Beijing High-level Conference on Climate Change:
Technology Development and Technology Transfer

TECHNOLOGIES, TECHNOLOGY TRANSFER AND BARRIERS

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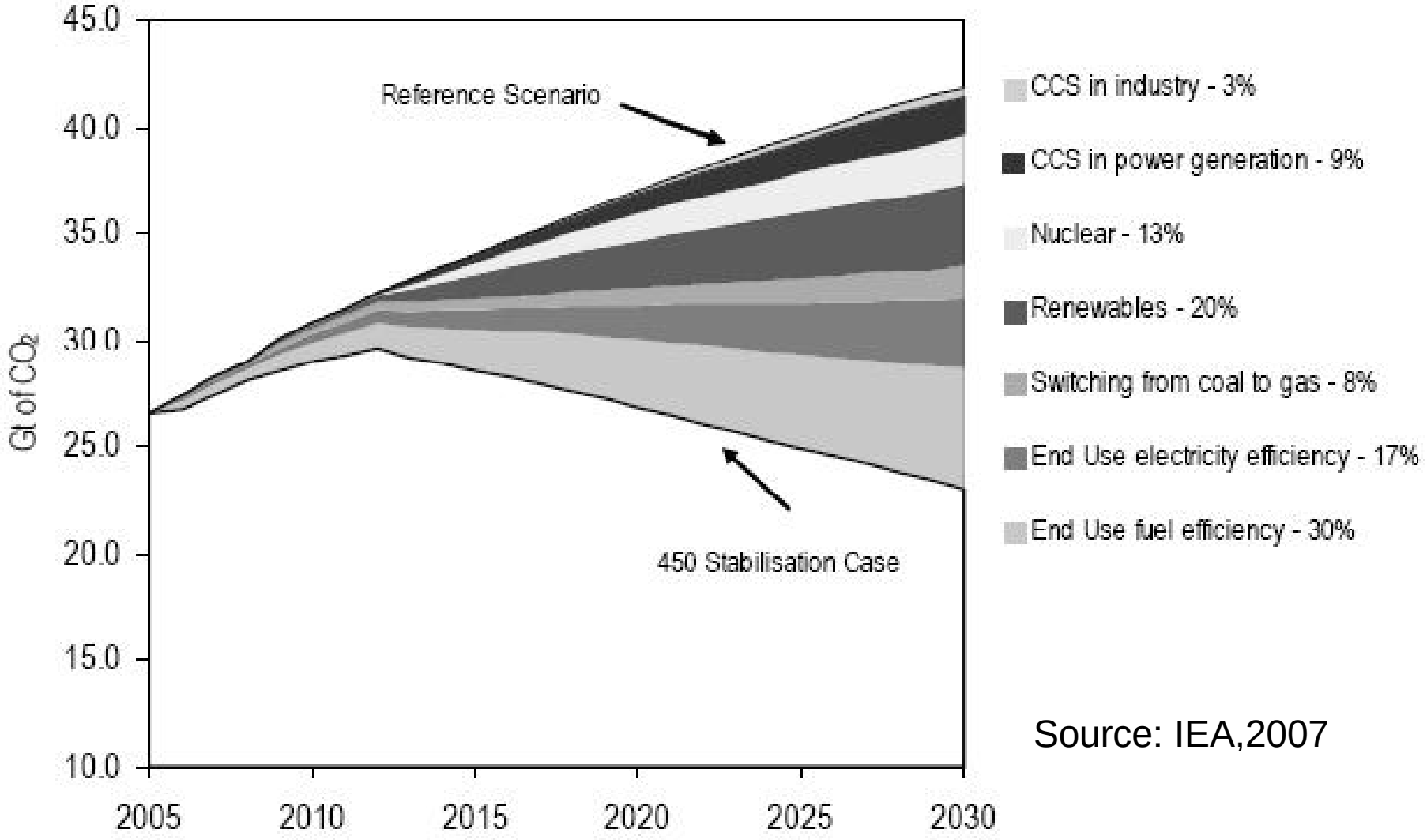
Potential CO2 emission reduction by technology area



Source: IEA,2007

Mitigation

Mitigation technologies to reduce GHG emissions and to enhance sinks aimed at reducing global warming. Mitigation technologies can be applied for:

- **Energy supply (e.g. renewables, fuel switching to less C intensive, co-generation)**

- **End-use (industry, transportation and buildings) and infrastructure (e.g. distributed elect. generation, efficient motors, hybrid vehicles, building envelop)**

- **CO2 capture, storage and sequestration (e.g. sugar/ethanol fermentation, enhanced oil production, reforestation/afforestation)**

- **Reduction of other GHG emissions (e.g. collection/destruction of HFC and PFC, landfill management, use of organic fertilizer)**

Source: US DOE, 2006

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Adaptation Measures

- **new hardware or science (hard types)**
  e.g. new irrigation systems, new crop varieties, desalination technologies.
- **different implementation approaches (soft types)**
  e.g. crop rotation patterns, advanced water recycling, vaccination.

Adaptation Actions

- **anticipatory**
  e.g. constructing dykes, advanced city planning, vector disease control, reservoirs and levees for flood management.
- **reactive**
  e.g. moving buildings to safer areas, improved public transport, efficient wind brakes, early warning and evacuation systems on coastal zones.

Mitigation and adaptation: synergies and trade-offs

Mitigation? **Adaptation?**	Actions decreasing GHG emissions, increasing sinks, protecting C pools	Actions increasing GHG emissions, decreasing sinks, destroying C pools
Actions decreasing exposure and sensitivity to climate change	***Synergies, e.g. urban planning, increased water efficiency, erosion control***	***Trade-offs adaptation ("adaptive emissions"), e.g., cooling, aircondit., irrigation***
Actions increasing exposure and sensitivity to climate change	***Trade-offs mitigation ("new vulnerabilities"), e.g. climate-sensitive biofuels***	***Actions leading to non-sustainable development, e.g. deforestation***

