united nations
educational, scientific
and cultural
organization

international atomic
energy agency

the
abdus salam
international centre for theoretical physics

SMR.1524 - 5

College on Evaluation of Energy Technologies and Policies for Implementation of Agenda-21

10 - 28 November 2003

Sustainable Energy Devleopment and Agenda-21

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Sustainable Energy Development and Agenda-21

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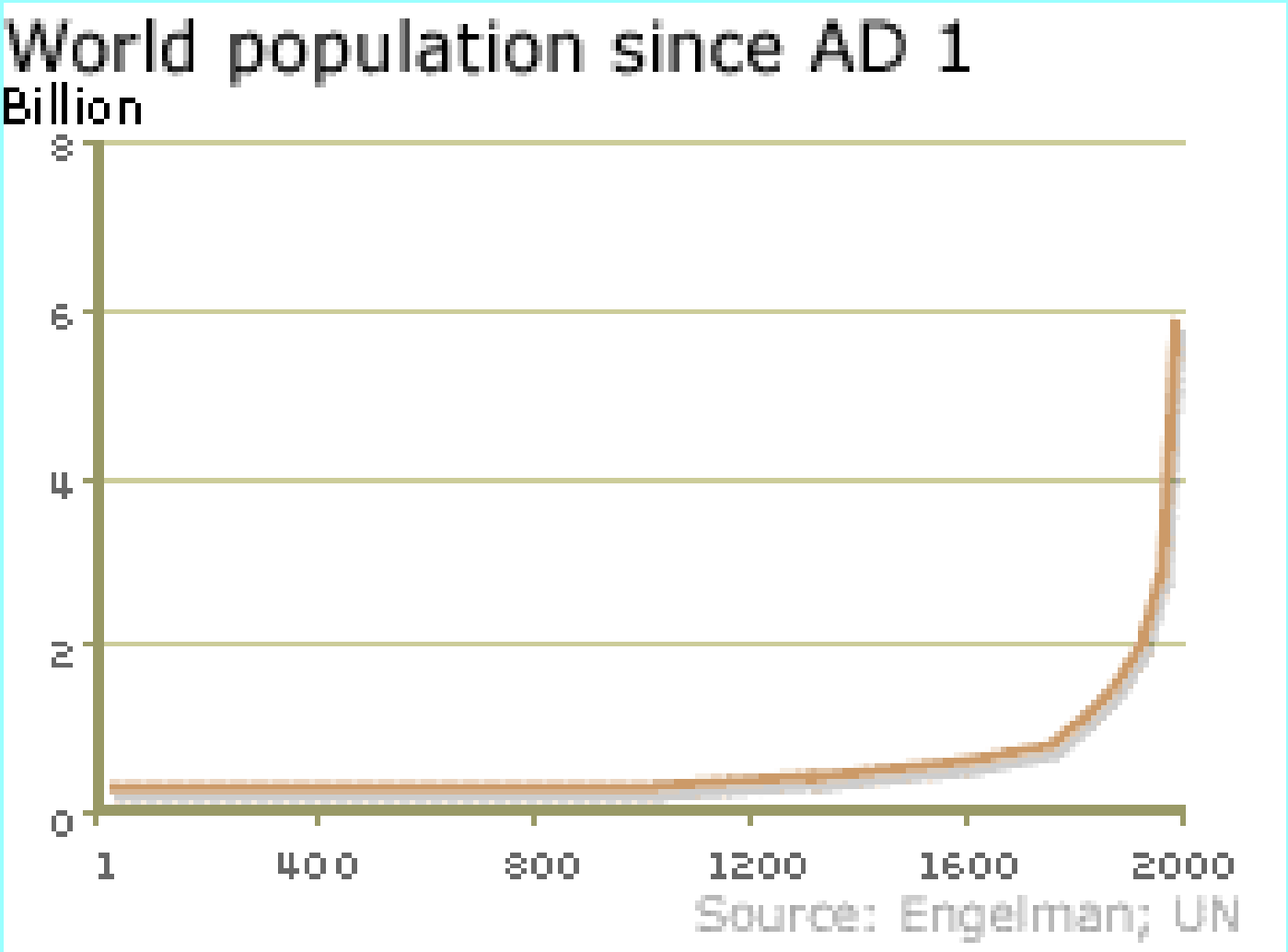
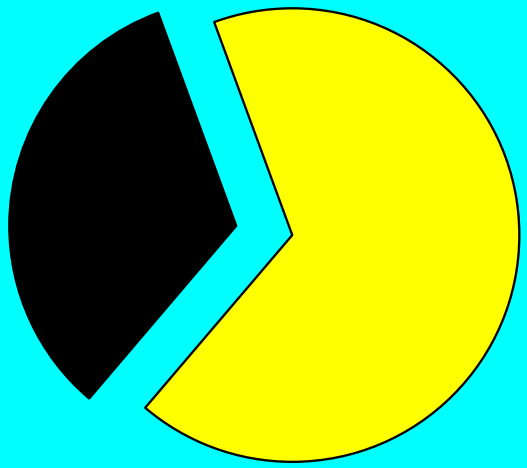
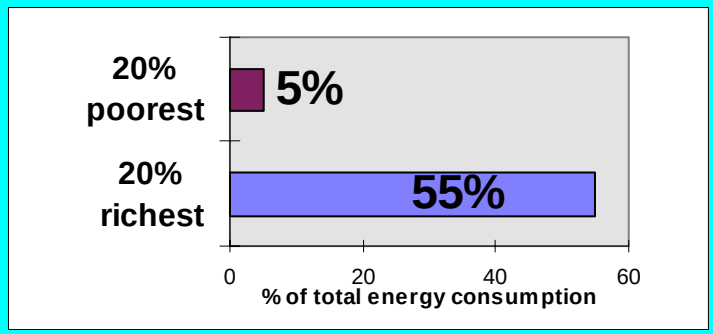
The world is confronted with worsening poverty, hunger, ill health, illiteracy, and the continuing deterioration of ecosystems on which we depend for our well-being.


