



# 1. Definition of Renewable Energy

Any energy resource that is naturally regenerated over a short time scale and derived

- directly from the sun (such as solar thermal, photochemical, and solar photovoltaic),
- indirectly from the sun (such as wind, hydropower, and photosynthetic energy stored in biomass), or from
- other natural movements and mechanisms of the environment (such as geothermal and tidal energy)

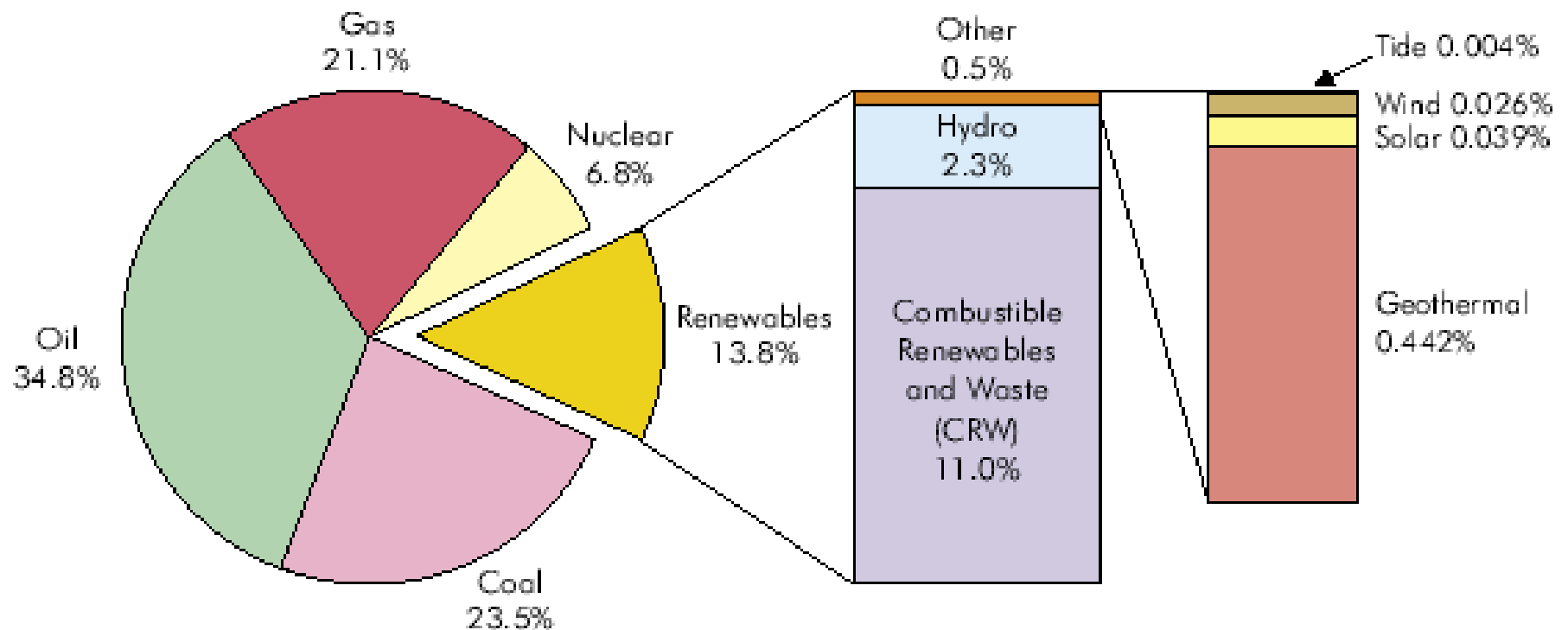
## 2. Global Renewable Energy Utilization Status

### Global Installed Capacity of Commercial RETs

Technology	Installed Capacity (approximate estimation)
Small Hydro	> 43,000 MW
Biomass	> 35,000 MW
Wind Power	> 32,000 MW
Geothermal	> 9,000 MW
Solar Photovoltaic	> 1500 MW
Solar Thermal	350 MW

