



PRE-REQUISITES FOR BIOFUEL PROGRAM PROMOTING SUSTAINABLE DEVELOPMENT

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TABLE 1
LONG TERM TECHNICAL POTENTIAL - RENEWABLE ENERGY SUPPLY

	Long-term Technical Potential (EJ/yr)	Demand for SRES Scenario ranges 515-2737 EJ/yr
HYDRO	>50	
GEOTHERMAL	>20	
WIND	>630	
OCEAN	>20	
SOLAR	>1600	
BIOMASS	>440	
TOTAL RENEWABLE	>2800	

SOURCE: IPCC, 2001

	TABLE 3 THE PROSPECTS FOR PLANTATIONS IN DEVELOPING REGIONS^a MILLION HECTARES					
	Cropland Measures			Alternative measures of land areas potentially available for plantations		
	Present Cropland ^b	Potential Cropland ^b	Cropland Required in 2025 ^c	Excess Potential Cropland in 2025 ^d	10% of Cropland + perm. Pasture + forest & wood-lands ^e	Degraded lands suitable for reforestation ^f
LATIN AMERICA	179.2	889.6	269	621	171	156 (+ 32)
AFRICA	178.8	752.7	268	484	176	101 (+148)
ASIA (ex-China)	348.3	412.5	522	-110	111	169 (+ 150)
TOTAL	706.3	2,054.9	1,059	995	458	426 (+330)

a. Except for the last two columns on the right, the data here are for the 91 developing countries for which the FAO estimated potential cropland areas (FAO, 1991).


b. From Table 2

c. The response Strategies Working Group of the Intergovernmental Panel on Climate Change has estimated that the area required for cropland in developing countries will increase 50 percent by 2025 (IPCC, 1991)

d. This is the difference between the potential cropland and the cropland requirements in 2025.

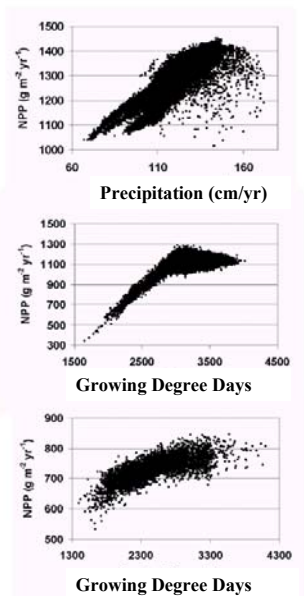
e. World Resources Institute, 1992.

f. The data refer to all countries on these continents, including China. The first entry is the sum of the land areas in logged forests, forest fallow, and deforest watersheds-all of which are estimated to be suitable for reforestation (Grainger, 1988). The number in parenthesis is 1/5 of the desertified drylands-the fraction of desertified drylands in developing countries estimated to be suitable for reforestation (Grainger, 1988).

	TABLE 2 PRESENT ^(a) AND POTENTIAL ^(b) CROPLAND FOR 91 DEVELOPING COUNTRIES MILLION HECTARES							
	Present Cropland	Potential Cropland						Total
		Low Rainfall	Uncertain Rainfall	Good Rainfall	Natural Flooded	Problem Land	Desert	
CENTRAL AMERICA	37.6	2.2	13.3	18.5	5.7	31.4	3.5	74.6
SOUTH AMERICA	141.6	26	37.5	150.3	105.7	492.7	2.8	815.0
AFRICA	178.8	73.4	96.8	149.3	71.3	358.1	3.8	752.7
ASIA (ex-China)	348.3	59.8	67.0	67.4	80.5	117.1	20.3	412.5
TOTAL	706.3	161.4	214.7	385.5	263.1	999.7	30.4	2,054.9

a) World Resources Institute, 1992

b) As estimated by the Food and Agriculture Organization (FAO) in 1991 (FAO, 1991). Potential cropland is defined by the FAO as all land that is physically capable of economic crop production, within constraints. It excludes land that is too steep or too dry or having unsuitable soils.



Relationships between predicted NPP and climate for each forest type: (a) hardwood NPP vs. annual precipitation, (b) pine NPP vs. annual growing degree days and (c) spruce-fir NPP vs. annual growing degree days. In data points falling off the relationship to the upper right reflect high elevation areas where temperature limitations become increasingly important.



