



energy and the challenge of sustainability

Sustainable Development Challenges

- Peace
- Social, incl. poverty alleviation
- Economic
- Environment,
 - Local
 - Urban
 - Regional
 - Global
- Energy is important in all these challenges and major changes are required to meet them

Energy and Development

- **2 billion** people have **no access to electricity** and an additional **2 billion** people have **access to unreliable** electricity.
- **2 billion** people cook using traditional fuels.

Energy and Women

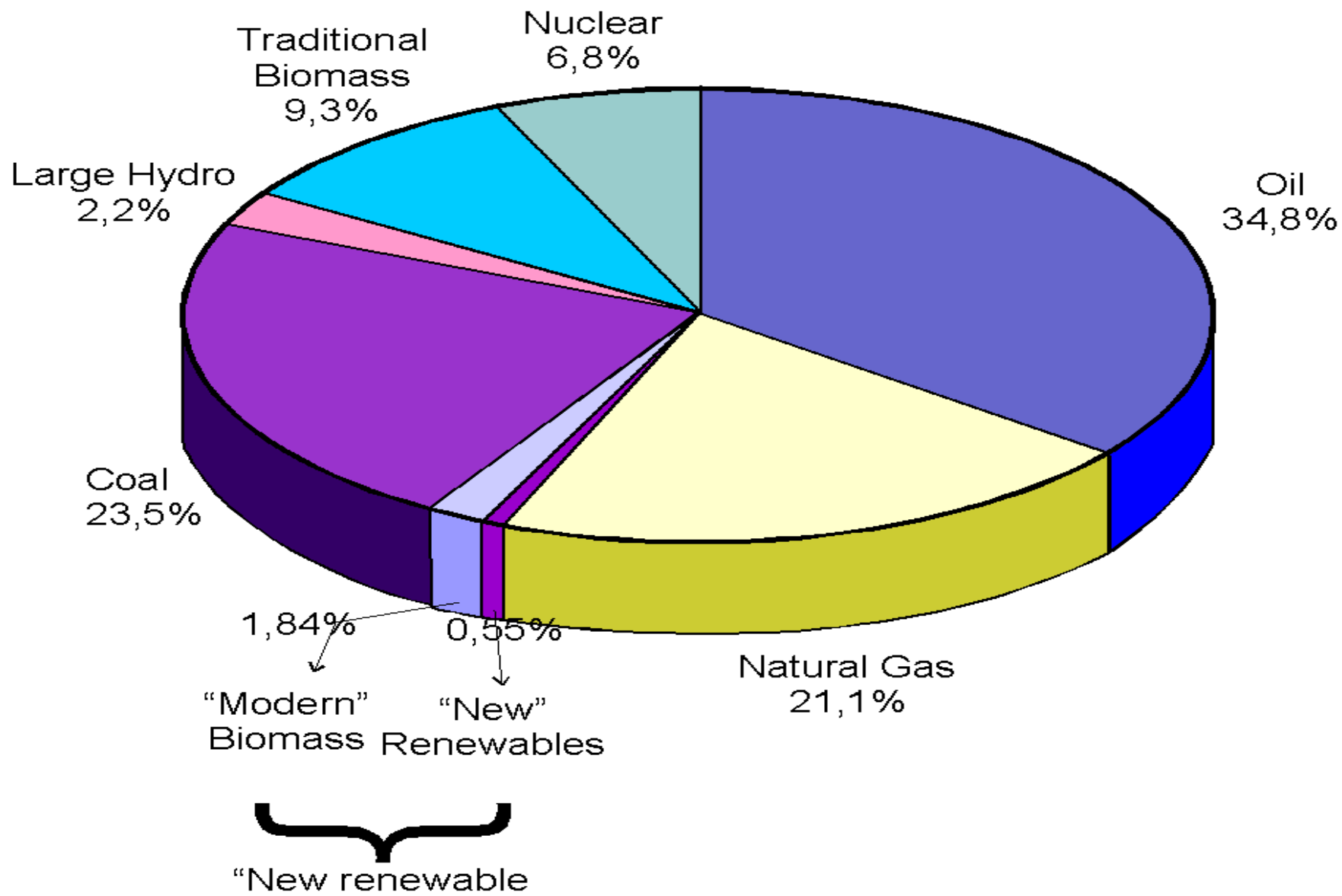
Heavy burden on millions of women and children:

- Millions are spending hours a day carrying fuel and water
- Millions are being exposed to high levels of indoor air pollution leading to **premature deaths**

Example: The World Health Organization estimates that air pollution indoor causes 2.7–3.0 million premature deaths a year, or 5–6 percent of global mortality.