Sathaye et al., 2008

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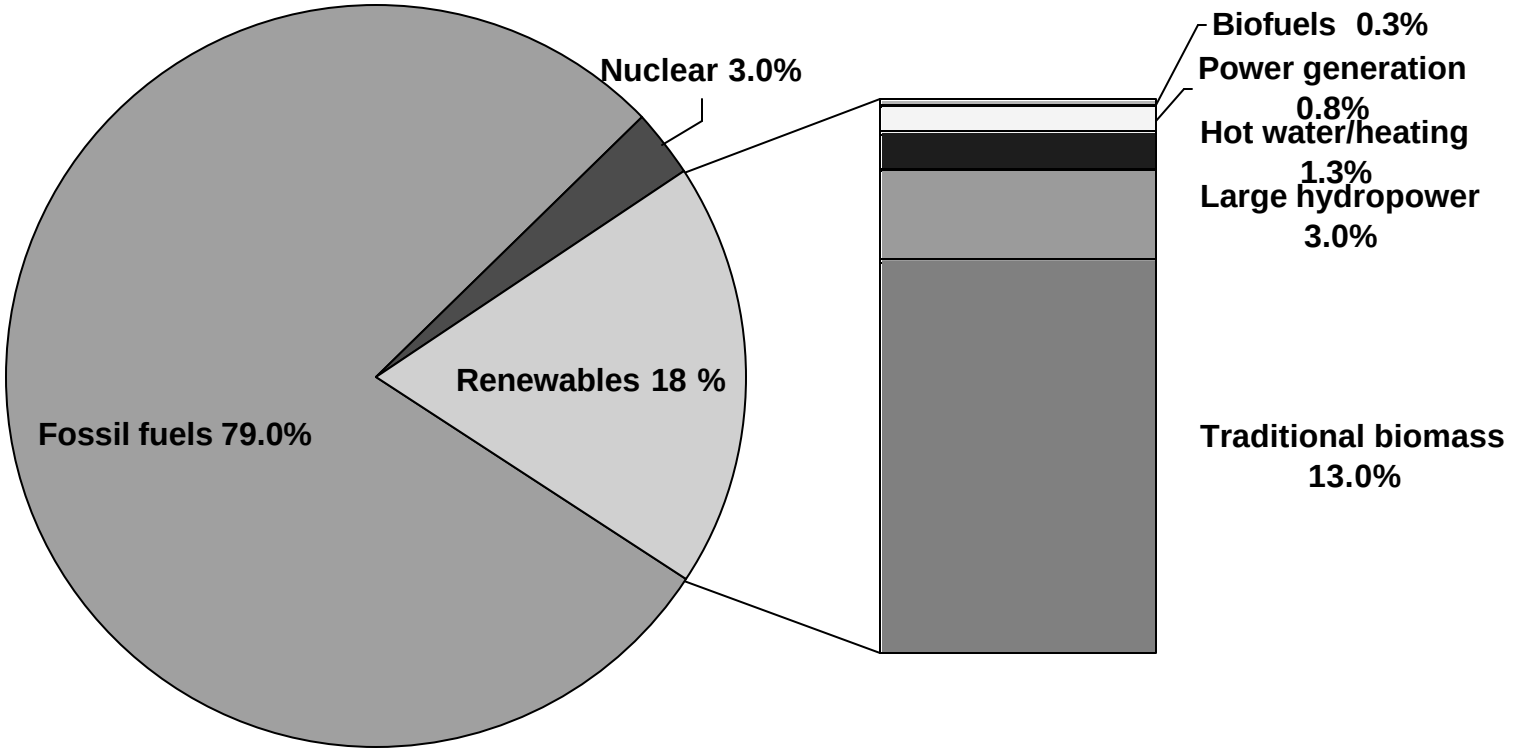
Renewable Energy share of Global Final Energy Consumption, 2006



Source: REN21,, 2007

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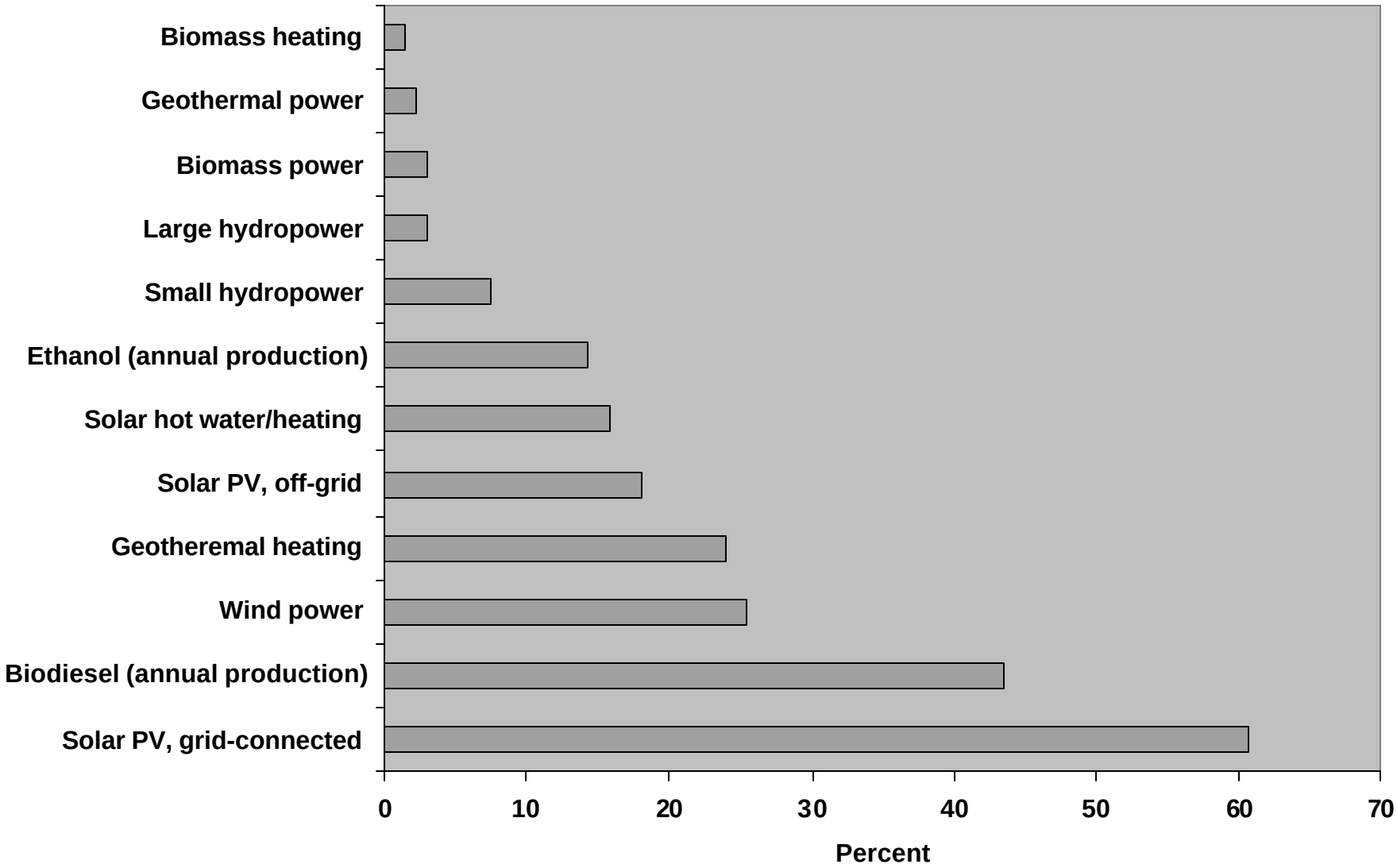
Average Annual Growth Rates of Renewable Energy Capacity, 2002-2006