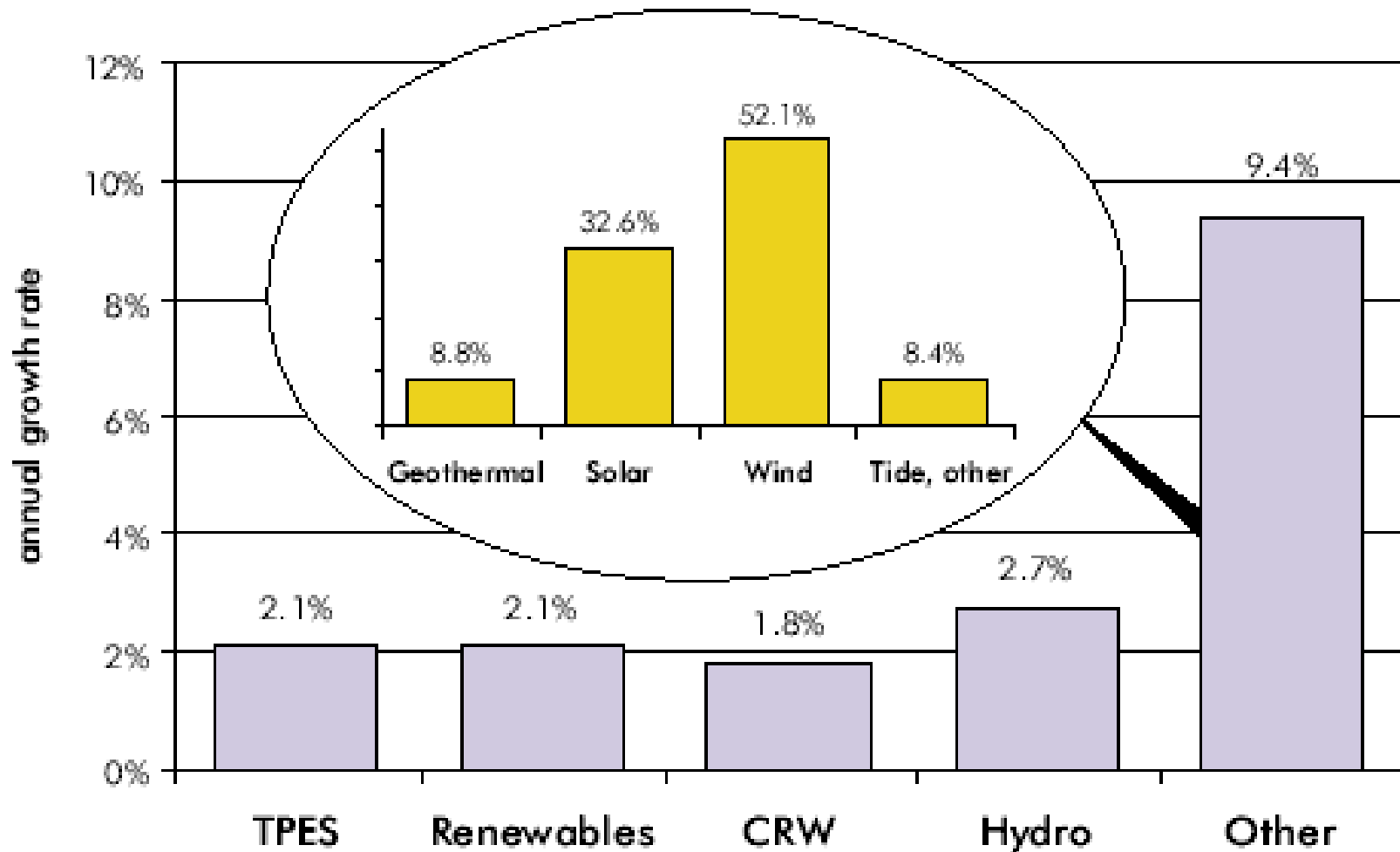
## 2. Global Renewable Energy Utilization Status (continued...)

