Active Solar)

- Solar Thermal (Low Temperature)
- Solar Thermal (High Temperature)
- Solar Photovoltaic (PV)

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Solar Heating

Solar Heating

- **3.1 x 10^6** m² is the area of solar heating collectors installed

  In Brasil (84% in the residencial sector; 15% in hotels and services; 1% in industrial sector)

- But this represents only **1.72** m² for 100 thousond inhabitants, far behind Cyprus (84.4), Barbados (26.9) e Turkey (13.5)

- The average increasing rate of installed area in Brasil is **14%,** while in Canadá is 50%, in Germany 39%, France and Grece around 34%.

Great opportunities to increase the use, both in residential and business applications. We need incentive legislation and credit to drive in this direction.

Main Solar Applications (Active Solar)

Solar Thermal (Low Temperature)

→ Solar Thermal (High Temperature)

Solar Photovoltaic (PV)

Direct Conversion of Solar Radiation – CSP Systems

Dishes

Cilinders

A 10 kW System by CEMIG

Hybrid of solar and fuel oil

Direct Conversion of Solar Radiation

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Central Tower

CEPEL´s Experience

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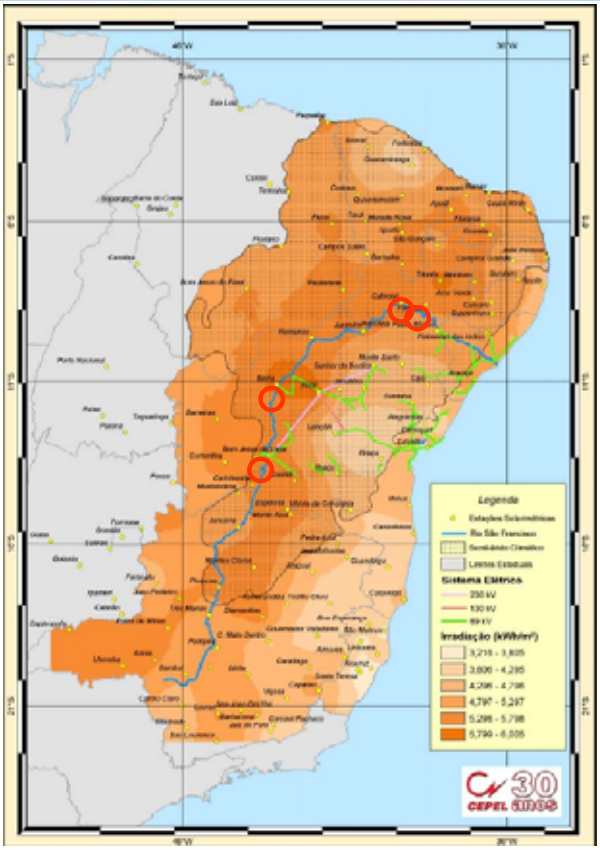
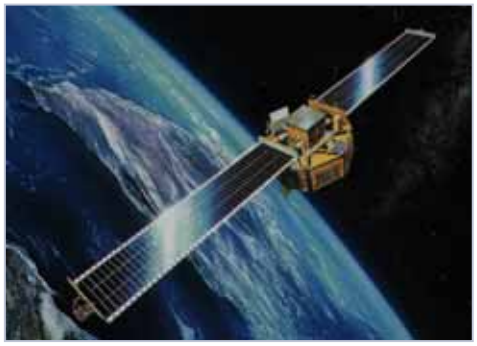


Ref: Caracterização de Sítios Potenciais na Região do Semi-árido Brasileiro para Implantação de Sistema Piloto Heliotérmico de Geração Elétrica, RT CEPEL DG 1105/2002.

	Sítios Potenciais	Justificativas
Opção 1	Barra (BA)	Irradiação Direta Anual = 2,14 MWh/m^2 Linhas de Transmissão de 69kV Disponibilidade de Subestação
Opção 2	Petrolina (PE)	Irradiação Direta Anual = 2,04 MWh/m^2 Linhas de Transmissão de 69kV e 138kV Disponibilidade de Subestação
Opção 3	Cabrobó (PE)	Irradiação Direta Anual = 2,00 MWh/m^2 Linhas de Transmissão de 69kV e 138kV Disponibilidade de Subestação
Opção 4	Bom Jesus da Lapa (BA)	Irradiação Direta Anual = 1,99 MWh/m^2 Linhas de Transmissão de 69kV e 138kV Disponibilidade de Subestação

With lower costs, CSP can be an important source of energy in Brasil, specially in the Northeast Region.