World population since AD 1
Billion
8
6
4
2
0
1
400
800
1200
1600
2000
Source: Engelman; UN

Energy Disparities

2 billion people without access to electricity and modern fuels

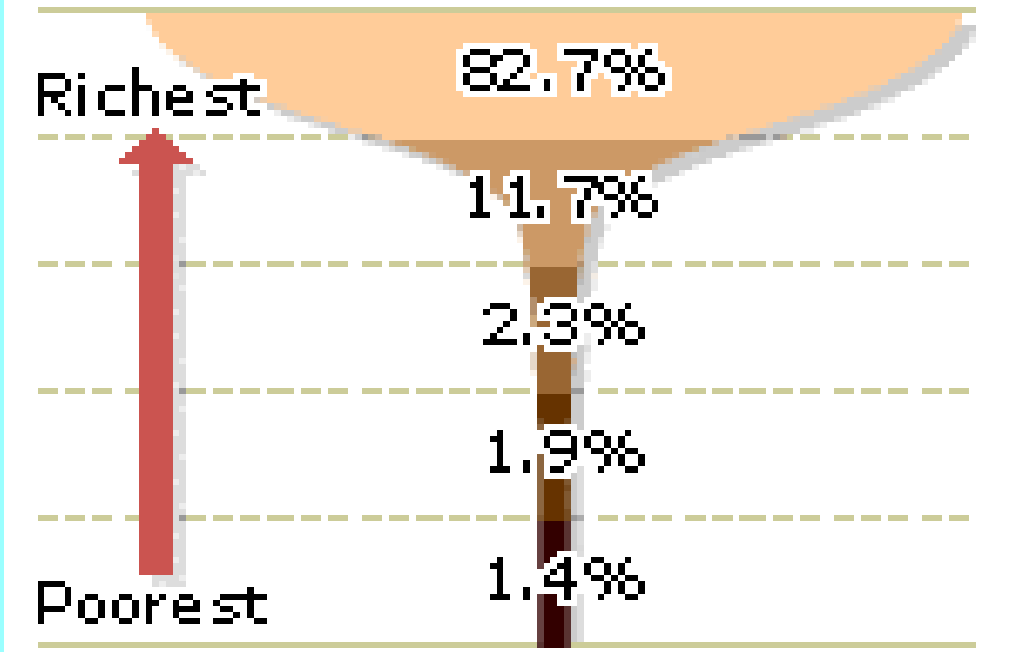




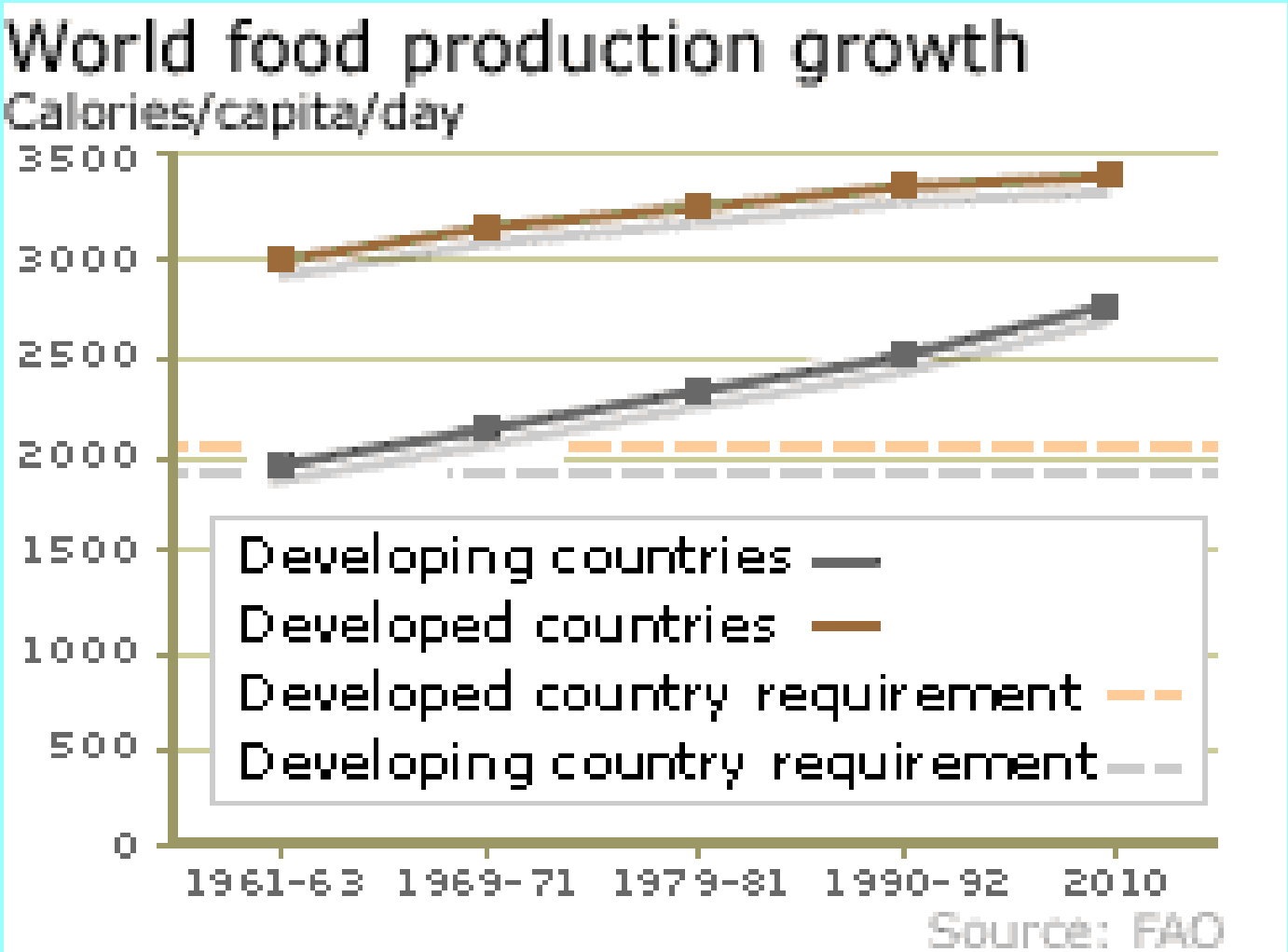

MAGNUM PHOTOS

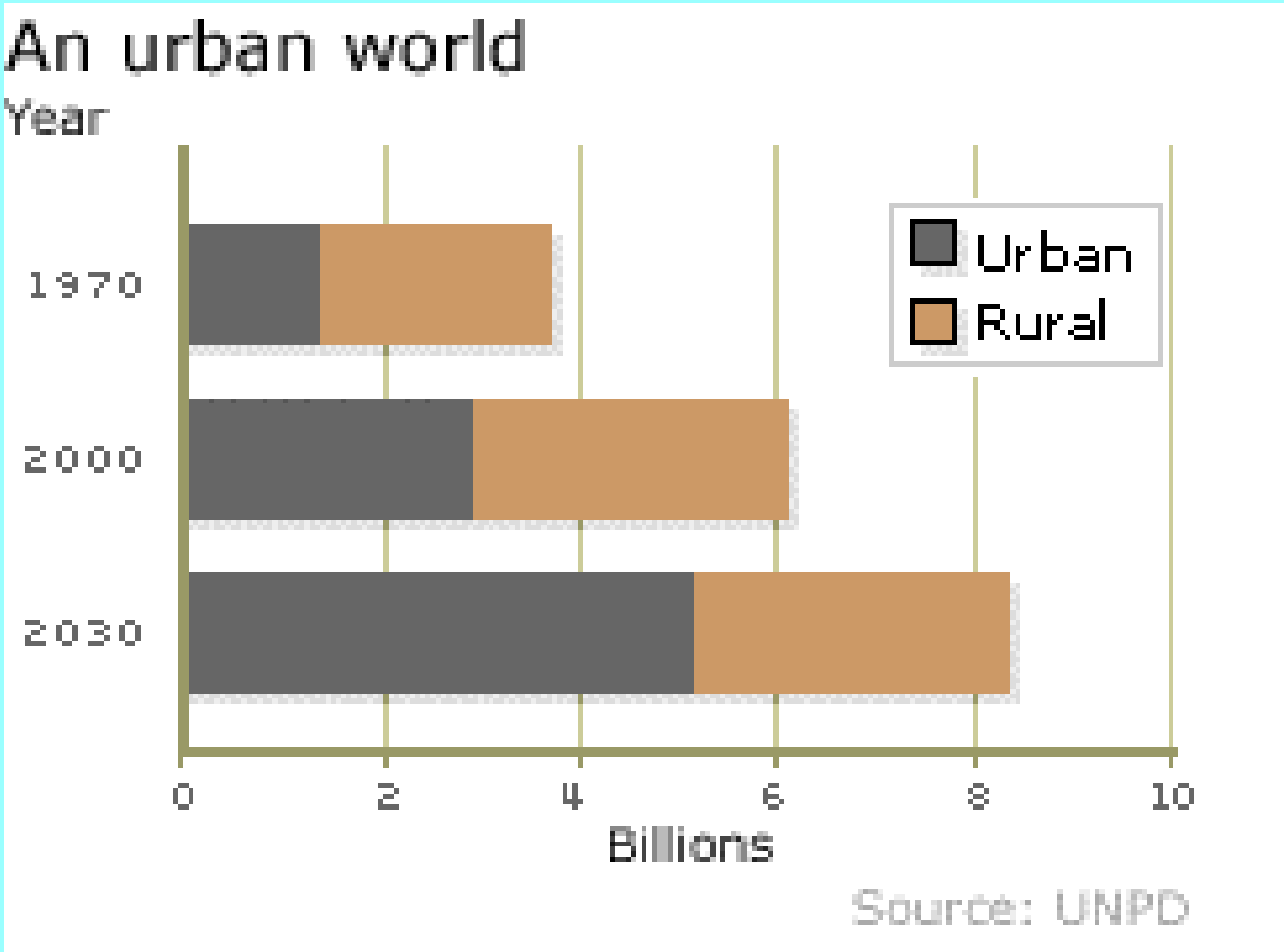
Distribution of world income

Each band represents an equal fifth of the world population

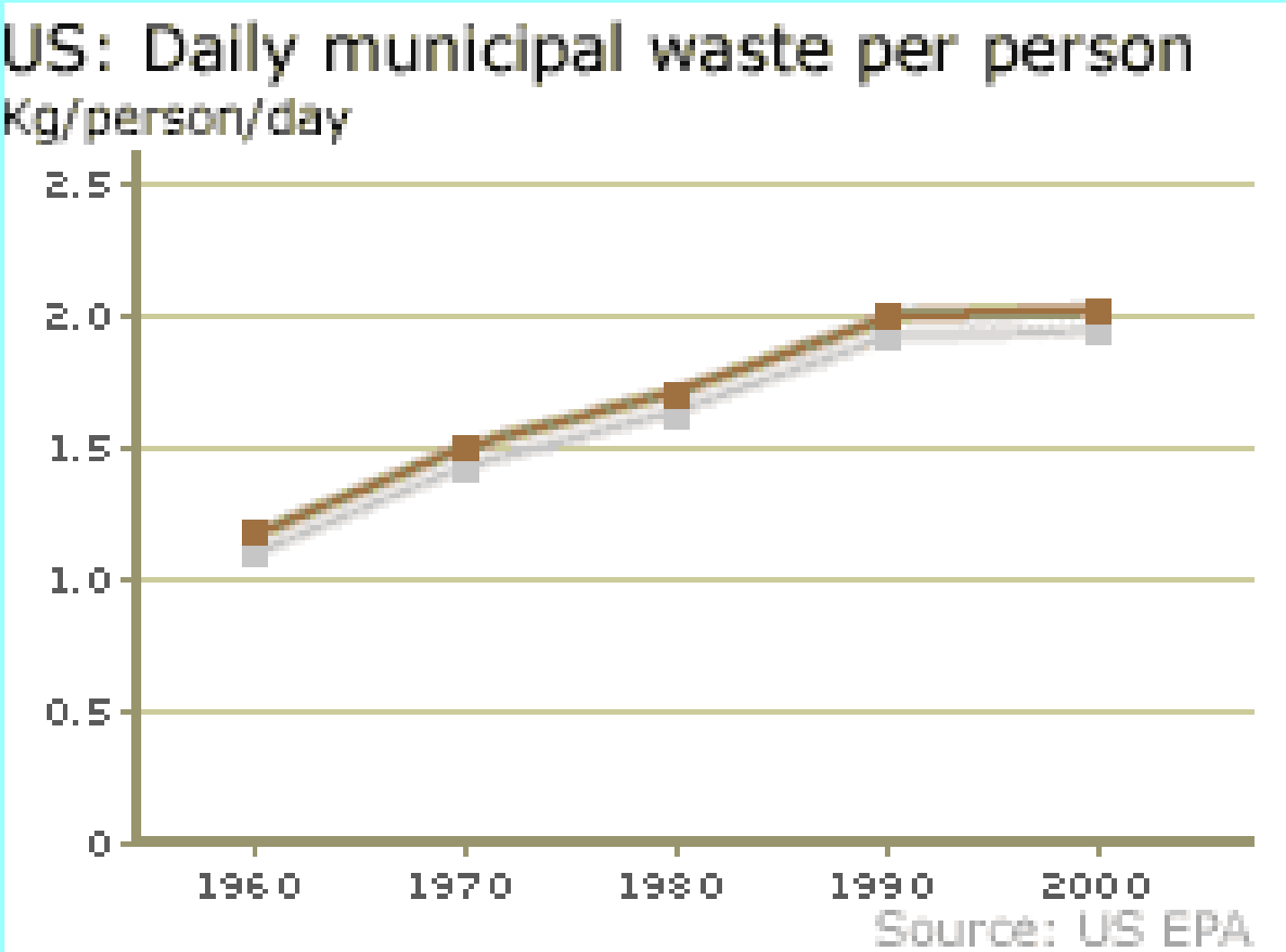


Source: UNDP, 1989


World food production growth