### World's Total Primary Energy Supply In 2000 [IEA]



## 2. Global Renewable Energy Utilization Status (continued...)

### Annual Growth of Renewables Supply from 1971 to 2000 [IEA]



# 3. Energy Services offered by Renewables



- Ø **Green Electricity** (Wind, SHP, Solar, Geothermal, Marine, Biomass)
- Ø **Green Heat** (Solar thermal, Geothermal, Biomass)
- Ø **Green Fuel** (Bio-diesel, Ethanol, Methanol)
- Ø **Shaft Power** (Wind, SHP)



# 4. Drivers for Renewables

- Ø Environment Pollution (Emission, Kyoto) - Canada
- Ø Energy Security (diversification) - Germany, Denmark, Japan, India
- Ø Expansive Off-grid Electrification (developing countries) – Bangladesh, India, South Africa

《Remaining Fossil Fuel Supply in Number of Years and Extractible Volume》

Fossil Fuel	Petroleum	Uranium	Natural Gas	Coal
Runs out in (Date of estimate)	<b>43</b> years (January 1998)	<b>72</b> years (January 1997)	<b>62</b> years (January 1998)	<b>231</b> years (Late 1993)
Extractible volume	1,195 billion barrels	4.36 million tons	144 trillion cubic meters	10,316 trillion tons



## 5. Resource Potential

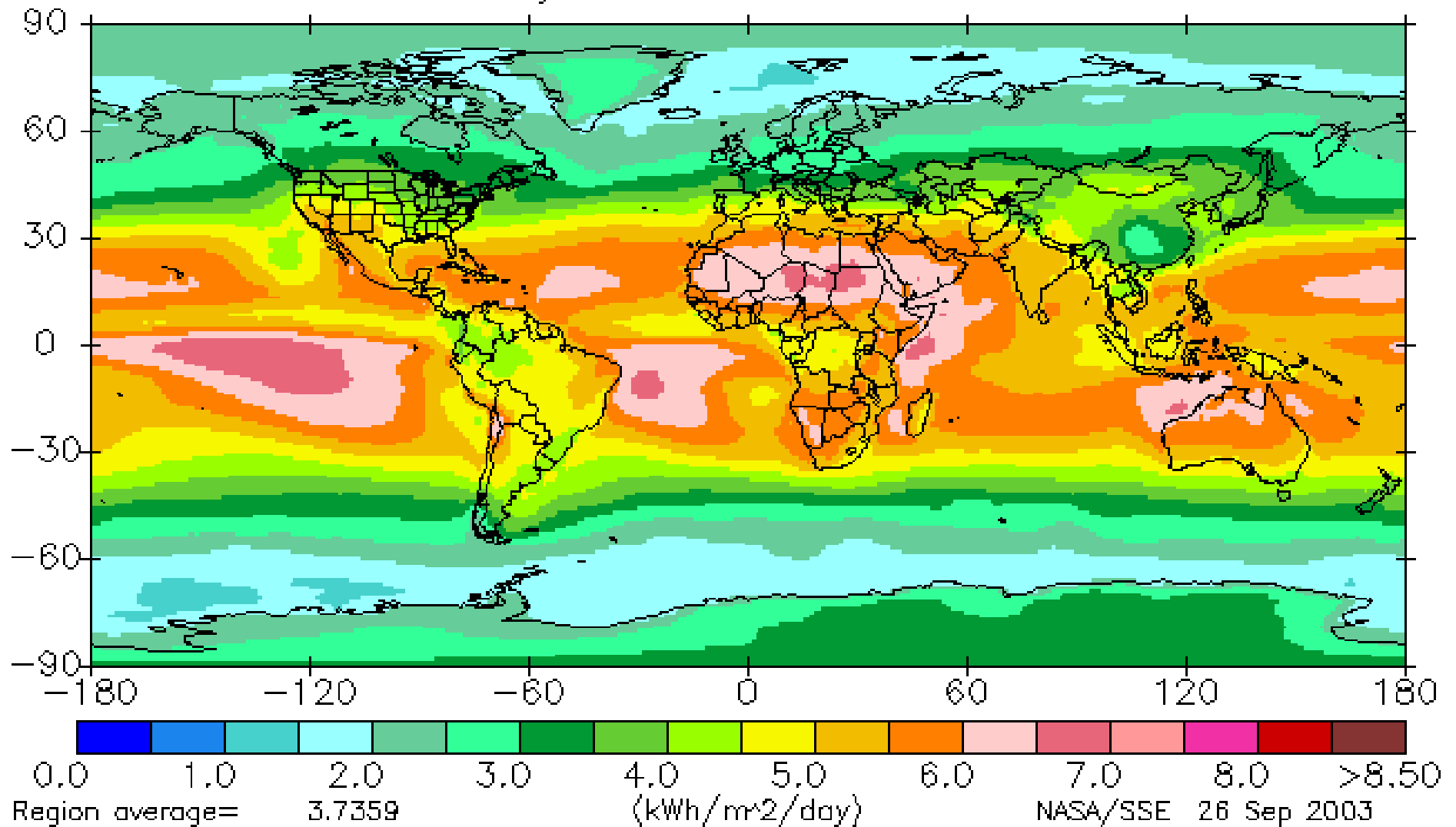
- Ø Renewable energies are highly site specific.
- Ø Renewables are intermittent source of energy.
- Ø Before undertaking a RETs project, resource assessment is must.
- Ø Among all the renewables, only solar energy can be harnessed anywhere in the world.
- Ø Reliable data for RETs projects does not exist in many countries (SWERA Project in 13 countries)