World Consumption of Primary Energy and Renewables, by Energy Type, 2000

Shares of total 418 EJ (9.96 Gtoe)



Environmental Degradation

Energy activities contribute to indoor air pollution, urban air pollution, acidification and global warming:

- 86% of anthropogenic emissions of sulphur dioxide
- Greenhouse gas emissions: 78% of carbon dioxide, 23% of methane
- A significant fraction of emissions of small

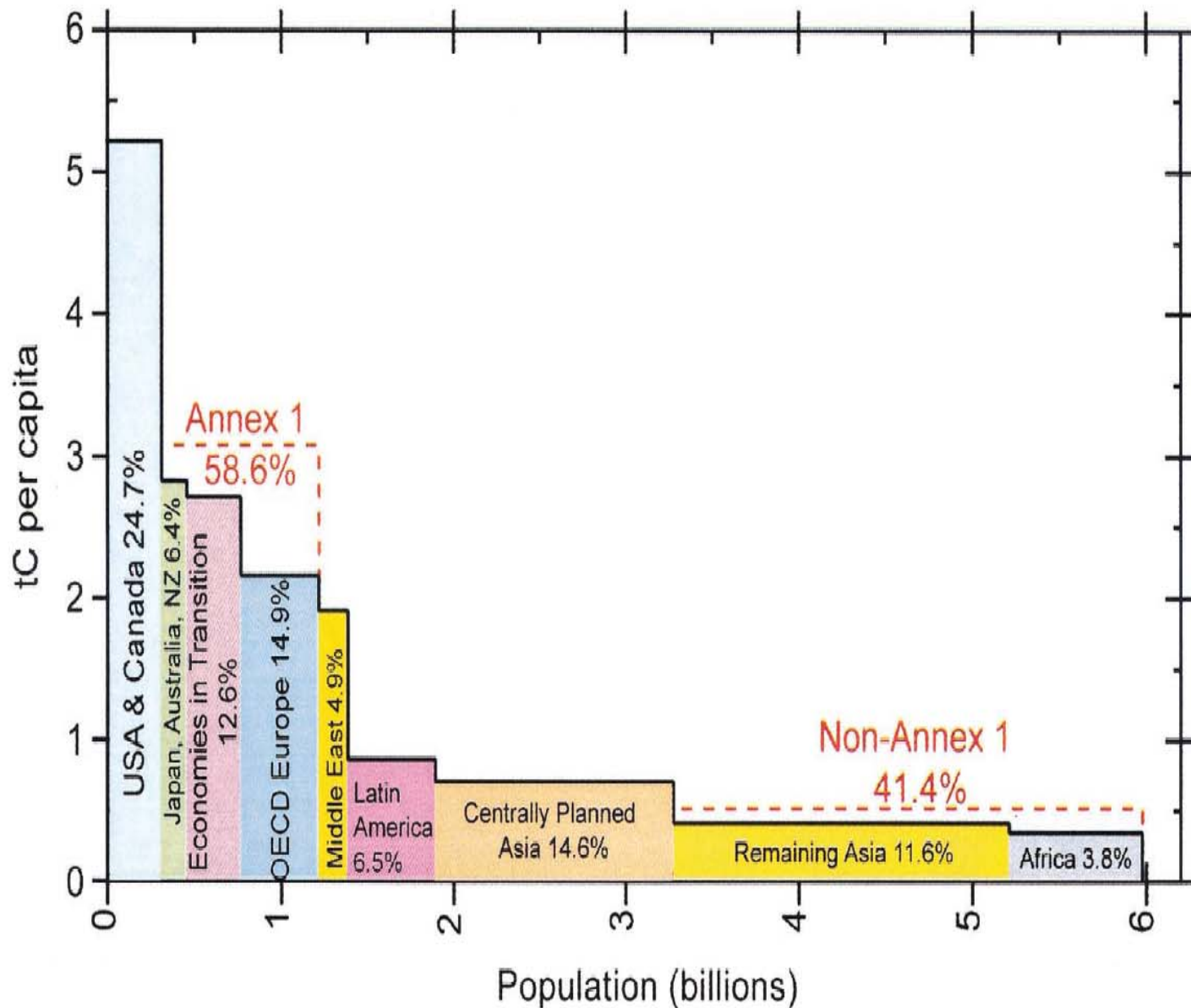
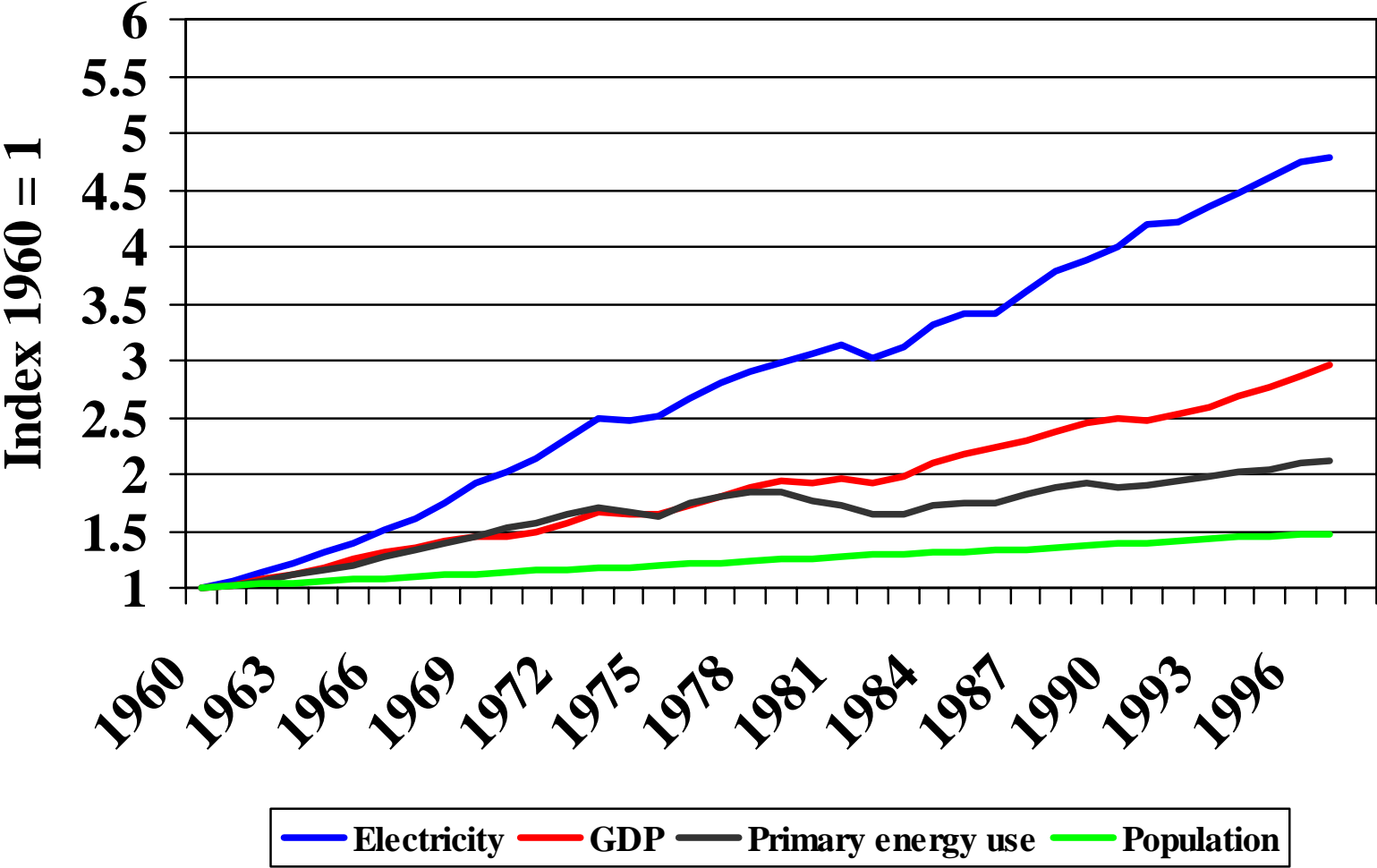