Calories/capita/day
3500
3000
2500
2000
1500
1000
500
0
Developing countries
Developed countries
Developed country requirement
Developing country requirement
1961-63
1969-71
1979-81
1990-92
2010
Source: FAO


An urban world
Year
1970
2000
2030
Urban
Rural
0
2
4
6
8
10
Billions
Source: UNPD


AP


US: Daily municipal waste per person
Kg/person/day
2.5
2.0
1.5
1.0
0.5
0
1960
1970
1980
1990
2000
Source: US EPA


AP


AP


AP

Agenda-21

The world is confronted with worsening poverty, hunger, ill health, illiteracy, and the continuing deterioration of ecosystems on which we depend for our well-being.

The present life-styles and pattern of production and consumption are un-sustainable.

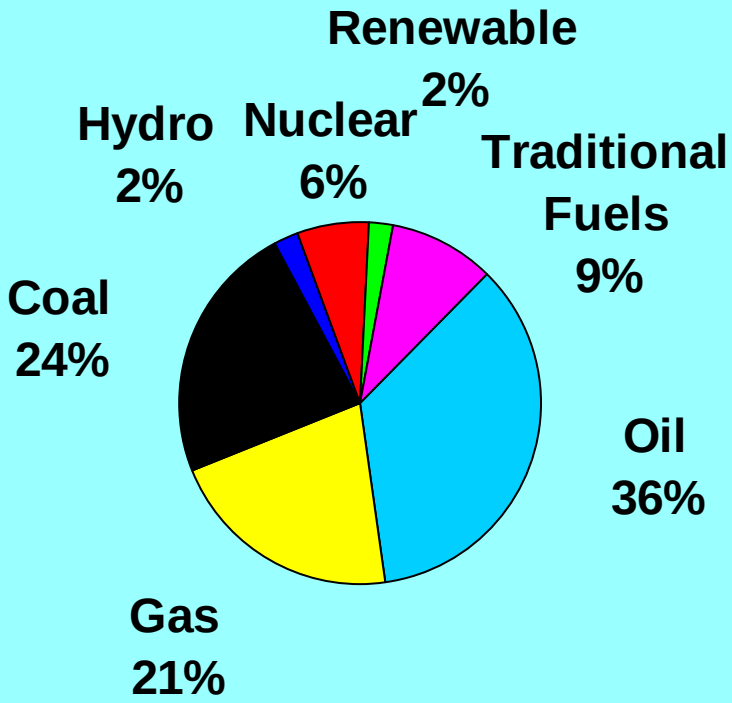
Social equity, economic growth and environmental protection

Agenda-21 – A blueprint for sustainability in the 21 century.

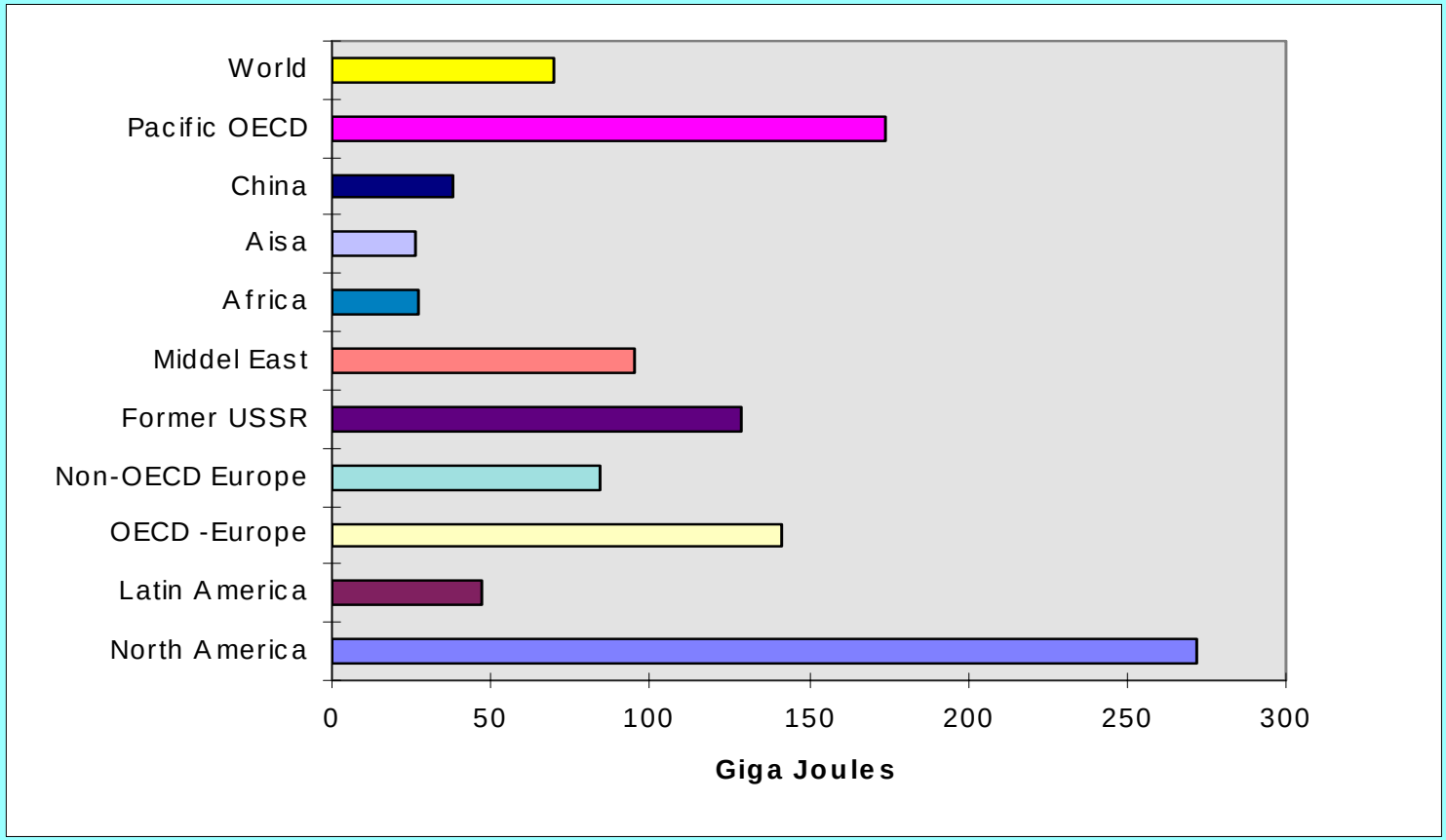
- Requires all countries to draw up a national strategy for sustainable development, and