Table 4 Direct Employment Requirements

Sector	Fuel Production (person-years per million tonnes oil equivalent)	Power Generation (person-years per TWh)
Natural Gas	428	250
Petroleum	396	260
Offshore oil	450	265
Coal	925	370
Nuclear	100	75
Energy saving	2000	-
Bioenergy (solid fuels)	2500	1145
Wood energy	4500	1000
Bioenergy (net of displaced jobs)		28-406

SOURCE: Grassi (1996), Scrase (1997)

PRE REQUISITES

TECHNICAL ASPECTS

- **Immediate availability of technology for**
 - Plantation or Forest/Crop Management
 - Harvesting or Collection
 - Transportation
 - Processing to Useful Energy
 - Distribution System to Reach Final User
- **Appropriate Physical Conditions**
 - Warm weather
 - High Solar Radiation
 - Medium to high availability of water
 - Land area
 - Modest to Good Soil Quality
- **Availability of Low/Medium Cost Manpower**

Figure 4:
Production Cost Ranges for Fossil and Renewable
Resources: 1990, 2000, 2005

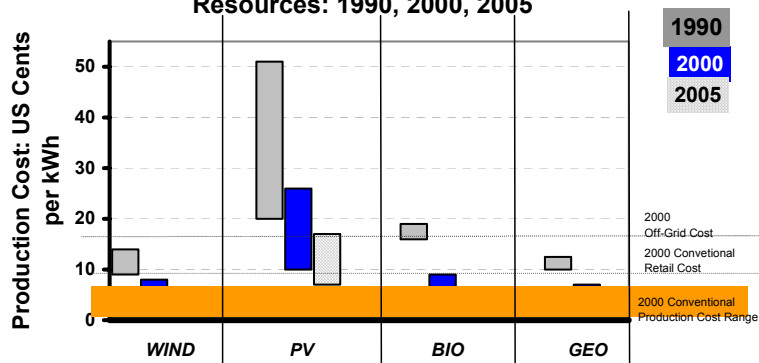
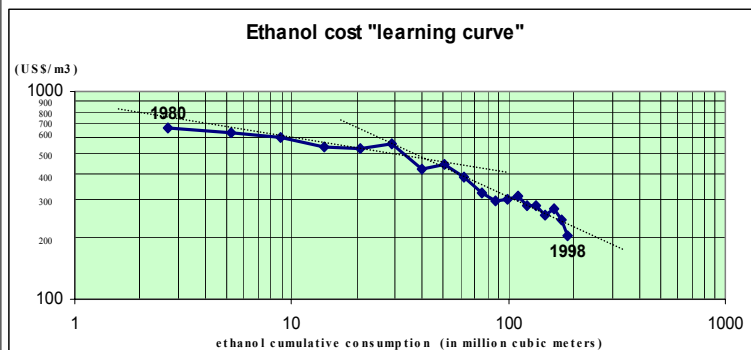
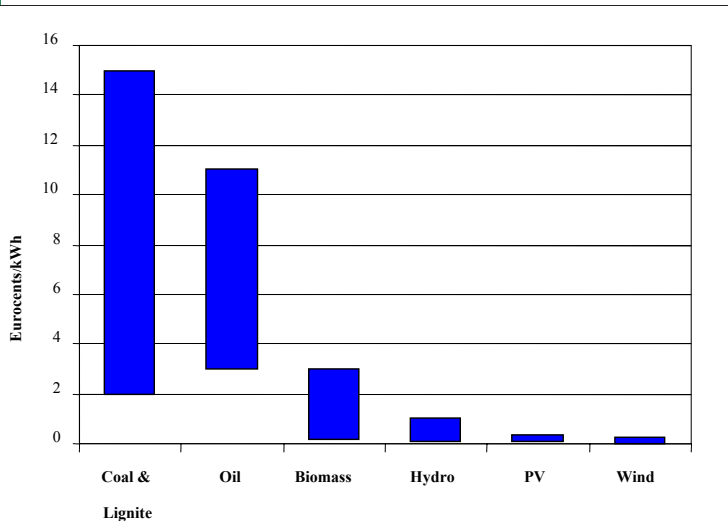


Figure 5: External costs for electricity production in the EU in Eurocent/kWh.
Source: Data from the European Commission - ENERGIE Programme (European Union 5th Research and Technological Development Framework Programme).