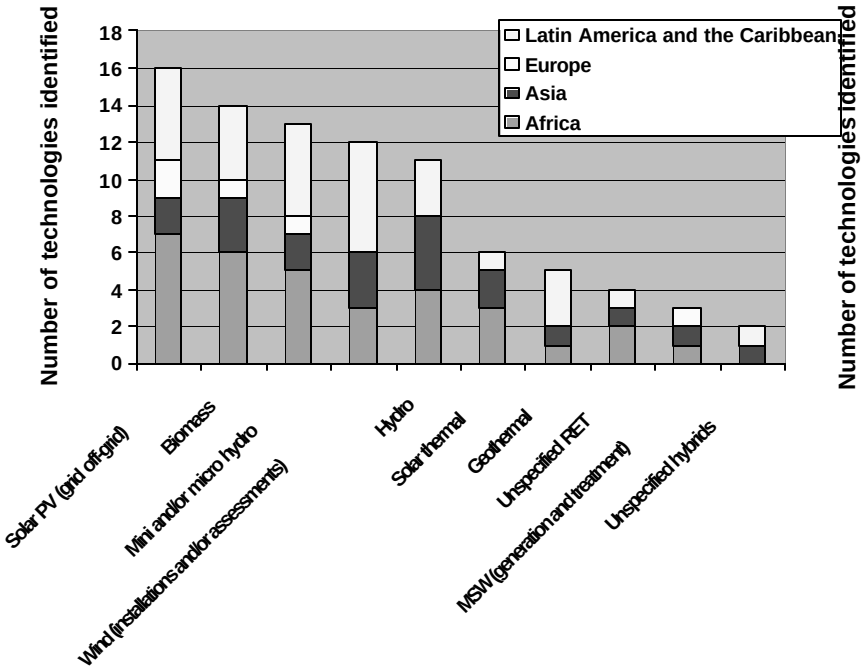


Source: REN21, 2007

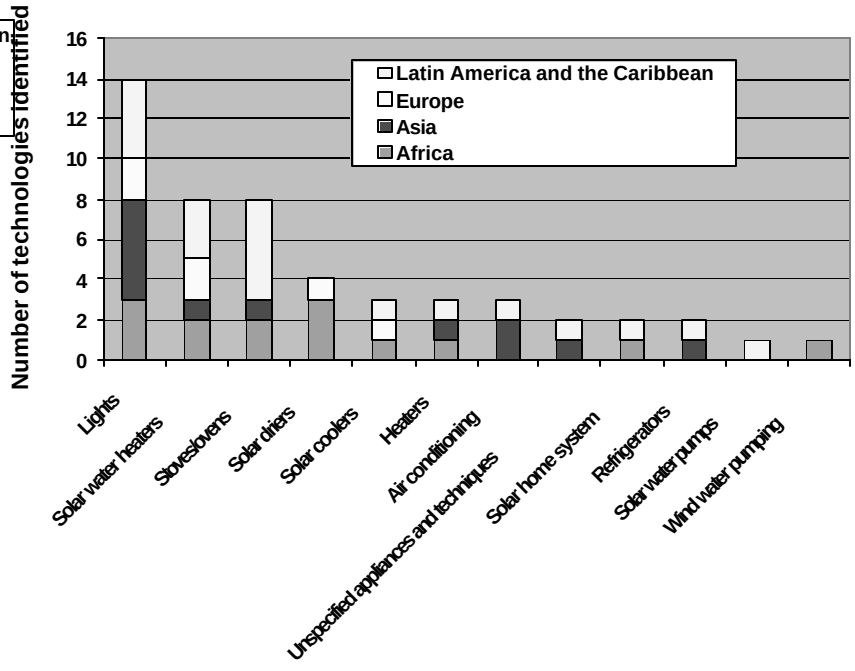
Technology Needs Assessments Results

- Carried out by developing countries studies under UN guidance
- Coordinated by UNFCCC/SUBSTA to enhance technology transfer

Commonly identified renewable energy needs



Commonly identified energy efficient technology needs in buildings and residential subsector



- Large needs of renewables and energy efficient technologies

Source: SBSTA, 2006

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Technological progress take place through

- scientific innovation and invention
- through the adoption and adaptation of pre-existing but new-to-the-market technologies
- through the spread of technologies across firms, individuals, and the public sector

(World Bank 2008a).

“TECHNOLOGY TRANSFER” (IPCC 2000).

The broad and inclusive term “transfer” encompasses

- **diffusion of technologies**
- **technology cooperation across and within countries**.

Covers technology transfer processes between

- **developed countries, developing countries and countries with economies in transition,**
- **amongst developed countries, developing countries, and countries with economies in transition**.

Comprises the process of

- **learning to understand**
- **utilize and replicate the technology**
- **includes the capacity to choose and adapt to local conditions and integrate it with indigenous technologies”**

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Principal channels by which developing countries are exposed to external technologies include:

(1)Trade

(2) FDI

(3) Contacts with highly skilled nationals working abroad, and with other information networks including

(4) Academia

(5) The media

(World Bank 2008b).