- Calls upon national governments, International Organisations and all other stake-holders to co-operate and work together for achieving sustainable and prosperous life for ALL.

World Energy Consumption Pattern



Energy Consumption per Capita



Fossil Fuels Availability

life time of reserves (years)

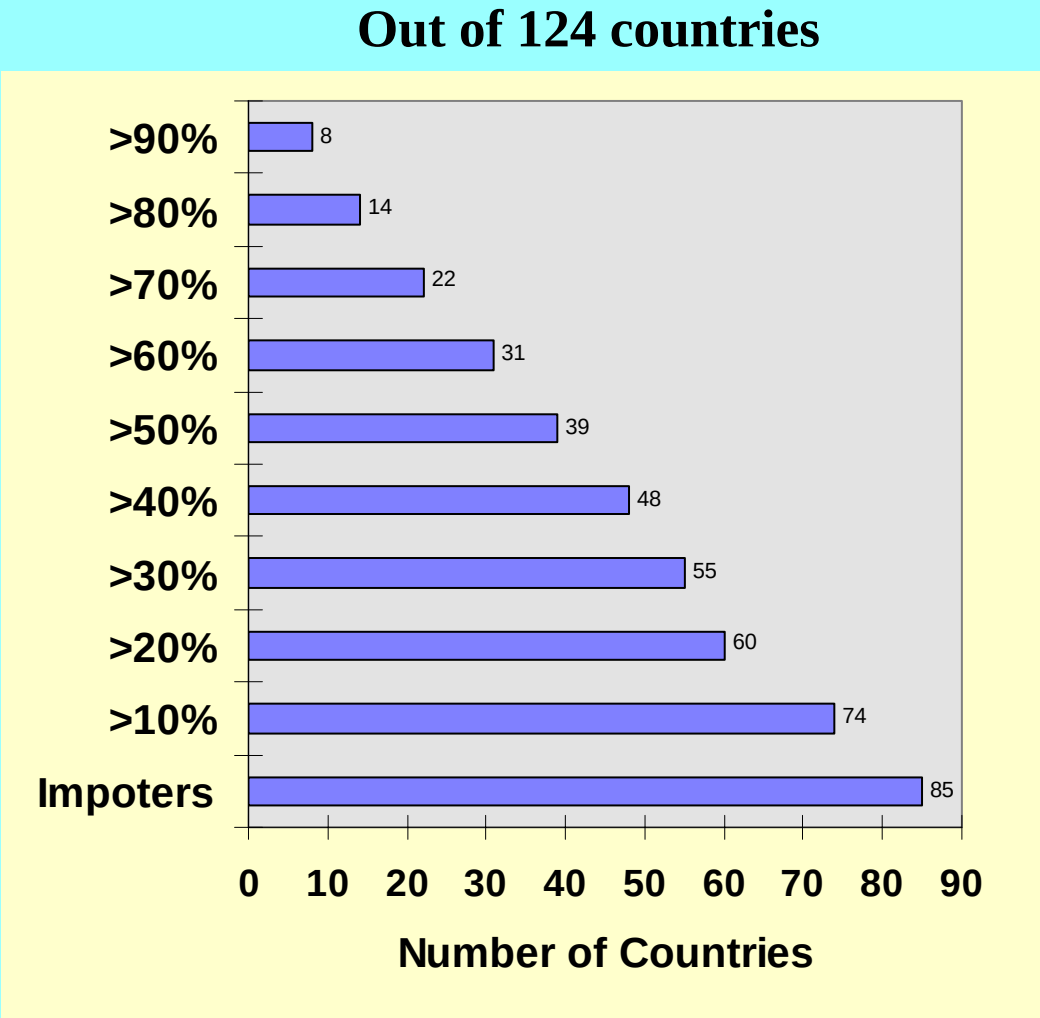
	A	B
Oil	45	200
Gas	69	400
Coal	452	1500
Total	170	630