## 5. Resource Potential (continued...)

# Solar Energy Potential

Annual Insolation

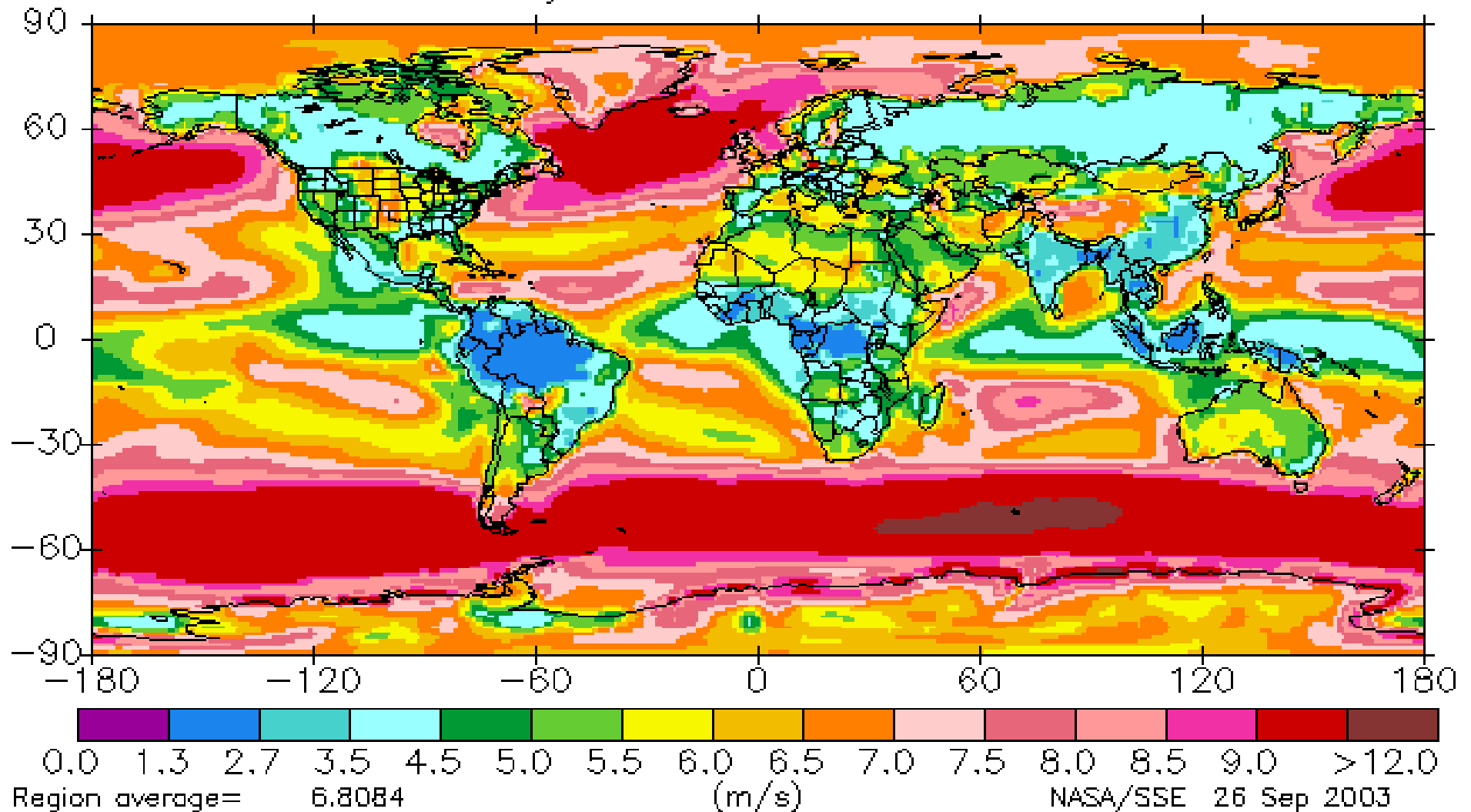
July 1983 – June 1993



## 5. Resource Potential (continued...)