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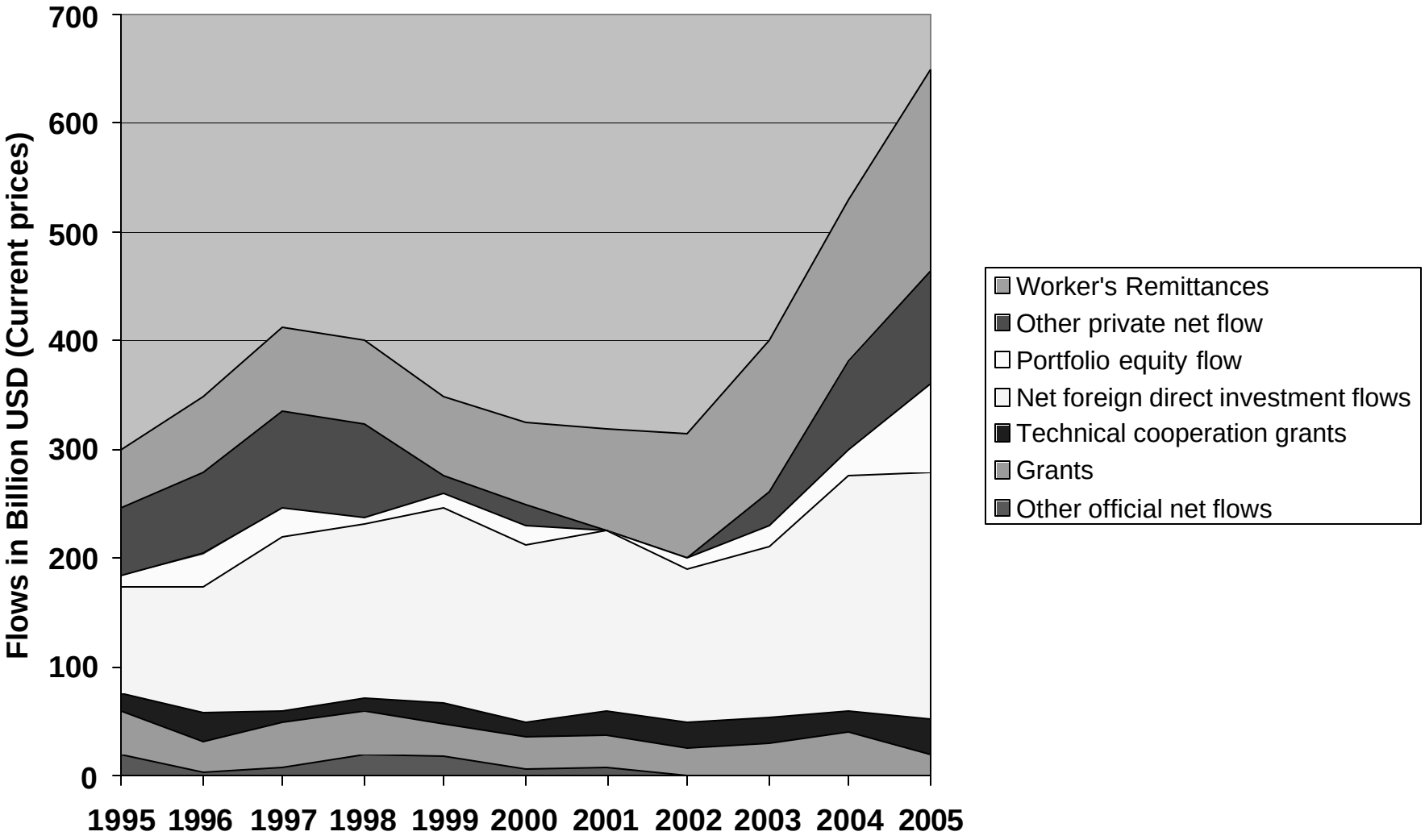
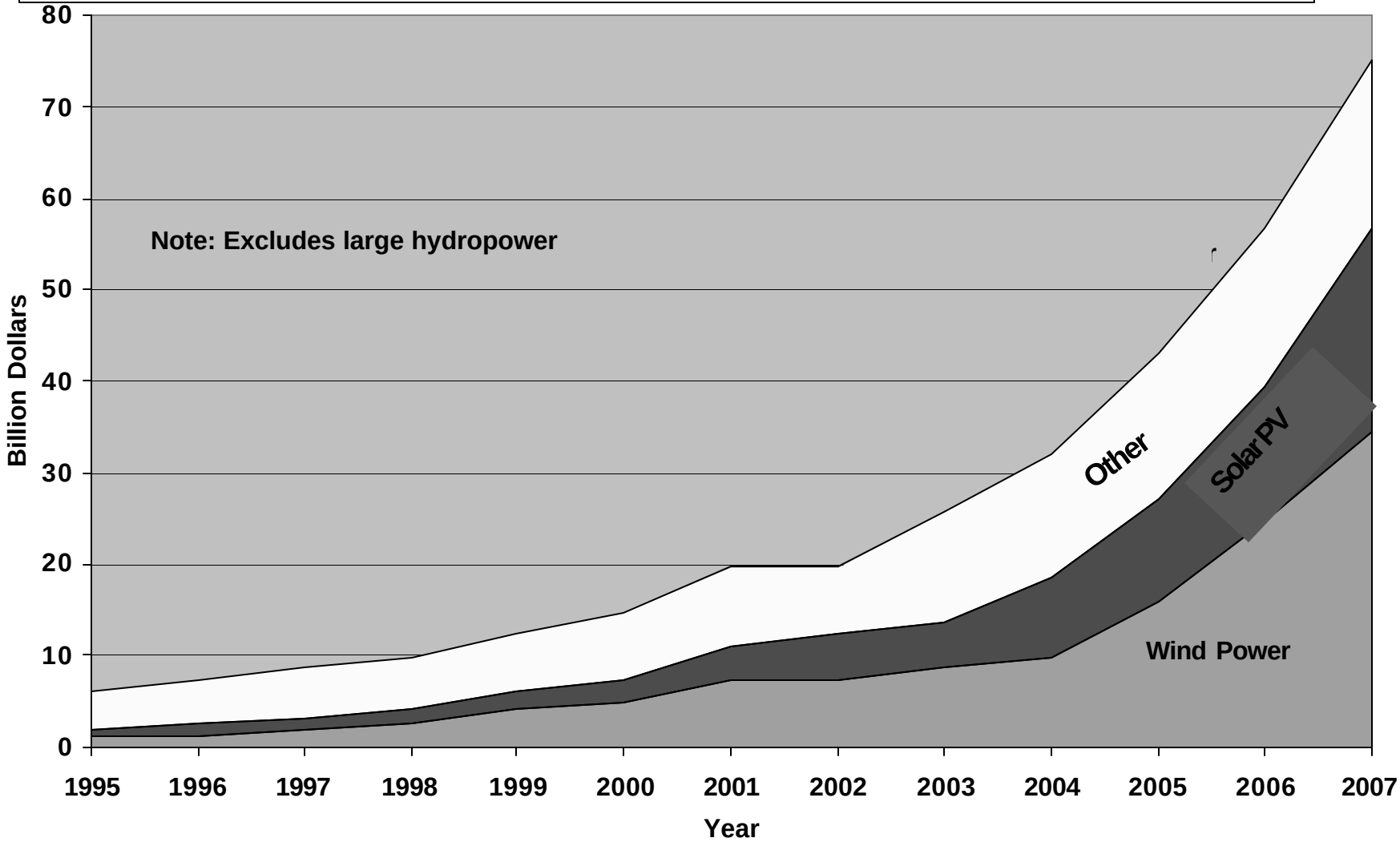
Trend in external financing in developing countries