A: Conventional reserves only

B: Conventional and Unconventional reserves

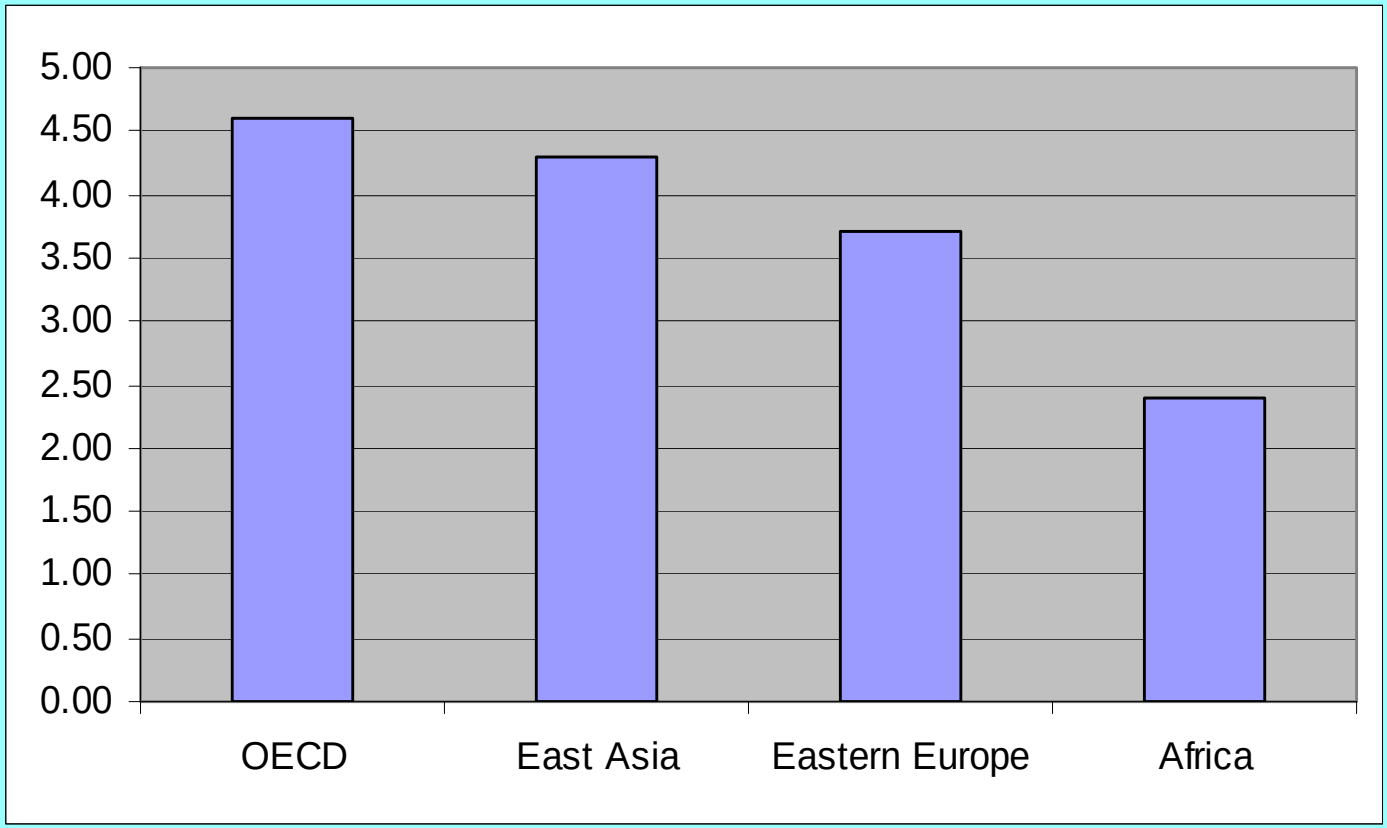
World Energy Assessment, UNDP/UNDESA/WEC, 2000

Energy Import Dependence



Productivity of Energy Use

(US $ PPP/kgoe)