### Wind Power Potential

Annual 50m Wind Speed  
July 1983 – June 1993



## 5. Resource Potential (continued...)

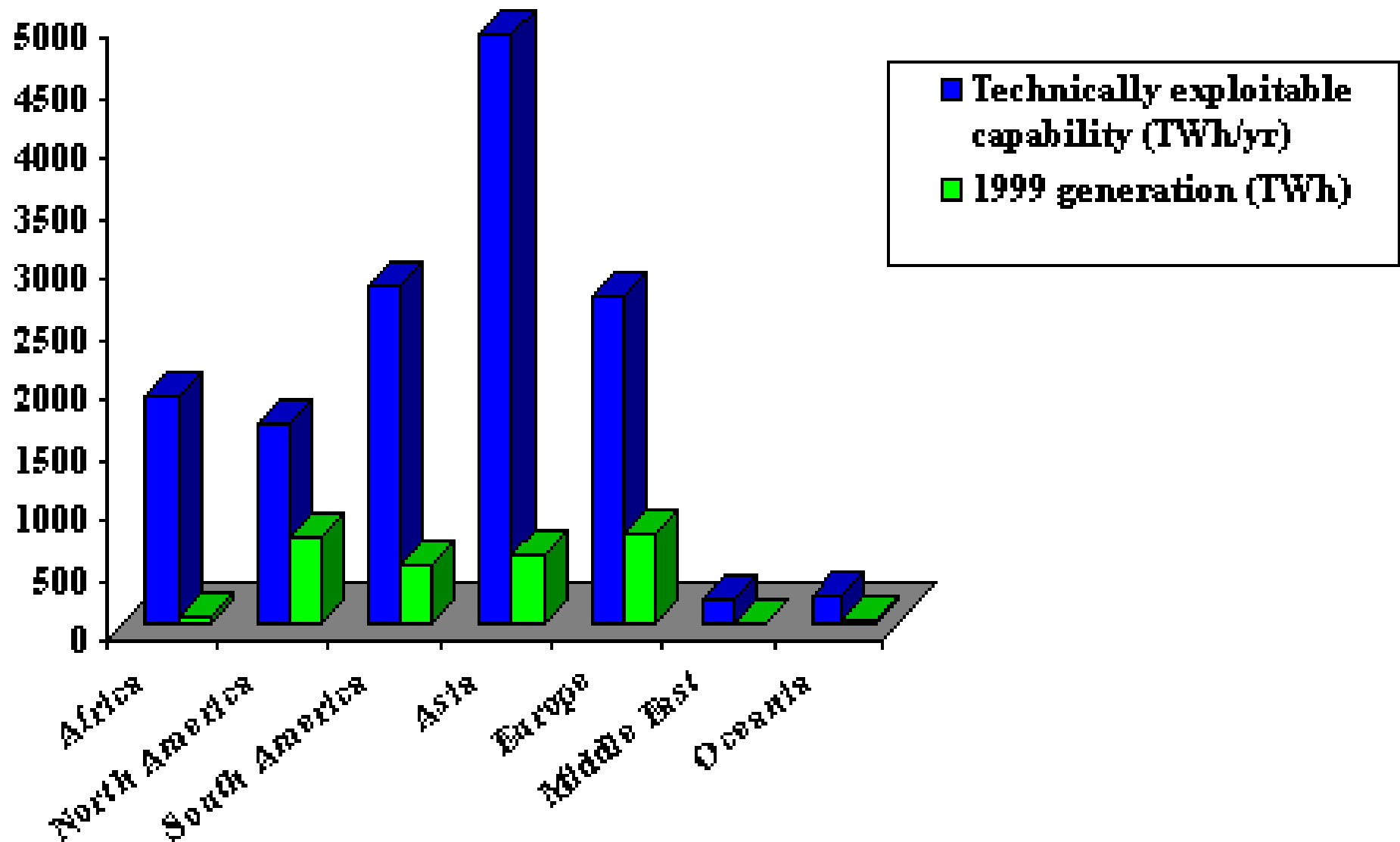
### Biomass Potential : Global Vegetation Distribution