Annual Investment in New Renewable Energy Capacity



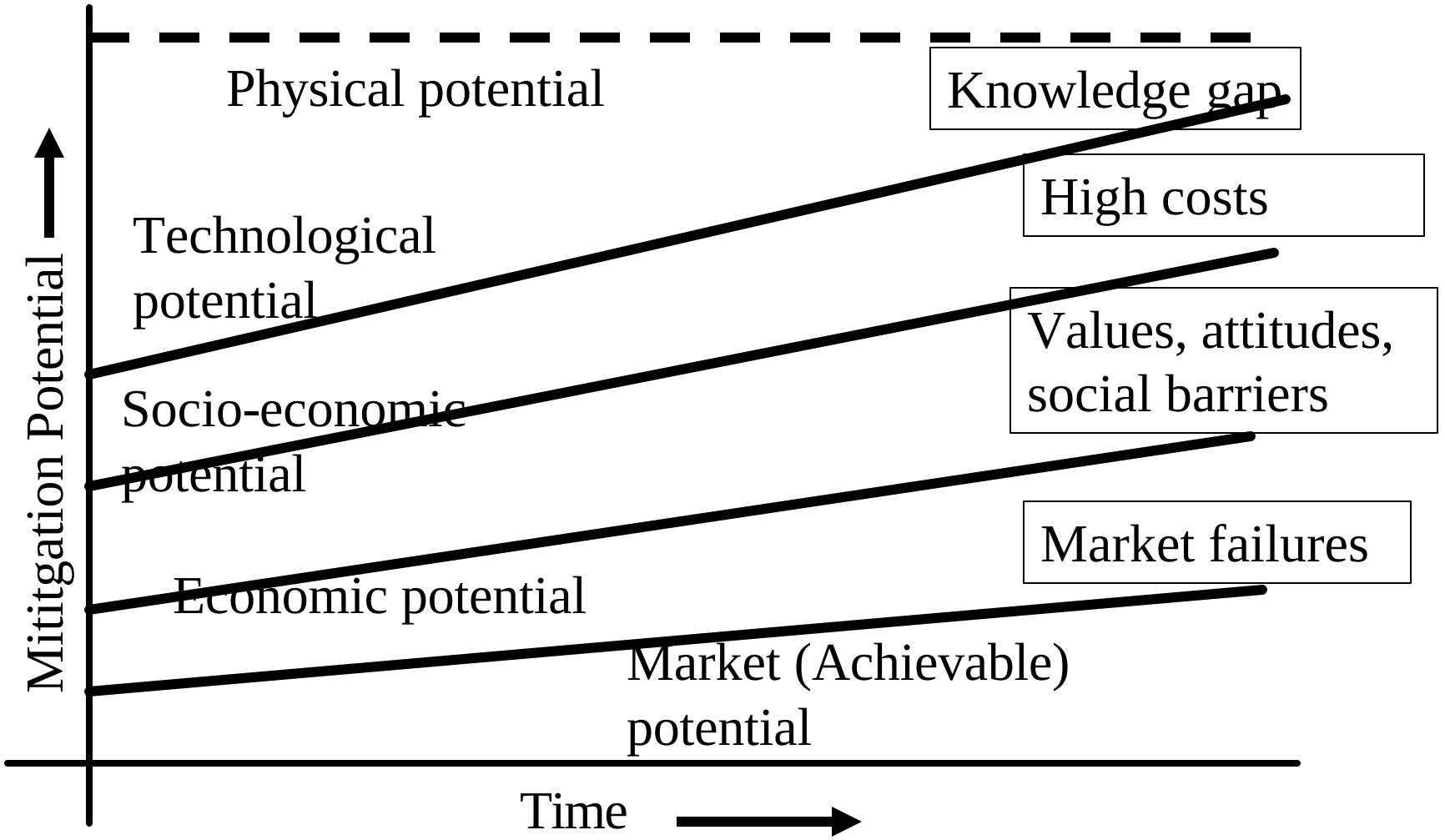
Source: REN21, 2007

What are the main barriers to technology transfer?

- Lack of data, information, knowledge, awareness
- High transaction costs
- Inadequate access to capital
- Risk aversion in financial institutions, incl. MDB's
- Trade barriers such as tariffs
- Insufficient human and institutional capabilities
- Poor understanding of local needs
- Lack of adequate codes and standards for EST's
- Low, subsidised conventional energy prices
- Absence of full-cost pricing
- Are intellectual property rights (IPR) a barrier or an aid to technology transfer?

Source: IPCC, 2000

Opportunities and Barriers -- A Classification



Source: IPCC, 2000

Market Failures to Achieving Economic Potential

- Inadequate or asymmetric information
  - Principal agent problem
- Lack of competition – Market power
- Externalities
- Trade barriers, such as tariffs or export restrictions

Source: IPCC, 2000

Social and Cultural Barriers to Achieving Socioeconomic Potential

EXAMPLES

- Individual behaviour
- Social values and preferences
- Cultural traits and norms
- Gender issues

Source: IPCC, 2000

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CONCLUSIONS

- **A concerted effort is necessary to diversify the energy matrix in favour of renewable energy and low-carbon technologies for electricity, heating, cooling, transport, cooking, etc. In developing countries, the key challenge is to bring the cost to affordable levels.**

- **The identification, analysis and prioritization of barriers are part of a country-specific process. Information available on barriers affecting the transfer to and the adoption by developing countries of environmentally sound technologies is clearly limited. More research is essential to allow a better understanding and a more comprehensive assessment of all the relevant barrier factors. In particular, it is very important to assess the main barriers to widespread transfer and adoption of currently available technologies that could significantly improve energy efficiency in developing countries.**

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Other Slides not Being Presented

Technologies for Mitigation

	Near-term	Mid-term	Long-term
	ENERGY SUPPLY		
Fossil fuels	IGCC[1] commercialization Solid oxide fuel cells Cleaner coal plants	Hydrogen (H_2) co-production from coal/biomass	
Hydrogen	Integrated stationary fuel cell systems Demonstration H_2 production from renewable sources	Low cost H_2 storage and delivery H_2 from renewable sources H_2 from nuclear power Renewable H_2-powered fuel cell vehicles	H_2 and electric economy
Renewable energy	Lower cost wind power Biodiesel Demonstration cellulosic ethanol Photovoltaic (PV) clad buildings Cost-competitive solar PV First-generation bio-refinery Distributed generation systems	Low-wind speed turbines Advanced bio-refineries Cellulosic biofuels Community-scale solar systems Water photolysis Energy storage options	Widespread renewable energy utilisation Genetically engineered biomass Biologically inspired energy and fuels
Nuclear fission	Advanced reactor and fuel cycle technology New fuel forms and materials	Generation IV nuclear plants Closed proliferation-resistant fuel cycles Minimization of wastes for geological disposal	Widespread nuclear power utilisation Advanced concepts for waste reduction
Nuclear fusion	Demonstration of burning plasma Research on high-energy-density physics	Fusion power plant demonstration	Fusion power plants

Technologies for Adaptation

MAJOR AREAS	TECHNOLOGIES AND PROCESSES
Extreme weather, climate and sea-level events	Climate models and systems for monitoring and early warning. Climate proofing infrastructure
Coastal zone management	To protect: tidal barriers, dune and wetland restoration and afforestation. To retreat: establishing set-back zones and creating upland buffers. To accommodate: improved drainage technologies and early warning and evacuation systems.
Water resource management	Desalination techniques. Reservoirs and levees for flood management. Advanced recycling. Efficient technologies for use in industrial cooling.
Agriculture	New varieties of crops. Advanced irrigation systems. Efficient wind breaks. Advanced erosion control techniques
Public health	Advanced urban planning to reduce heat island effects. Improved public transport. Disease vector control. Vaccination.