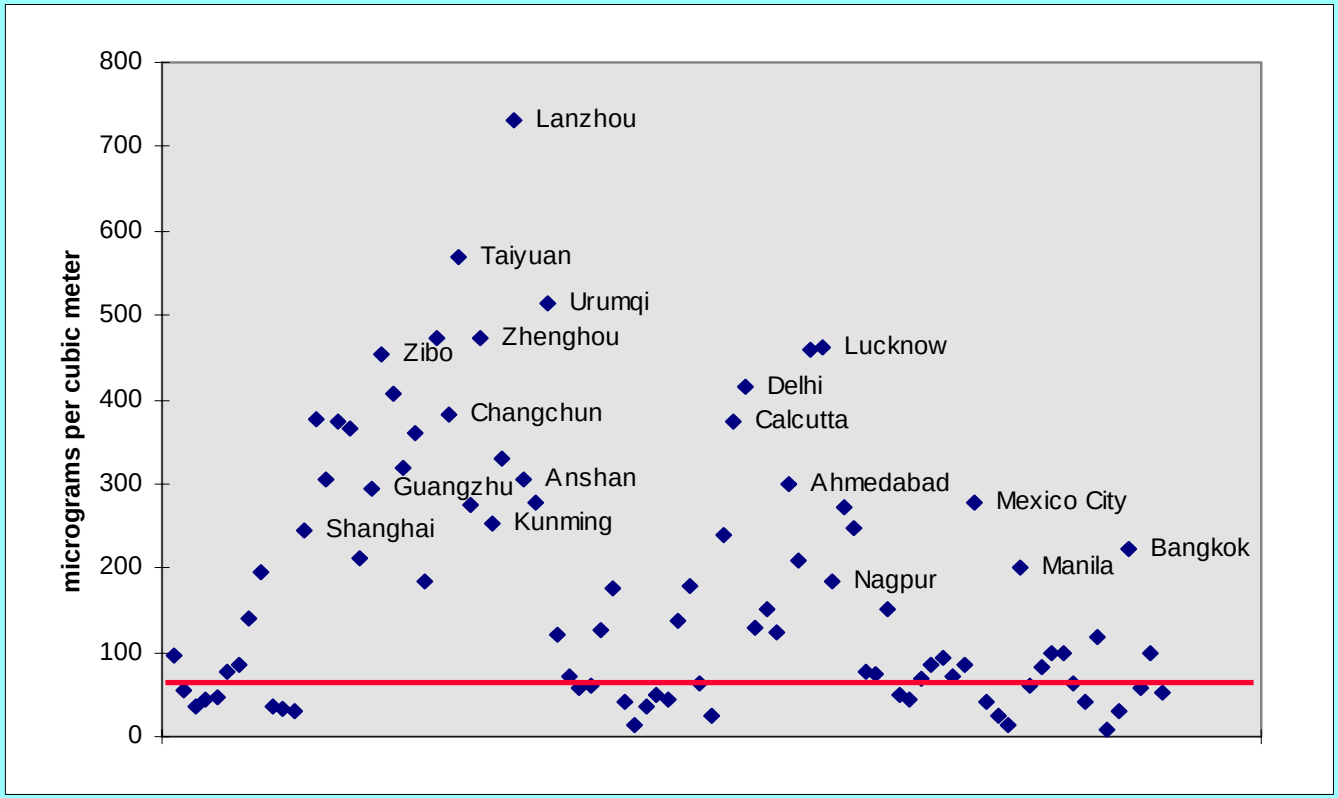


Global Atmospheric Emissions from Fossil Fuels Consumption

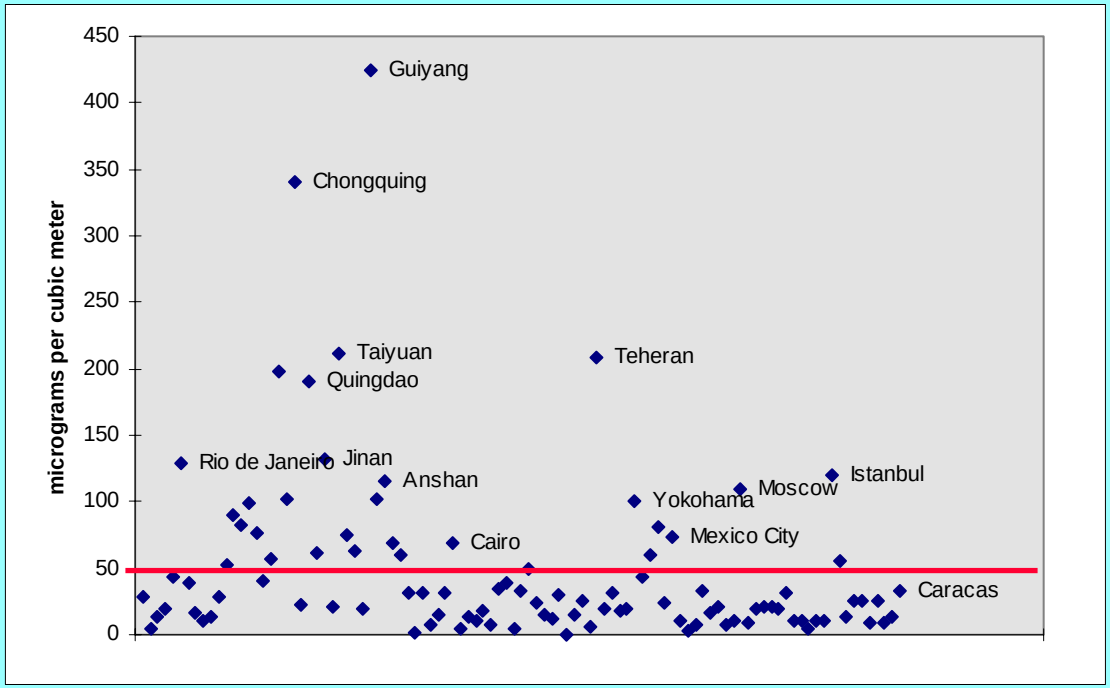
CO_2	5.8 billion tons C
CH_4	84.6 million tons
SO_2	71.6 million tons
NO_x	63.0 million tons
HC-	42.0 million tons
PM	130.2 million tons
Hg	735 tons
Cd	880 thousand tons
Pb	88.5 thousand tons

World Energy Assessment, UNDP/UNDESA/WEC, 2000

Concentration of Particulates in Urban Areas

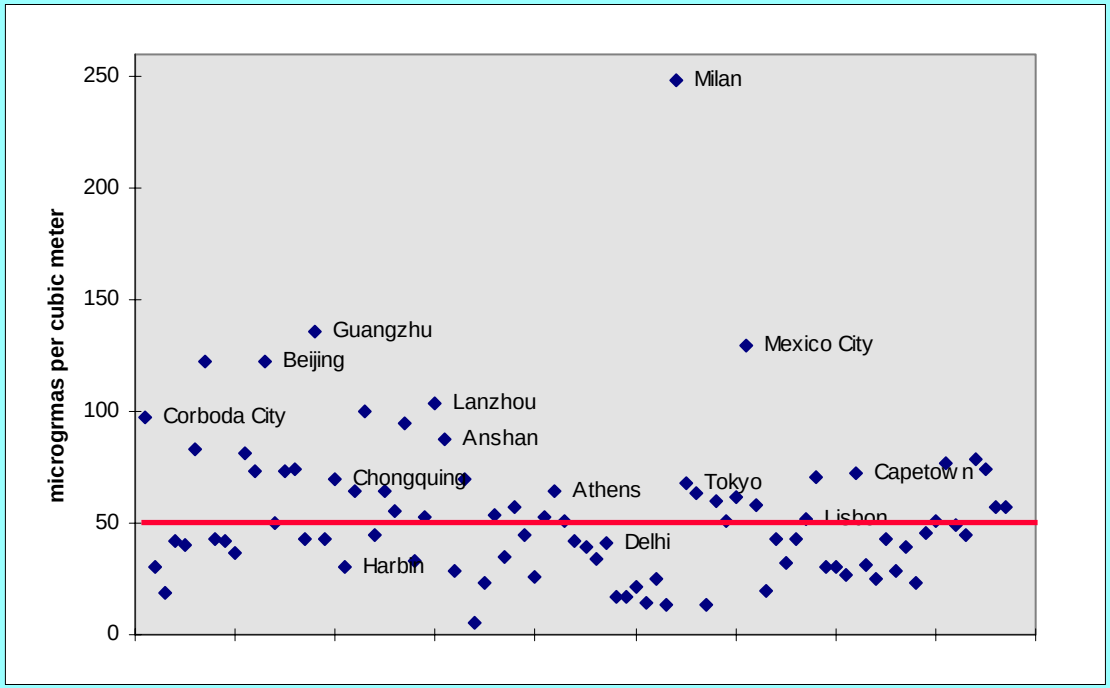


Concentration of SO2 in Urban Areas



Maximum permissible level recommended by WHO

Concentration of NOx in Urban Areas



Maximum permissible level recommended by WHO

Urban Population Exposed to Un-Safe* Concentrations of Pollutants

- **Particulates** **285 million**
- **SO_2** **156 million**
- **NO_x** **237 million**

