

Renewable Energy – an international perspective

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Overview

- Surprising facts about Renewable Energy
 - ✓ Examples of specific trends
- What's behind the success of RE?
- Global Energy Scenarios & RE

Facts about RE – surprising!!

- US\$ 30 bn invested in 2004 (excluding large hydro), compared to US\$ 150 bn in conventional sector
- RE power capacity of 160 GW world wide (excluding large hydro), with 44% in developing countries
- RE contributes to only ~4% of global power sector capacity

Trends in World Energy Use by Source, 1995-2005

Energy Source	Annual Rate of Growth (%)
Wind	28.6
Photovoltaics	26.2
Geothermal*	3.1
Hydroelectric	1.6
Oil	1.7
Natural Gas	2.5
Nuclear	1.8
Coal	2.5

*Data for 2000

EPI, 2006

More surprising facts about RE

- Fastest growing energy technology in the world is grid-connected photovoltaic (60% increase in period 2000-2004)
- Solar thermal collectors provide hot water to ~40 million households worldwide (2 million geothermal heat pumps used in 30 countries)
- Biomass-fueled heating provides 5X more heat worldwide than solar & geothermal combined
- Production of biofuels (ethanol + biodiesel) > 22 bn litres in 2004 (~3% of gasoline consumed worldwide). Ethanol provided 44% of all non-diesel motor vehicle fuel consumed in Brazil in 2004

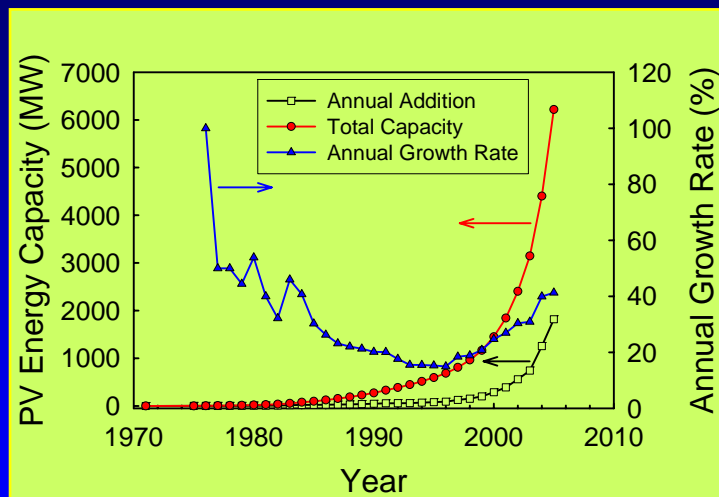
More surprising facts about RE

- More than 3.7GW bagasse combined heat and power (CHP) is installed worldwide
- 16 million households cook and light their homes with biogas
- 4.5 million green power consumers in Europe, USA, Canada, Australia and Japan in 2004
- Direct jobs from RE industry > 1.7 million in 2004, including 0.9 million for biofuels production

Renewables 2005 – Global Status Report
(2005); Bell (2005); WWI (2006)

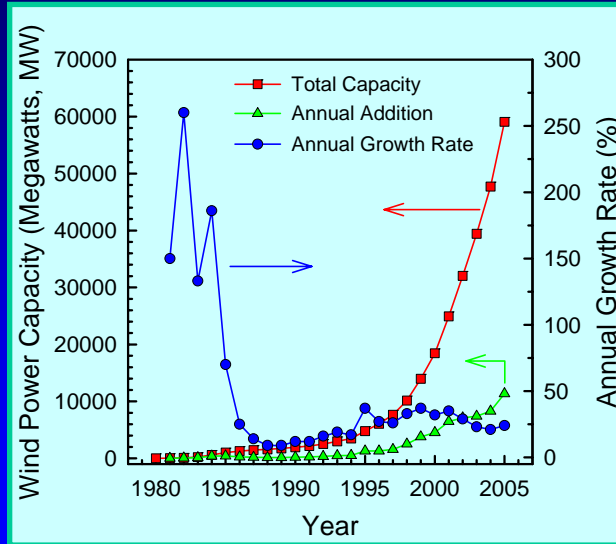
Some specific trends

PV Energy Capacity, 1970-2005

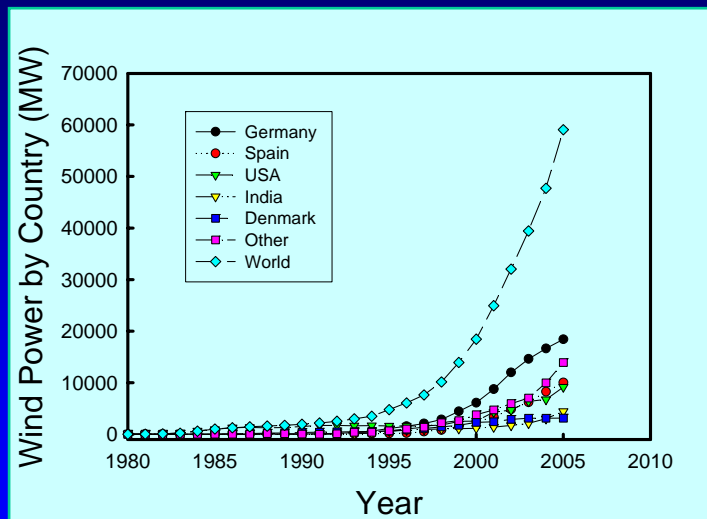


EPI (2006); Photon International (March 2006)