Technology Change Factors	
Market conditions	**Ease of market entry for new firms and technologies; availability of capital; the degree of internalization of social and environmental concerns through taxes, subsidies, insurance and other mechanisms; and the degree of competitiveness, including any oligopolistic practices or informal arrangements between government and the private sector**
The legal system	**System of intellectual property rights (IPRs); the allocation (e.g., among firms or between the public and private sectors) of liability for past and future environmental damage; freedom of speech and information; and ease of litigation;**
The physical infrastructure	**Design of cities and other settlements, transport systems and utilities; and their flexibility in permitting the adoption of alternative technologies, lifestyles and production systems**
Social and political structures	**Role of the public in decision-making; the location of power in institutional and social relationships; the presence of formal or informal alliances involving government, industry and the media; and the allocation of roles within households and communities**
Culture	**Cultural diversity; the role of technology and material consumption in establishing individual identity, status and social bonds; and tendencies towards competition and cooperation, conformity and distinction**
Psychology	**Awareness, understanding, and attitudes relating to energy efficiency, its causes and potential impacts, and to changes in technology and lifestyles.**

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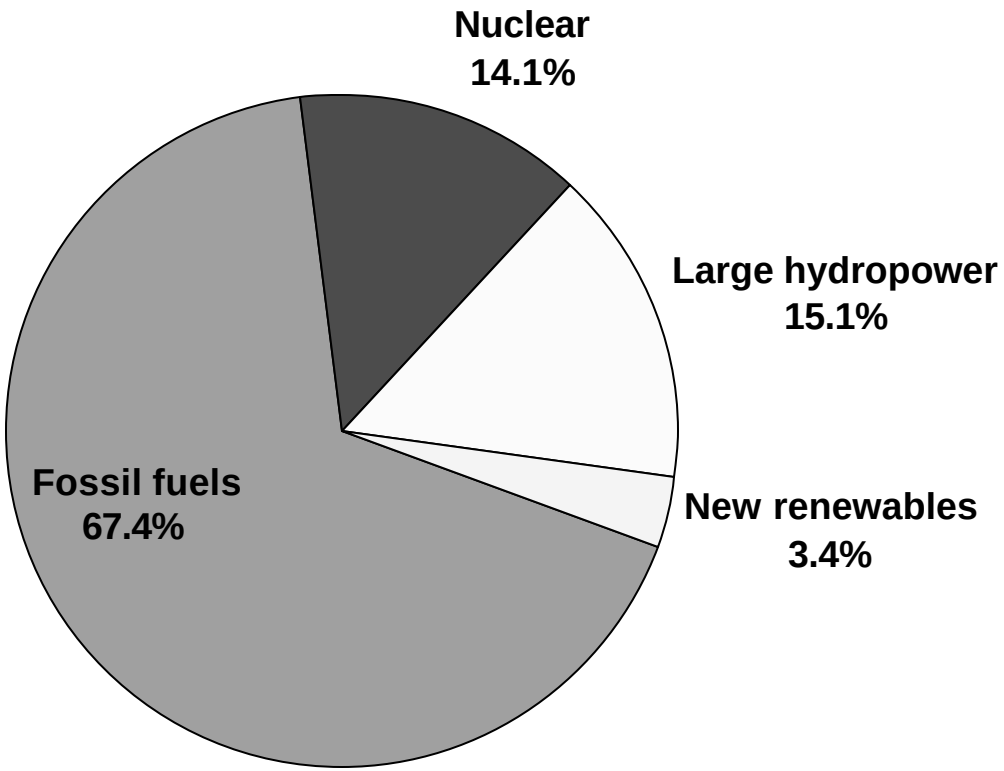
Share of Global Electricity from Renewable Energy, 2006



Source: REN21, 2007

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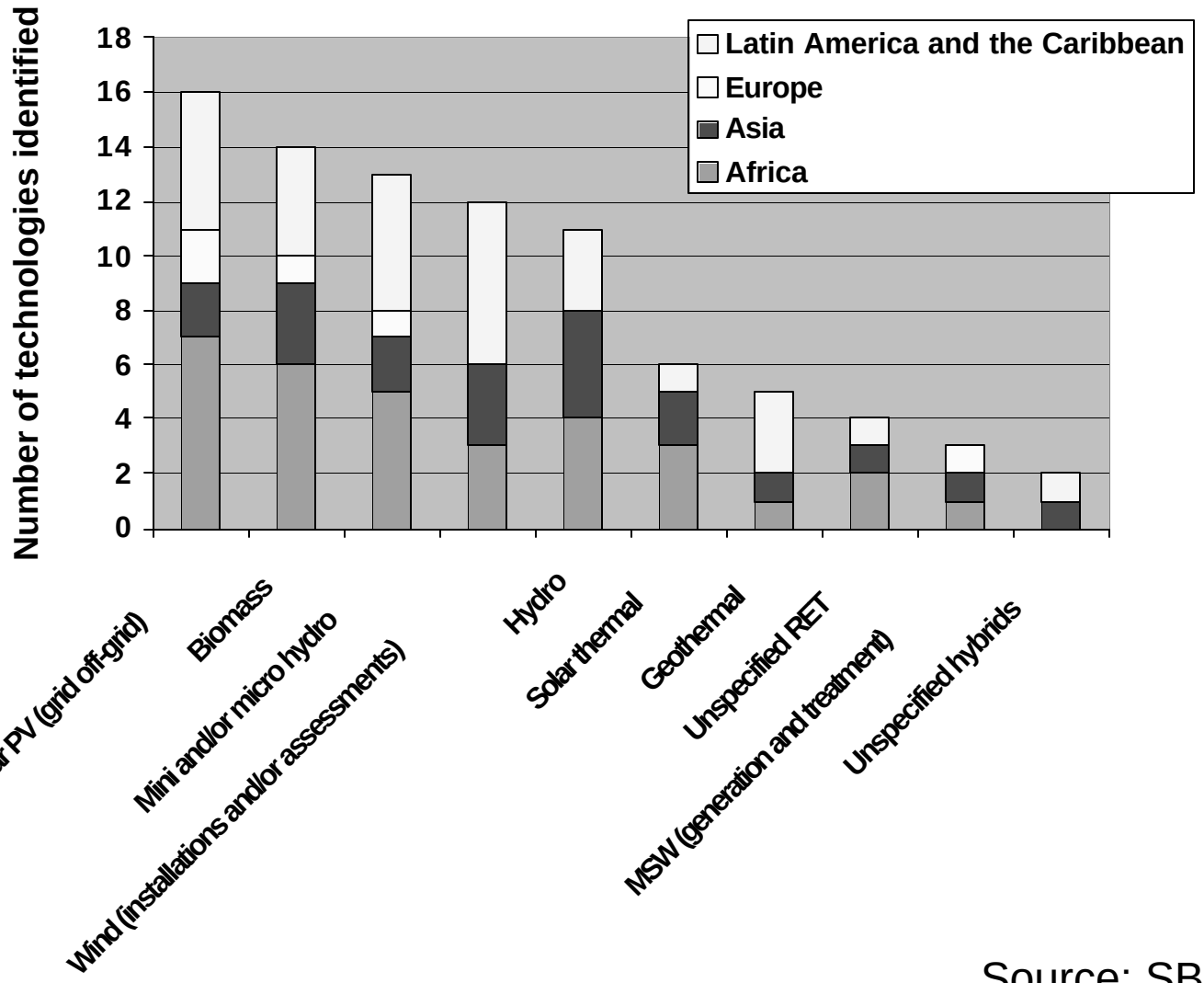