*** Concentrations higher than recommended by WHO**

Impacts

500,000 premature deaths every year

4-5 million/year additional cases of chronic bronchitis

EXTERNAL COSTS

	Costs (mEcu/kWh)	Equivalent lives lost (per GWa)
Coal	**5.3 – 15.0**	**37**
Lignite	**10**	**27**
Oil	**12**	**32**
Gas	**0.4 – 1.0**	**2**
Wind	**0.8 - 2.2**	**0.3**
Hydro	**2.3**	**0.8**
Nuclear	**0.4 - 2.5**	**1**

Note: Externalities of greenhouse gas (GHG) emissions, i.e., <u>of climate change not included</u>

Source: Adapted from European Commission (1995)

Sustainable Energy Development
Major Issues

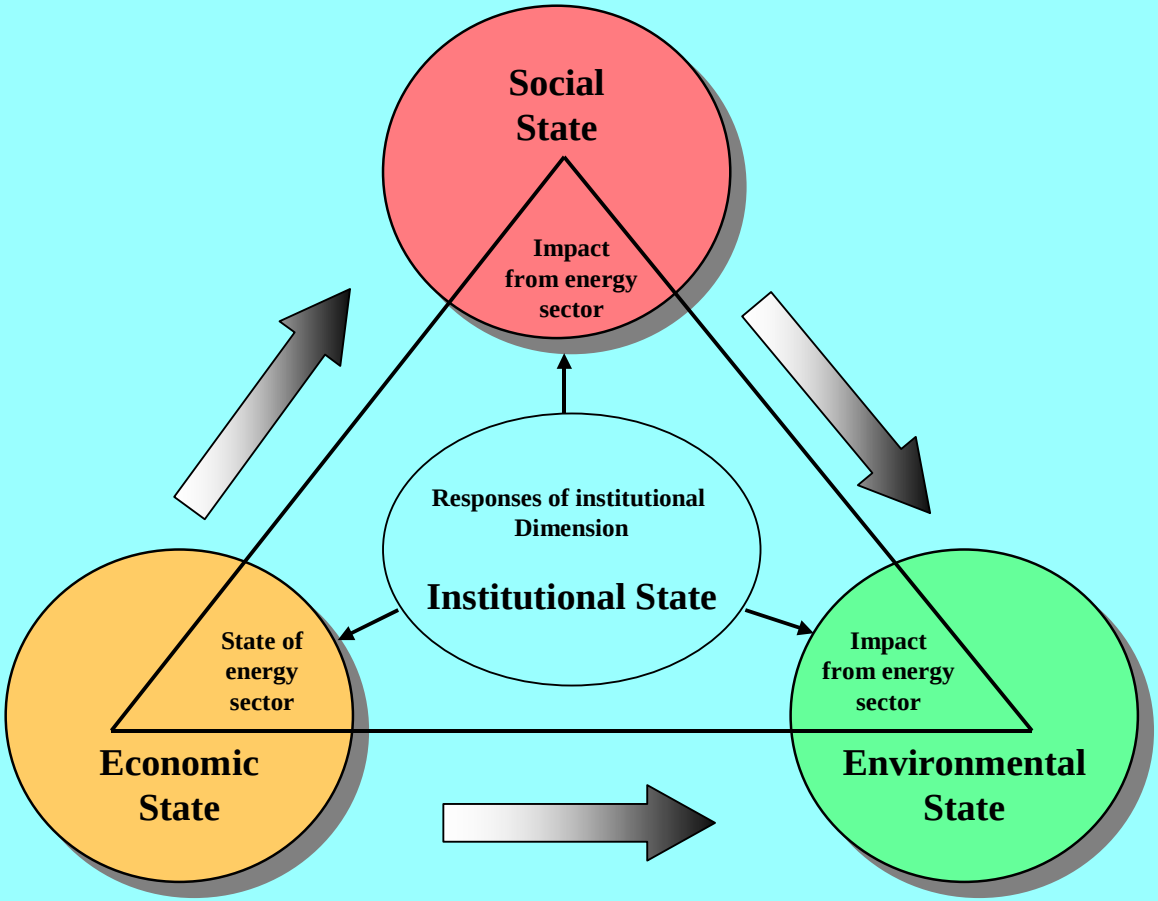
Availability, Accessibility, Affordability

Energy Security

Energy Efficiency

Environmental Congeniality

Dimensions of Sustainable Energy Development



Sustainable Energy:

Energy that is produced and used in ways that simultaneously support human development over the long-term in *all* its social, economic, and environmental dimensions

- **Accessible and acceptable energy service supply chains**
- **Affordable and reliable energy services**
- **Energy service supply chains that do not interfere with nature's equilibria**

1. ***Economic compatibility*:**

   Sustainable energy services must be accessible and affordable. Their prices must cover the full cost to society, i.e., external costs should be internalized.

If a technology, or the service provided by it, is not economically competitive – in a holistic sense – it is NOT sustainable.

2. *Environmental compatibility*:

The inputs and outputs to and from each link of the energy system chain must minimally intrude upon nature's flows and equilibria, i.e., do not overload the carrying capacity of ecosystems.

Decommissioning of energy technologies, fuel cycles and infrastructures, which both returns occupied land to green space and recycles material, must be technically and economically feasible.

Temporary environmental damage may be acceptable as long as restoration is feasible later on.

3. Sociopolitical compatibility:

The technology links of the sustainable energy system must be tolerated by the general public. Satisfying the preceding criteria will prove instrumental in influencing public perceptions and attitudes.

4. Intergenerational compatibility:

Energy services must be based on inexhaustible energy sources or the use of finite sources that lead to the creation of sustainable substitutes. Wastes from the energy system must not pose a risk to future generations.

5. *Geopolitical compatibility*:

Ideally, energy sources should be evenly distributed geographically, allow for secure supplies and pose no threat to the security of other countries.

6. *Demand compatibility*:

The quality of energy services cannot be inferior to the equivalent services provided by the established system – rather it must have the potential of becoming significantly better. Supply densities must match demand densities.

Sustainable Energy Development

There is no technology without risks, wastes or interaction with the environment.

Therefore, it does not make sense to discuss a particular technology in isolation.

Rather, one has to compare the performance of one technology or energy service chain with its alternatives.