**Green** : Vegetation coverage - **Brown** : Deserts  
**White** : Snow and ice - **Blue** : Ocean Waters

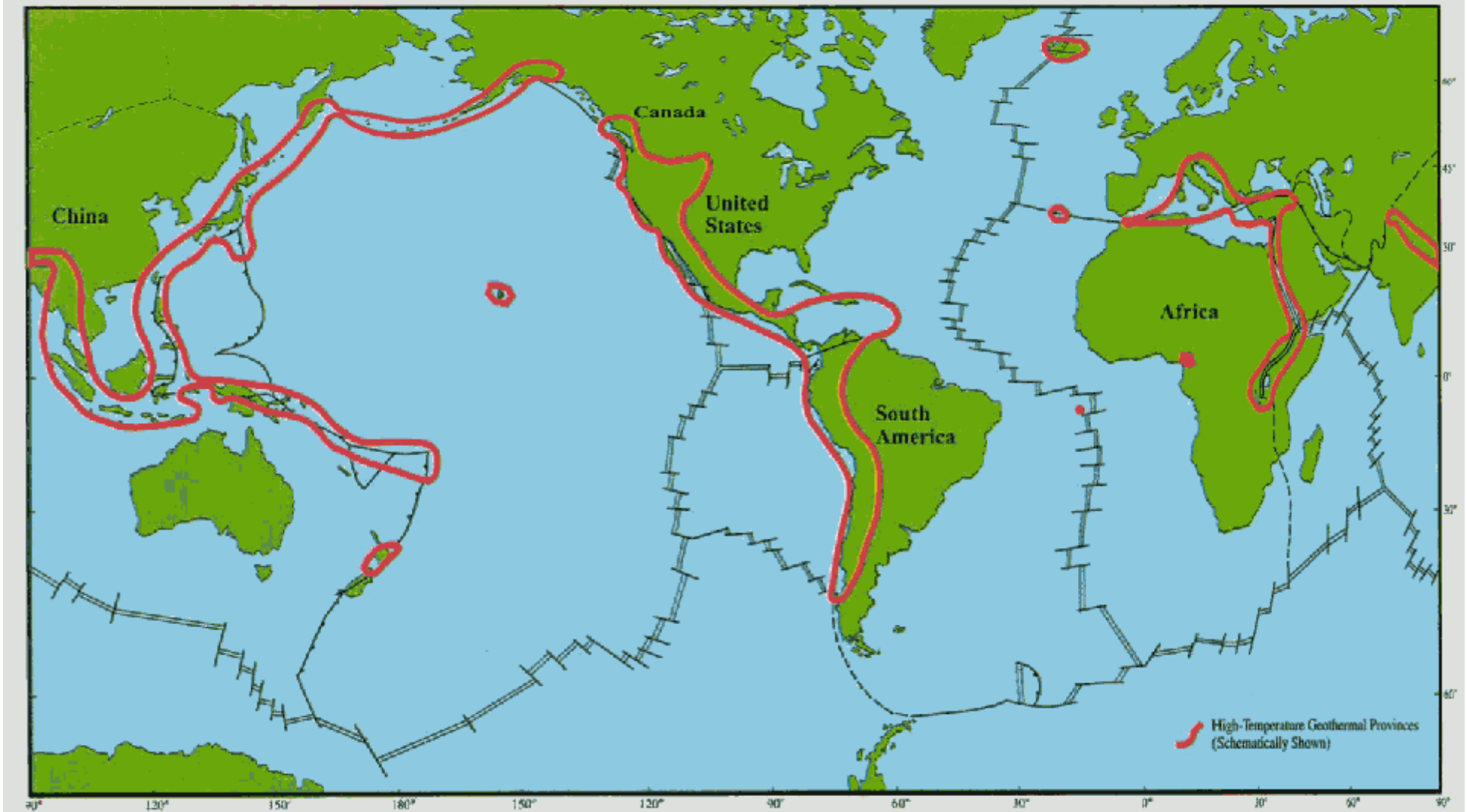
## 5. Resource Potential (continued...)