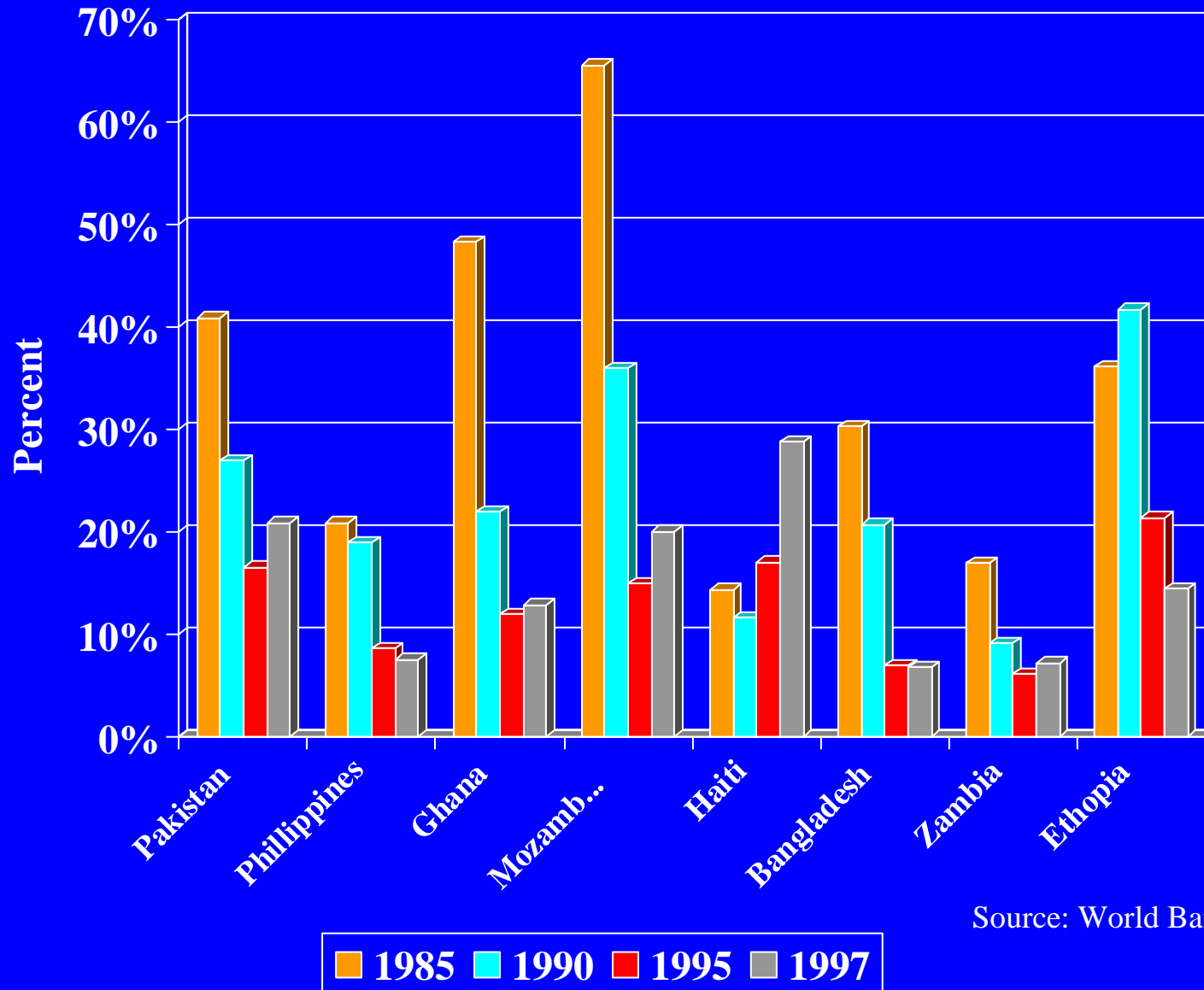
Fig. 1. Per-capita fossil CO₂ emissions in 1999 averaged for nine geographical regions and grouped into Annex 1 and non-Annex 1 countries. Height of bars gives the average per-capita annual emissions of each region. Width of bars gives the population. Area of bars is proportional to the 1999 CO₂ emissions from fossil fuels and cement production; the percentages given indicate the fraction of 1999 global emissions attributed to each region.