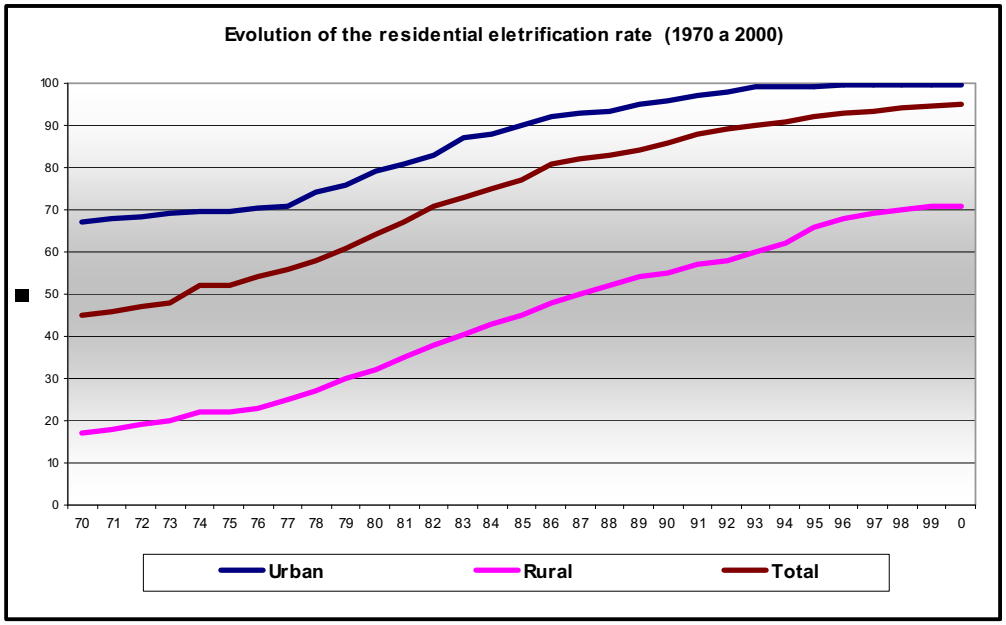
PV – Grid Connected

PV Neurather See (Alemanha) 360kWp

CEPEL´s Solar Roof

- Evaluation of grid connected systems
- PV Systems, 16 kWp, operating since 2002

Universalization: chalenges

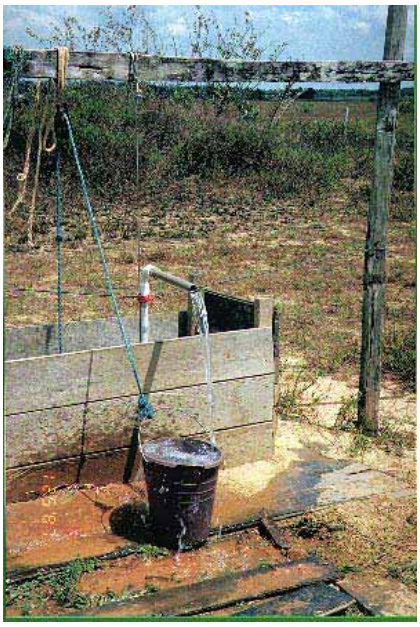


Source: CEPEL-DTE Report - 211035/2003 - giannini@cepel.br

Ministério de Minas e Energia

LPT 05.09.07

Region	Acummulated Connections	Number of People	Resources (R$)
Norte	183.496	917.480	718.352.612,02
Nordeste	614.919	3.074.595	2.019.508.013,03
Sudeste	292.228	1.461.140	643.597.231,31
Sul	106.740	553.700	203.594.187,27
Centro-Oeste	93.789	468.945	387.784.257,47
TOTAL	**1.291.172**	**6.358.420**	**3.972.836.301,10**



Community pumping system

Pumping system and health center

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Community TV set

Small farm pumping system

Instalações Fotovoltaicas Projeto Ribeirinhas – Amazonas (Parceria Eletrobrás)