PRE REQUISITES (Continuation 1)

ECONOMIC ASPECTS

- Interest in Creation of Medium/Low Employment Opportunities
- Capital availability for Investment
- Medium/Low Production Cost for Biofuel

Table 5 Renewable Energy Markets in Developing Countries	
Application	Indicators of Existing Major Markets
1. Rural residential and community lighting, TV, radio, and telecom	11 million households receive lighting from biogas 950,000 households with solar home systems (out of 300-500 million households not connected to electric grid) 170,000 household-scale wind-power generators 25,000 PV-powered cellular and satellite phones (serving a rural community)
2. Rural small industry, agriculture, and other productive uses	10,000 PV or wind-powered water pumps (out of 10 million off-grid water pumps total, mostly diesel powered) 100 PV-powered drinking water purifiers/pumps 40 MWp PV for off-grid industrial and telecommunications needs
3. Village-scale mini-grids	5,000 small hydro mini-grids (relative to 100,000 diesel-powered mini-grids) 200 solar or wind hybrid village mini-grids (with diesel)
4. Rural residential and commercial cooking	250 million more-efficient biomass stoves (out of [#] households that use biomass for cooking) 7000 solar cookers 20000 households cook with biogas fuel
5. Residential/commercial heating	110,000 homes with solar hot water systems 8700 MWth geothermal direct heat production
6. Grid-based bulk power markets	55,000 MW installed capacity producing 200,000 GWh/year (mostly biomass and small hydro) ^[1]
7. Transport fuels	15 billion liters/year ethanol vehicle fuel produced from biomass 180 million people live in countries mandating mixing of ethanol with gasoline

Source: E. Martinot, 2002

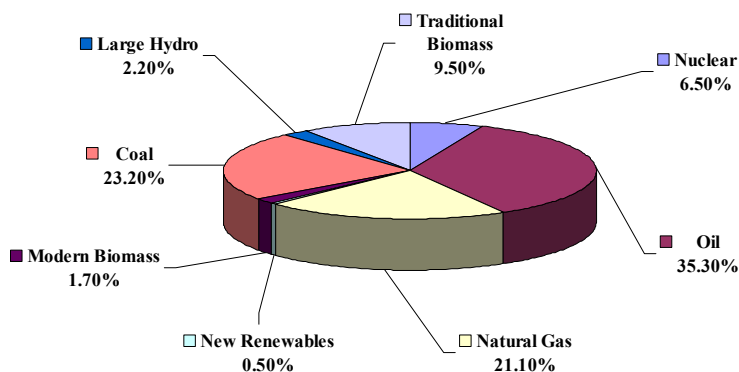
^[1] Some of this capacity serves small village mini-grids rather than central power grids

**TABLE 6 – RENEWABLE ELECTRICITY GRID-BASED
GENERATION CAPACITY INSTALLED AS OF 2000 (MEGAWATTS)**

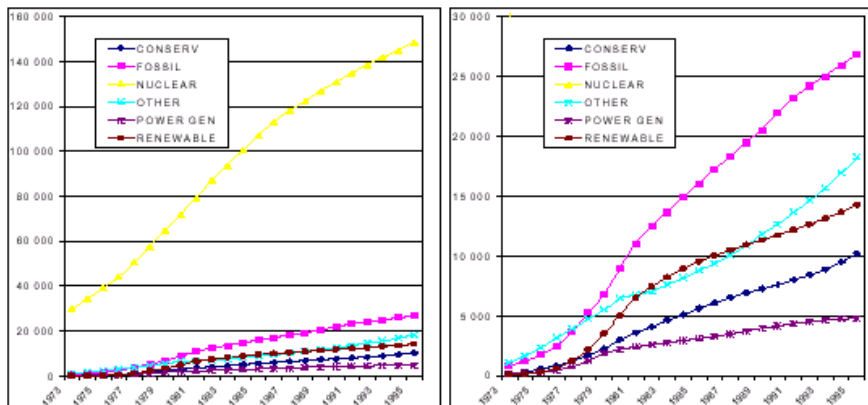
Technology	All countries	Developing countries
Wind power	18,000	1,700
Small hydropower	36,000	19,000
Biomass power	38,000	30,000
Geothermal power	8,500	3,900
Solar thermal power	350	0
Total renewable power capacity	100,000	55,000
Large hydropower	680,000	260,000
Total world electric power capacity	3,400,000	1,500,000