### Hydropower Potential :Regional Distribution



## 5. Resource Potential (continued...)

# Geothermal Potential



**Ground-source heat pump can be used almost anywhere.**



## **6. Success Stories**

- Ø Wind Power in Germany**
- Ø Solar PV Market of Japan**
- Ø Domestic Solar Collector Market of China**
- Ø Small Hydro Power (SHP) in China**
- Ø 'ProAlcool' Programme of Brazil**
- Ø Solar Home System (SHS) installations by Grameen Shakti in Bangladesh**
- Ø Family Hydro in Vietnam**
- Ø Wind Home Systems at Inner Mongolia of China**

## 6. Success Stories (continued...)

### Wind Power in Germany

- Ø Most successful wind power programme in the world with 14,283 wind turbines
- Ø 12,828 MW Installed Capacity (More than 1/3<sup>rd</sup> of total global installations)
- Ø 17 pfennig (9 US cents) per kWh



## *6. Success Stories (continued...)*

### **Solar PV Market of Japan**

- Ø Most Successful PV Program in the world.**
- Ø Installed Capacity of 250 MW**
- Ø Manufacturing 50% of total global capacity**



## 6. Success Stories (continued...)

### Domestic Solar Collector Market of China

- Ø Up to **10 million households** served
- Ø Cumulative surface area of **26 million m<sup>2</sup>**.
- Ø Annual **growth rates of 10-20%** and
- Ø Over a thousand factories manufacturing and selling solar systems.



## *6. Success Stories (continued...)*

### **Small Hydro Power (SHP) in China**

- Ø Installed around half of the world's SHP capacity**
- Ø 20,000 MW installed capacity**



## *6. Success Stories (continued...)*

### **'ProAlcool' Programme of Brazil**

**Ø More than two thirds of global ethanol is consumed in Brazil.**

**Ø In 2000, 40% of automobile fuel consumption and 20% of total motor vehicle fuel consumption in Brazil was ethanol**

**Ø Government policies mandate the blending of ethanol with all petrol sold and all petrol stations must sell pure ethanol**

**Ø US\$140 billion has been saved over the past 25 years**

## 6. Success Stories (continued...)

# SHS installations by Grameen Shakti in Bangladesh

- Ø On June 1996, **Grameen Shakti (GS)** came into existence as a renewable energy company.
- Ø GS has already installed 15,000 Solar Home System (SHS) in Bangladesh.



## *6. Success Stories (continued...)*

### **Family Hydro in Vietnam**

- Ø **Over 100,000 low-income households living in rural, rice-farming regions of Vietnam rely upon family-hydro (between 100 and 200W)**
- Ø **Used for domestic lighting, radio and, in some cases, televisions.**



## *6. Success Stories (continued...)*

### **Wind Home Systems at Inner Mongolia of China**

- Ø **More than 140,000 households have been electrified with small wind generators in the range of 100 to 300 W.**
- Ø **Nomadic herdsman typically use wind systems for lighting and television.**