Source: SBSTA, 2006

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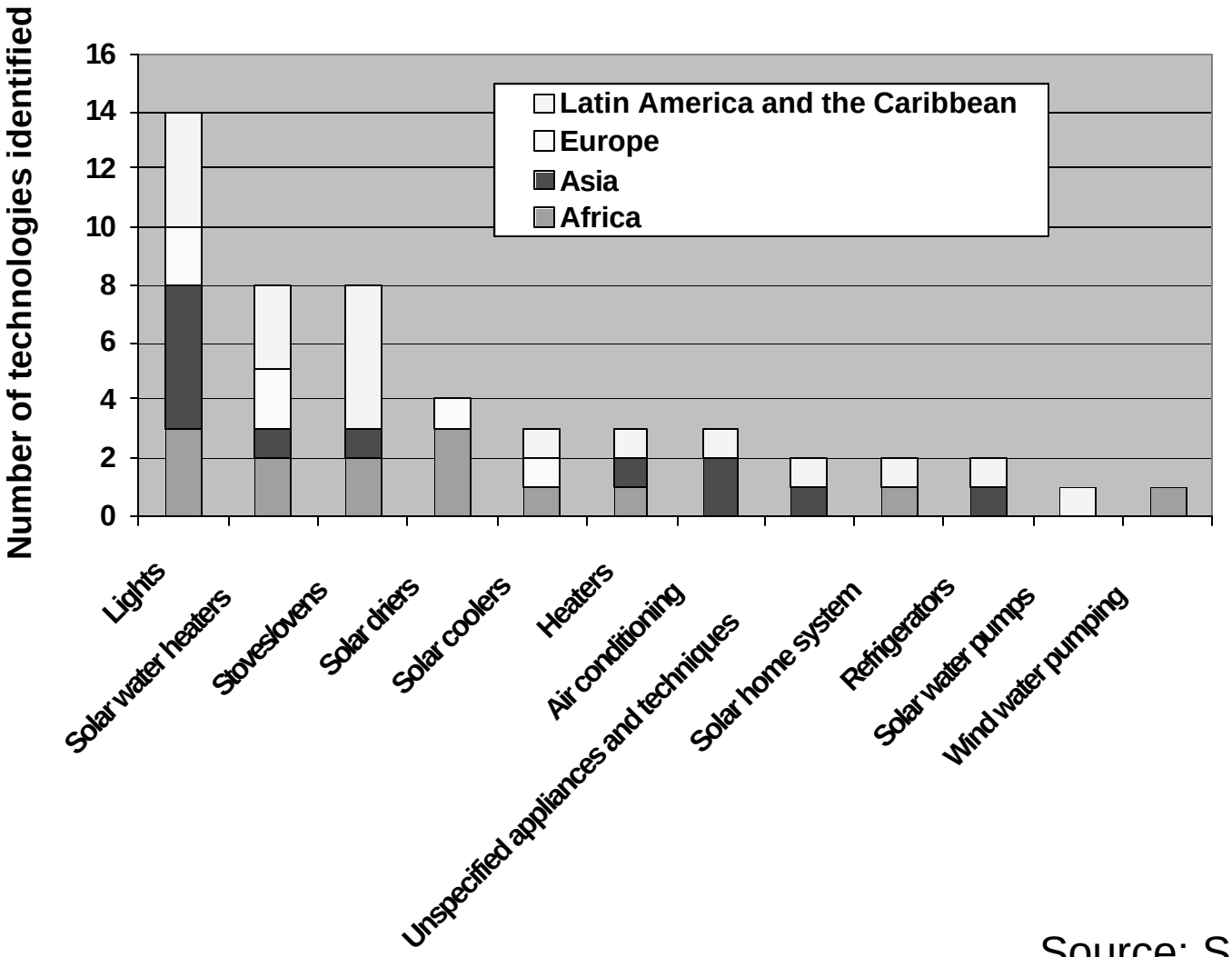

Source: SBSTA, 2006

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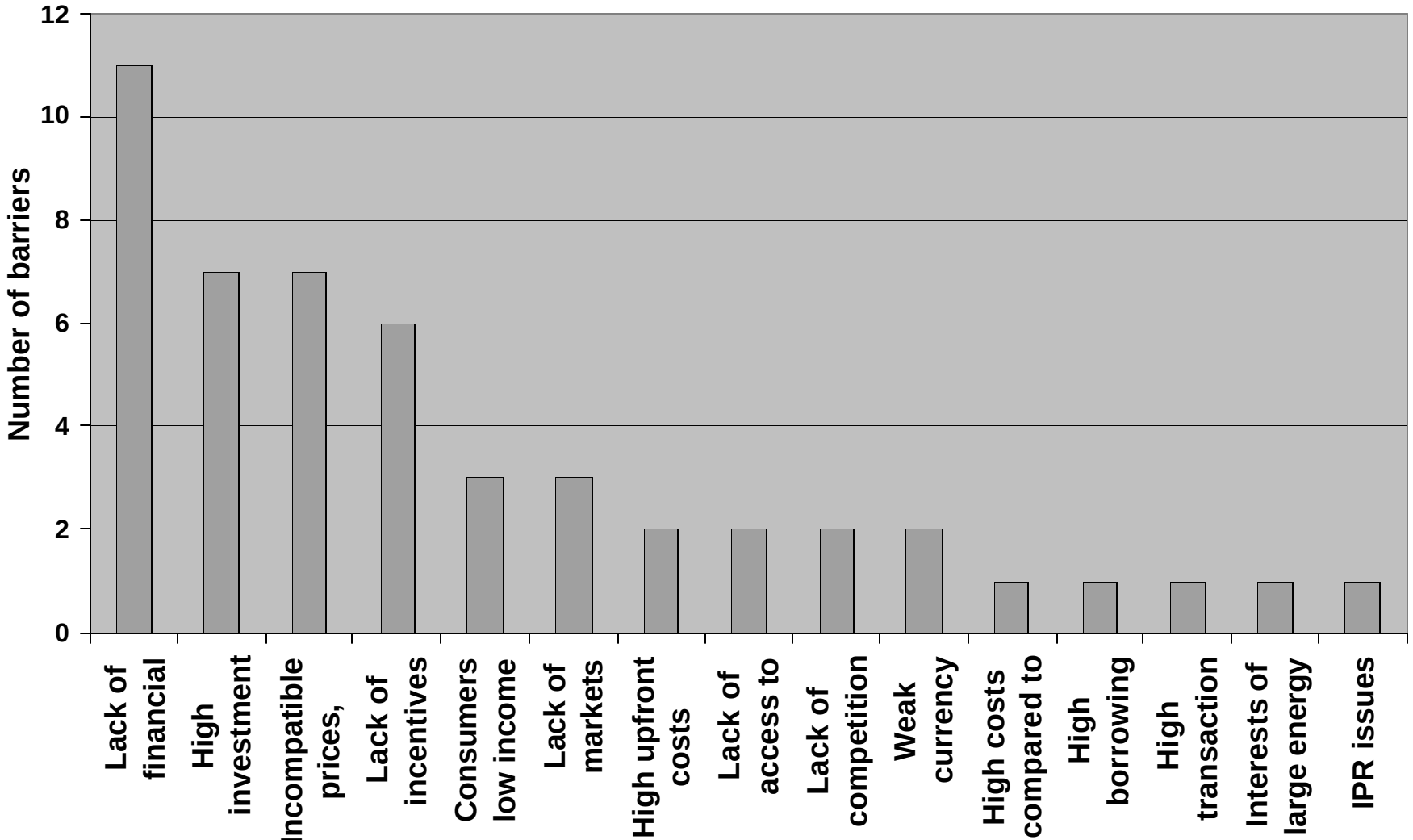
Frequency of economic and market barriers to technology transfer reported by non-Annex I Parties