SOURCE: Martinot et al, 2002

**World Consumption of Primary Energy and Renewables,
by Energy Type - 1998**



CUMULATIVE PUBLIC ENERGY R&D by MAIN CATEGORY (106\$90)



CUMULATIVE PUBLIC ENERGY R&D – RENEWABLE ENERGY (106\$90)

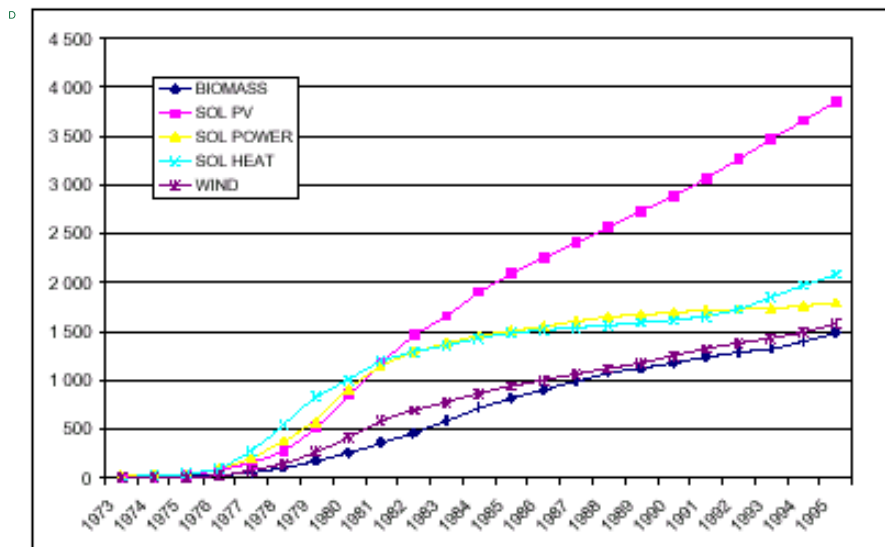
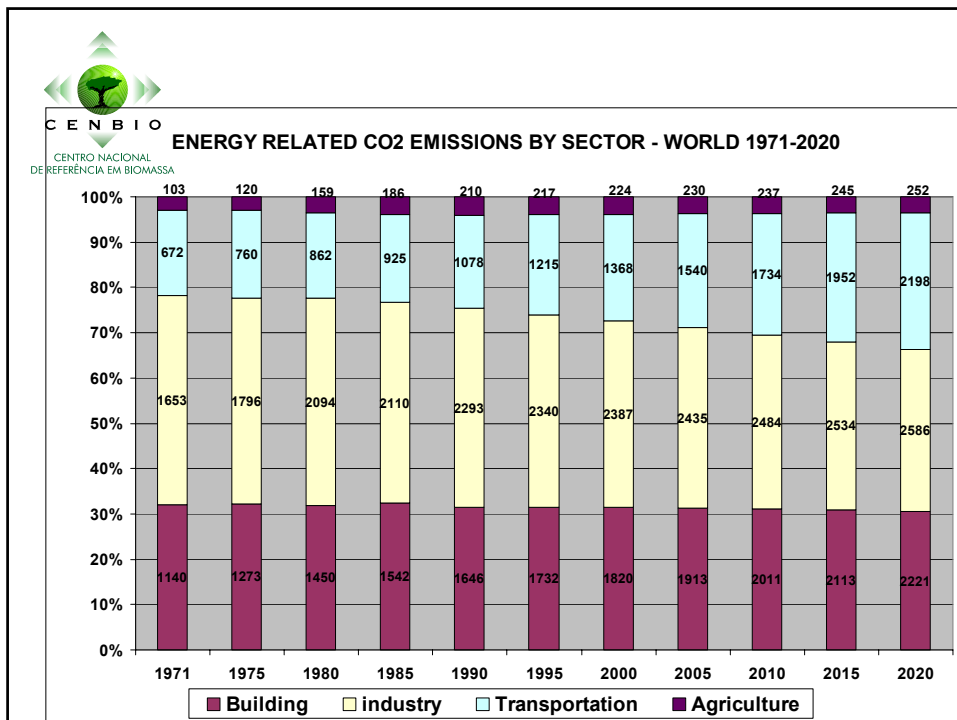
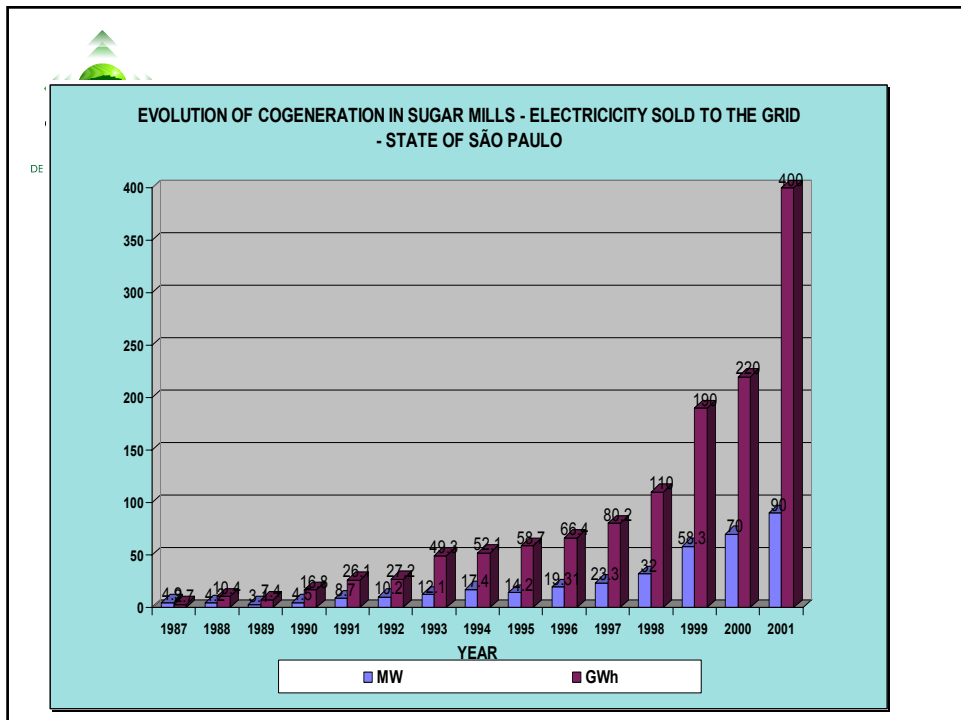