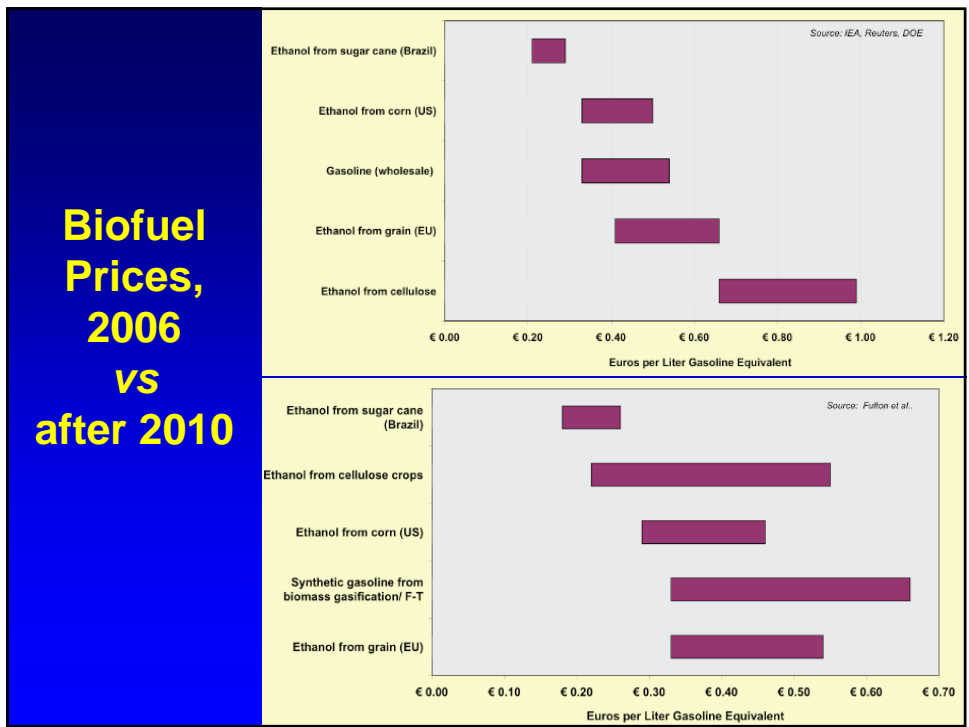
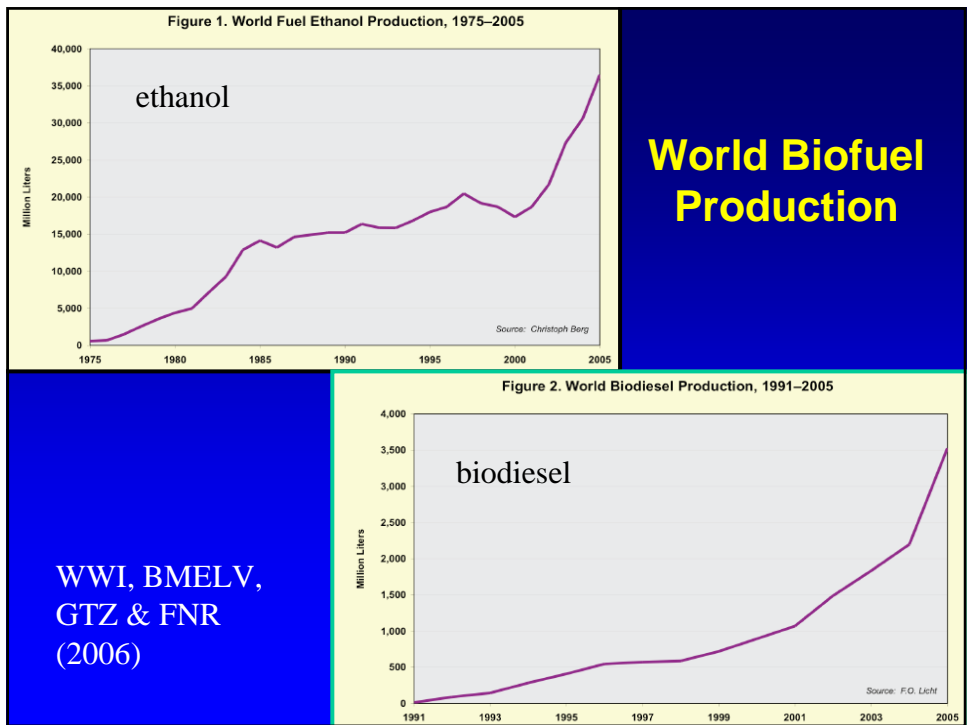
World Wind Power Capacity, 1980-2005



Wind Power Capacity by Country - 1980-2005



EPI, 2006



What's behind this success?