Source: SBSTA, 2006

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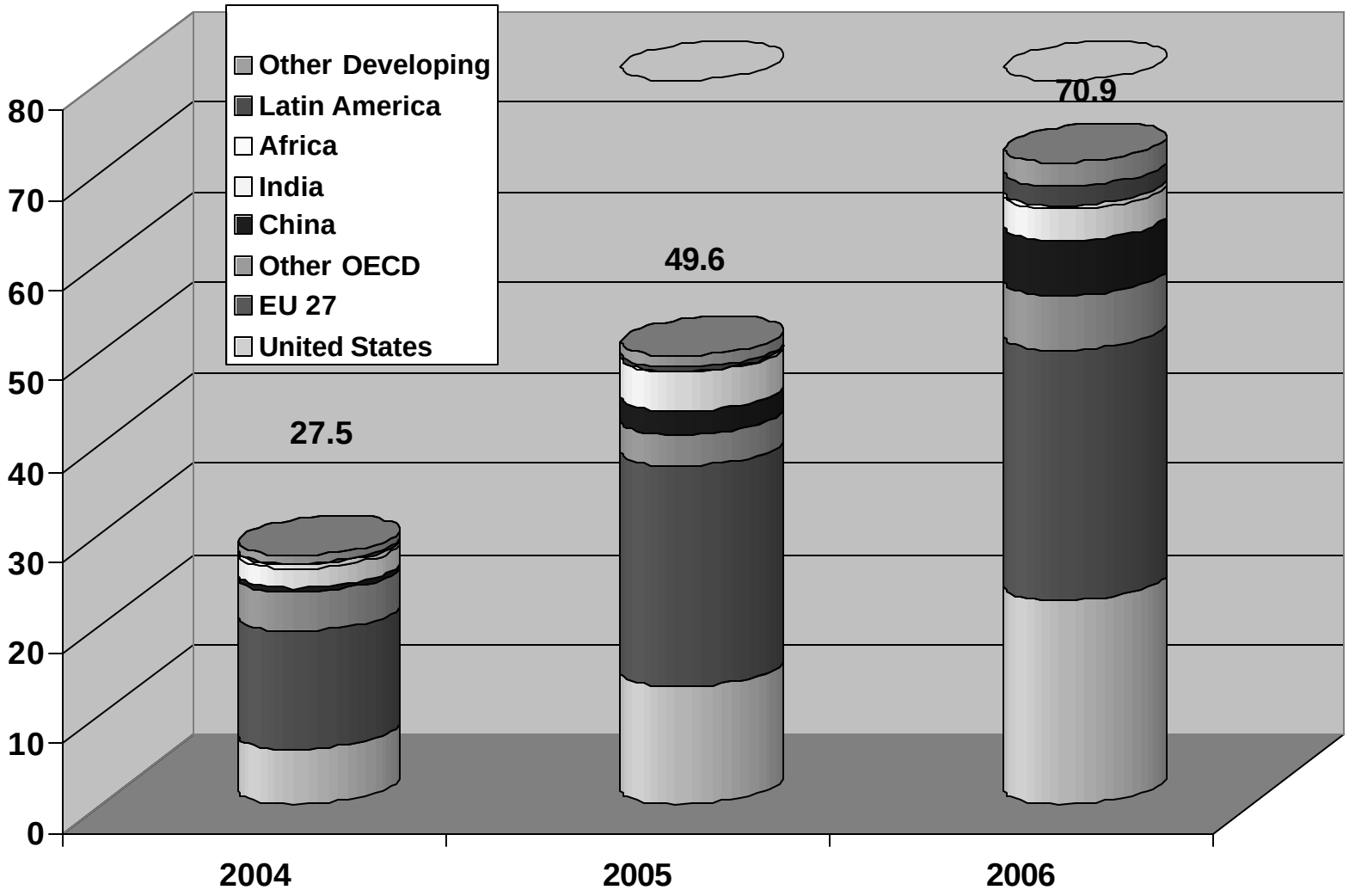
Global Investment in Sustainable Energy by Region, 2004 - 2006: $ billion



Policies, Measures and Instruments(PMI)

- Market based instruments (taxes, tradable permits, subsidies, deposit/refund systems)
- Standards, product bans, energy mix requirements
- Voluntary agreements
- Information, and labeling programs
- Government investment/ R&D spending

Source: IPCC, 2000

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Case Studies (continuation 1)

2: Brazil's sugarcane-based ethanol industry

Ethanol consumption surpass gasoline (24Mm3) plus 4 Mm3 exported

Local R&D activities in improved agricultural technologies in public&private research centers since 1970

Knowledge transfer from OECD countries through R&D center

Local development with the help of new technologies implemented by international companies pushing the demand side: flexfuel cars and ethanol powered airplanes; flexfuel motorcycles reaching market; generation of surplus electricity for the grid with high pressure boilers

Local technology offered to other tropical countries - Angola

Case Studies (continuation 2)

A US Example of Technology Transfer: Lawrence Berkeley National Laboratory

- **LBNL is managed by the University of California (UC) for the US Department of Energy (DOE)**
- **Industry and other users can access technologies developed through research funded by the US government**
  - Seek licenses to the technologies
  - DOE and industry jointly sponsor research and industry conducts research with laboratory scientists in a public-private partnership
- **Patents and copyrights from research belong to UC staff and not the US government**
  - Licensed to developers, distributors, or users worldwide
- **Collaborative research between LBNL and other scientists worldwide is a common practice where patents and copyrights may be shared**

Case Studies

1: Increase of FDI in China – the wind sector

Limited JV: materials and technology developed/owned by foreign company but manufactured with Chinese labour and materials; (2) JV: foreign company develops technology, owned by Chinese company and are made with Chinese labour and materials; and (3) China owned: Chinese Co. develops/owns the technology and oversees the production of the materials).

CONCLUSIONS

•Little transfer of wind power technology, due to the local content requirement and concerns about IPRs.

•Presently Chinese owned technology is less developed than the one available at international level

SUGGESTIONS

•Focus on policies to support demonstration, testing, and certification of locally manufactured technologies and

•Develop channels for informal knowledge transfer, such as through the establishment of R&D centres.