Table 2: Market Forces		
Forces stimulating RE →	G8 vehicles to influence forces ←	Forces restraining RE
Aspirations to eradicate poverty	National RE plans	Lack of awareness of RE options/ benefits in DC's, IFI's & lack of co-ordination
Aspirations to improve local/global environment		Vested interests and subsidies for conventional energy, ignorance
Aspirations to diversify for energy security		Vested interests in conventional energy, ignorance
Energy market liberalisation		Decrease ODA/IFI support for energy projects
Cost reductions for RE technology		Lack of awareness / trust / familiarity with RE technology, other barriers to RE project development; apparent cost competition
Increased FDI / trade promotion Increased role of private sector	ECA, public-private-partnership, tax and other incentives, risk mitigation, global corporate initiative	Vested interests in conventional energy and export credit support Decreased role of government
Global integration	Coherent action, policy co-	Market immaturity





PRE-REQUISITES (Continuation 2)

INSTITUTIONAL ASPECTS

- **Availability of Legislation for**
 - **Recognition of Independent Power Producer**
 - **Enforcement of Production and Use of Alternative Sources of Energy**
 - **Short-term Subsidies or Levelized Playing Field between Energy Sources**
- **Existence of Institution Caring Specifically of Alternatives Sources of Energy**

ENVIRONMENTAL ASPECTS

- **Society Awareness on Such Issues**
- **Synergism with Environmentally Sound Practices**

SOCIO – ECONOMIC ASPECTS

- **Country Decision to Invest in Energy**
- **Political Support**
- **Synergism with Sustainable Development**