Changes in GDP, Population, Primary Energy Use and Electricity Use in OECD Countries, 1960-1997



Source: IEA, 1999

Oil Imports as Share of Export Earnings in Various Developing Countries, 1985-97



Oil imports in OECD, %

	1996	2010	2020
North America	45	63	63
Europe	53	74	85
Pacific	90	96	96
Total OECD	56	72	76

Towards a more Sustainable Future

The linkages described lead to a demand for change of the present energy system development

- The magnitude of the change required is not small
- The challenge is to find a way forward that addresses all the issues simultaneously

Technical Options for a more Sustainable Future

- **Improved Energy Efficiency** - especially at the point of end-use in buildings, electric appliances, vehicles, and production processes.
- **More Renewable Energy:** such as biomass, wind, solar, hydro, hydro, and geothermal
- **Advanced Energy Technologies:**
 - next generation fossil fuel technologies
 - nuclear technologies, if the issues associated with nuclear can be resolved.

Energy Resources

- Conventional oil and gas could last at least 50-100 years.
- Total fossil fuel resources will last at least several hundreds of years
- This means that there will *not* be a resource constraint driven change of the world energy system for a long time to come
- Renewable energy flows are some 10,000 times current global energy use



Modernizing biomass

- Huge resource, presently 10% of world energy demand, mostly in developing countries
- Used inefficiently, serious pollution, mostly an indoor air quality issue
- Options: convert to liquid or gaseous fuels, and/or electricity
 - Gasification, biogas or producer gas
 - Decentralized power generation, for local and grid needs

Outlook for wind energy

- Rapid global growth, 30+ % per year
- 40 GW total installed capacity in 2003
- Rapid cost decline
- “Baseload” wind power possible
- Huge potential, remote from markets
- Multi-GW wind power plants + storage + HV transmission

Can Sustainable Energy Futures be visualized?

- Scenario development – thought experiments – is a useful tool in evaluating possible combinations of assumptions.
- There are many combinations of technical options that would support sustainable development.
- An energy future compatible with sustainable development will not happen by itself, thus policy change is required.

Policies for Sustainable Energy

- Making markets work better, including mobilizing investments
- Focusing on the innovation chain
- Reforming the power sector
- Increasing capacity to support policy and institution building, and transfer of technology

Making markets work better

- Setting the right framework conditions (including continued market reform and appropriate regulatory measures and policies) to encourage competitiveness in energy markets and protect public benefits
- Setting accurate price signals, including removal of subsidies to fossil fuel energy and some internalization of externalities (conventional energy currently subsidized at the rate of \$100 - 200 billion/year)

The Innovation Chain

- Research and Development
- Demonstration projects
- Early deployment (cost buy-down)
- Widespread dissemination

Energy R&D in IEA countries

- Declined 50% 1982 to 2000
- 8% to renewables
- [2% to biomass]
- 12% to efficiency
- Rest to nuclear and fossil fuels

Policy options: cost-buy-down and dissemination

Good ideas for policy implementation are gaining ground around the world

Renewable Portfolio Standards (RPS)

Subsidies with “sunset” clauses

Concessions

Retail financing

Clean Development Mechanism

WSSD and Energy

- “energy” for the first time part of the international agenda!
- The context is Energy for Sustainable Development!
- Improve access
- Sustainable biomass
- Cleaner use of fossil fuels
- Substantially increase the share of renewable energy, “with a sense of urgency”
- Reduce market distortions
- Implement CSD-9



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