Policies (legislation)

1. At least 48 countries worldwide have some type of *RE promotion policy*, including 14 developing countries
2. At least 32 countries and 5 states/provinces have adopted **feed-in policies** (power generation promotion policy)
3. National renewable portfolio **standards** (e.g. **RE targets**) & **net metering**
4. **Fiscal/economic** incentives (e.g. rebates, grants, subsidies, tax credits, Carbon tax, tradable RE certificates/carbon trading, green power purchasing, RE financing schemes)

Integrated RE Policy

1. Leapfrog on available experience to integrate renewable energy policy with non-energy sector and cross-sector issues (e.g. tourism industry, education, transportation, urban planning etc...)
2. Address energy market barriers & distortions that either increase the cost (relative) of RE or unfairly discriminate against RE choices
3. Electricity market reforms (e.g. Independent Power Producers (IPP), distributed energy systems etc...)
4. R&D + successful RE project demonstrations
5. Public-Private partnerships & community participation

Global Scenarios

Stockholm Environment Institute - Global Scenario Group

Figure 1.1 Summary Table of GSG Scenarios and Trends in Some Key Variables

Scenario	Population	Economy	Environment	Equity	Technology	Conflict
<i>Conventional Worlds</i>						
<i>Market Forces</i>	↗	↗	↘	↘	→	→
<i>Policy Reform</i>	↗	↗	→	→	↗	↘
<i>Barbarisation</i>						
<i>Breakdown</i>	↔	↔	↘	↔	↘	↗
<i>Fortress World</i>	↗	↗	↘	↘	→	↗
<i>Great Transitions</i>						
<i>Eco-communalism</i>	↔	↔	↗	↔	↗	↔
<i>New Sustainability Paradigm</i>	↗	↗	↗	↗	↗	↘

Source: Gallopin et al (1997)

Global Energy Scenarios

Summary of following:

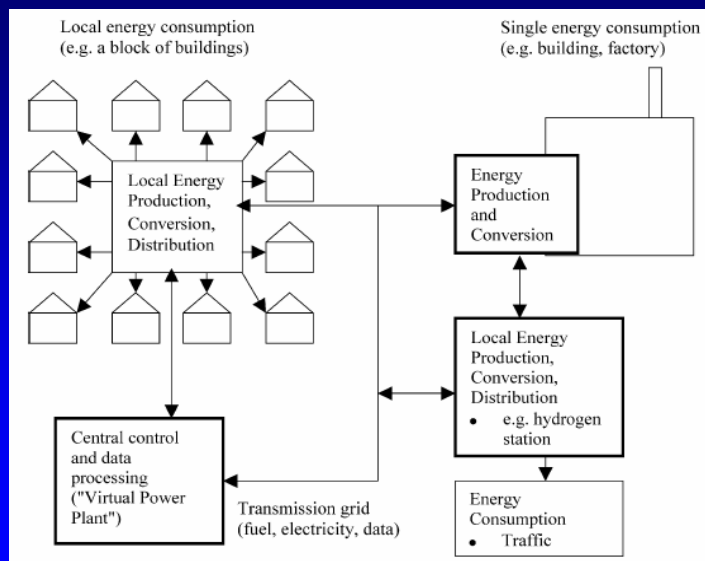
- Shell's scenarios
- Stockholm Environment Institute
- World Business Council for Sustainable Development
- Intergovernmental Panel on Climate Change
- Millennium Development Project
- Country level scenarios: UK; Canada & The Netherlands

IEA 2003, Energy to 2050

Key Features of Future Energy Sources & Systems

- Reduced reliance on fossil fuels (strong volatility of market)
- Increased Energy efficiency & emissions trading
- Shift to renewable energy sources
- Difficulty of identifying winning technologies in periods of high innovation (i.e. mix of energy sources)
- Generation of electricity from waste (organic)
- *Shift towards distributed power supply*
- Social science investigation of behavioural issues (i.e. understanding barriers to transitions)

Distributed Energy Systems (DES)



Renewable Energy Systems lend themselves extremely well to DES

Alanne & Saari (2006)

Centralized vs distributed system

Centralized		Distributed	
Benefits	Drawbacks	Benefits	Drawbacks
<ul style="list-style-type: none"> • Information easy to find • Responsibility, management and expertise easily placed • Only a few educated persons needed • Uniformity 	<ul style="list-style-type: none"> • Units must be large • Large by-investments • 'all the eggs in the same basket' • Long distances between production and consumption • Cannot work independently • Lack of individuality • Inflexibility 	<ul style="list-style-type: none"> • Scalability • Shared load • Ability to 'live' in networks • Can work independently • Individuality • Flexibility • Even distribution of political, technological, economic and social resources • Increased control at the local level • 'Not all the eggs in the same basket' 	<ul style="list-style-type: none"> • Fragmented information • Lack of uniformity and consistency • Considerable effort in management and education

Alanne & Saari (2006)



THANK YOU!!

“We all live on an island”
 (Photos courtesy of Dr Prasad Modak)