Transporte dos equipamentos fotovoltaicos

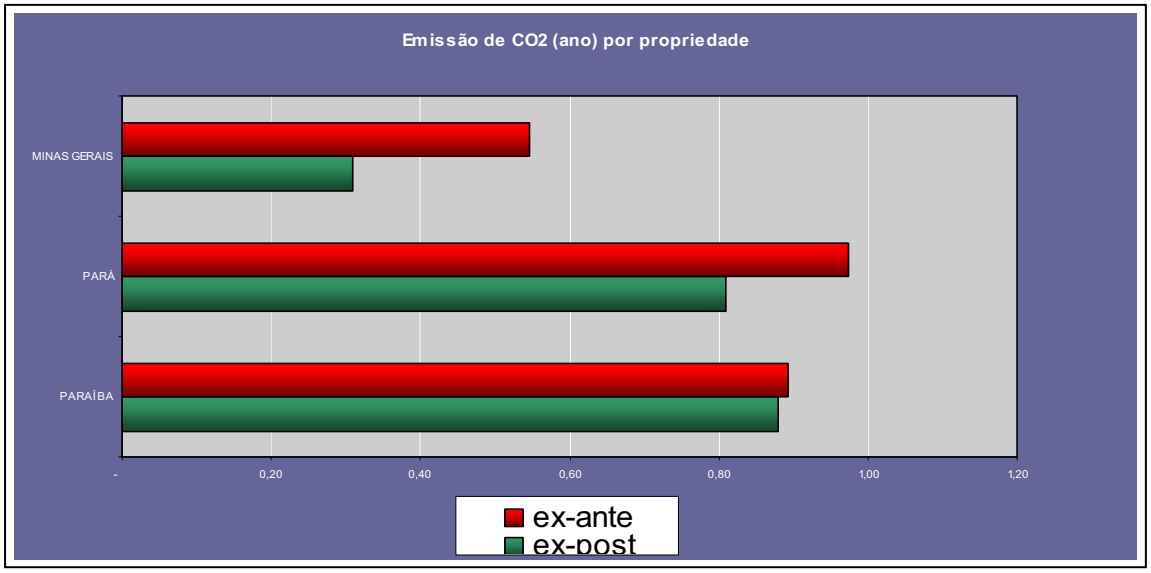
Sistema solar fotovoltaico instalado em N.S.P. Socorro – Manacapurú

Cepel – Eletrobrás rural electrification assessement

Almost 9000 rural properties analised after electrification

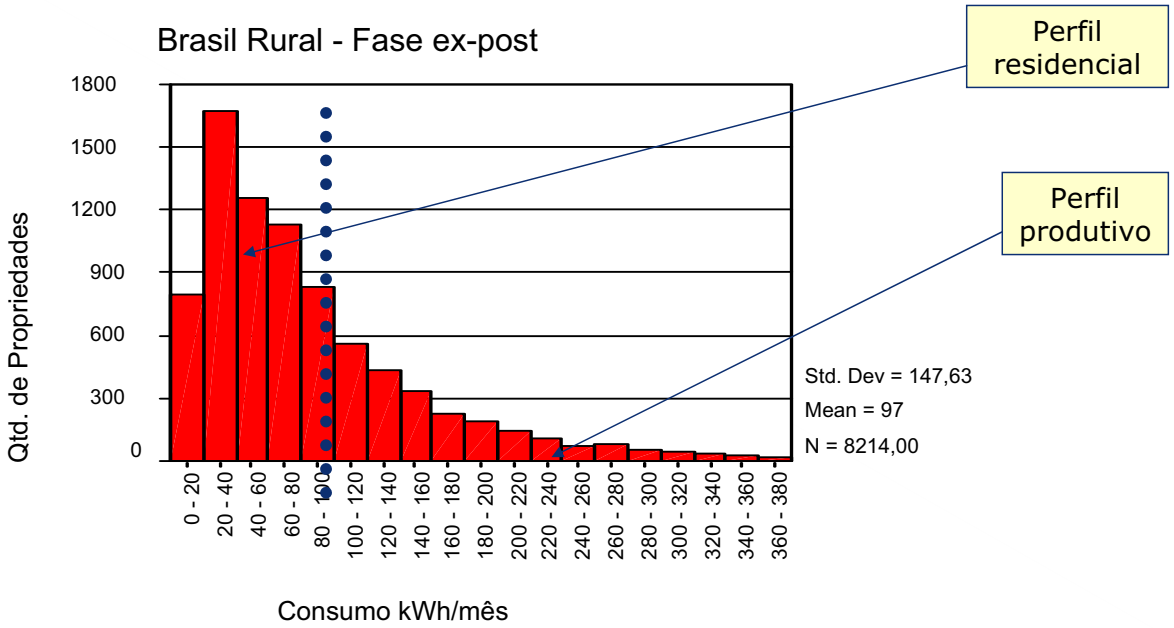
Rural Eletrification and CO2 Emission

- Drop of the emission in the majority of states
- **PARAÍBA:** 2% , **PARÁ:** 17% e **MINAS GERAIS:** 43%



Rural Areas – Eletricity Consumption

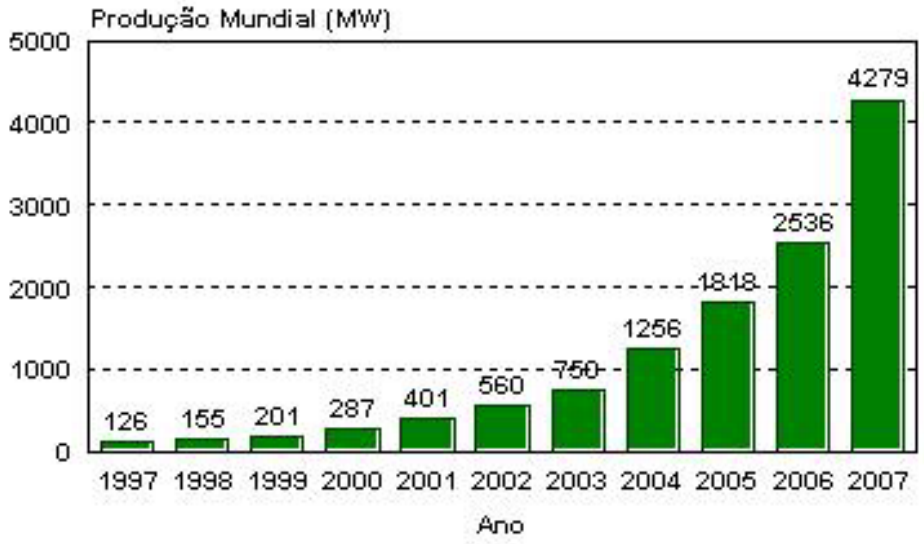
Consumo de Energia Elétrica



- **PV seems to be the natural solution for small communities electrification far from the grid. But PV solutions has to come together with programs of improving the production capabilities of the community. If not, there is a risk to have just a waste of resources.**

- **We do not produce PV modules in industrial scale anymore but producing equipment in Brasil generates much less CO2 emissions (clean electricity mix)**

PV WORLD PRODUCTION (MW)



III – Conclusions

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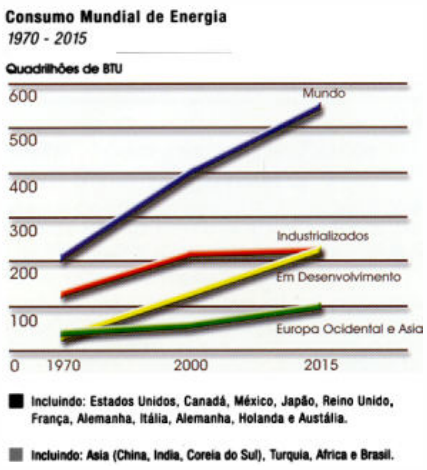
•With lower prices of equipment, due to technical improvements and production scale, higher prices of conventional sources and the increasing concern with environmental impacts, the penetration of renewable energies can be higher than conservative nowadays forecast.

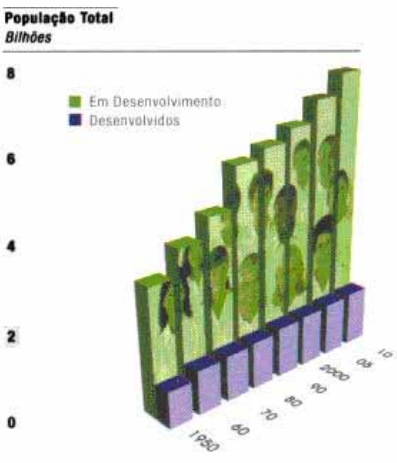
• Intermediate and small systems can be economically feasible in specific applications even with the present price conditions.

- **Brasil is already a renewable energy country (hydro and biomass). This can be a barrier to the introduction of other renewable sources if their costs are significantly higher than other alternatives.**

- **Joint programs between countries and regions, changing technology and experiences, exploring synergies and improving production scale, seems to be a way to lower costs and strength the role of renewable energies in the near future.**

Population Growth





FONTE: Informativo da Eletronuclear - agosto 2001

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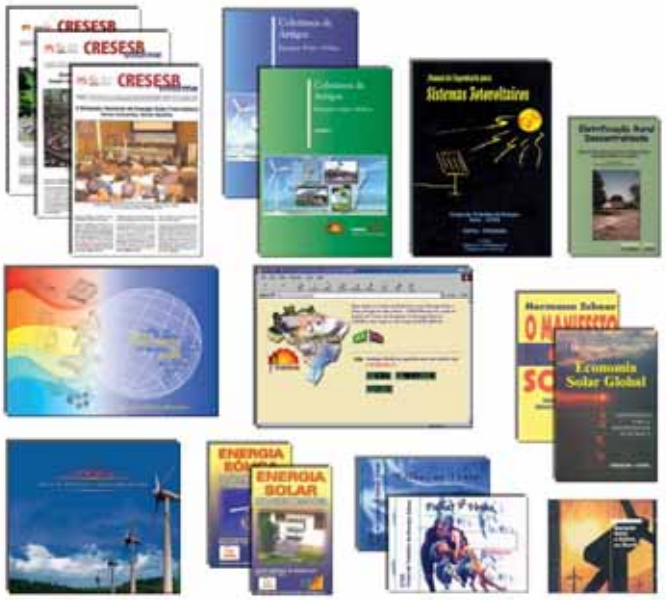

OBRIGADO PELA ATENÇÃO!

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A energia que movimenta o Brasil

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