Risks and opportunities for renewable energy caused by climate change

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Risks due to climate change

Discussed quite widely in this conference

Changing frequencies of extreme weather events (e.g. floods and draughts)
Long term changes in rainfall patterns (run-off, soil humidity)

Risks concerning decision making (policy risks)
Illustrative map of future climate change impacts related to freshwater which threaten the sustainable development of the affected regions. Ensemble mean change in annual runoff (%) between present (1980–1999) and 2090–2099 for the SRES A1B emissions scenario. Areas with blue (red) colours indicate the increase (decrease) of annual runoff. (Bates et al. 2008.)
Opportunities for renewables

Energy efficiency improvement and renewables are most important alternatives for the reductions of greenhouse gas emissions.

Other alternatives:
- Carbon capture and storage (CCS)
- Nuclear power
- Increase of biospheric carbon sinks
- Emission reduction concerning other sectors (waste, agriculture, industry) and other gases

A wide spectrum of measures needed in order to reach deep enough emission reductions.
Global greenhouse gas emissions by sectors in 2005

The emissions sum up to approximately 46,000 MtCO$_2$ eq. Data source: CAIT, cait.wri.org. *) The estimated effect of land use change & forestry, 8,000 MtCO$_2$, is for the year 2000.
Fossil Fuel Emissions: Actual vs. IPCC Scenarios

Raupach et al 2007; Le Quere et al. 2009

Projection 2009
Emissions: -2.8%
GDP: -1.1%
C intensity: -1.7%
If the objective is to limit the temperature rise to 2°C

- Global emissions should peak within ten years,
- Global emissions should be 50-85% lower than 2000 by 2050,
- Emissions from the developed countries should be 25-40% lower by 2020, 80-95% lower by 2050.

www.ipcc.ch
CO$_2$ emission from fossil energy use

Emission reduction scenarios for limiting the emission by 50% and by 85% corresponding the overlimit emissions and underlimit emission for a temperature rise level of 2 C.
Figure 5.8 ● World energy-related CO₂ emission savings by policy measure in the 450 Scenario
IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN)

1) Introduction (Renewable energy and climate change) (5% share of the whole report)
2) Bioenergy (15 %)
3) Direct solar energy (10 %)
4) Geothermal energy (5 %)
5) Hydro power (5 %)
6) Ocean energy (5 %)
7) Wind power (5 %)
8) Integration of renewable energy into energy systems (15 %)
9) Renewable energy in the context of sustainable development (10 %)
10) Mitigation potential and costs (10 %)
11) Policy, financing and implementation (15 %)
Way of work

Start of work in Jan 2009 (First meeting of authors)
Two commenting reviews for the draft report

Executive summary (of about 20 pages) will discussed and accepted by line by line procedure by government delegations early in 2011
Figure 10.5.3: Relative position of various renewable energy technologies within the innovation chain. (Source: IEA, 2008a, p. 181).
Global CO₂ emissions in the Baseline and 2°C mitigation scenarios

Globalized

Regional

Baseline
2°C, Gross
2°C, With afforestation
2°C, With CCS

Global emissions, Pg CO₂

2000 2020 2040 2060 2080 2100

2000 2020 2040 2060 2080 2100

CCS

Book: Energy Vision 2050, VTT 2009
Total power generation capacities in 2020–2050 in the World, 2°C Market scenario

- Wind
- Bio
- CCS
- Fossil
- Nuclear
- Hydro
Annual capital expenditures on new power and heat generation capacity in the World in 2020–2050, 2°C Market scenario

- Wind
- Bio
- CCS
- Fossil
- Nuclear
- Hydro

Annual capital costs, billion €

(Global)
Total investments needed by 2050 are huge

In addition to electricity generation, large investment are needed in transmission capacity, heat generation capacity and especially in energy efficiency (producing energy services with smaller amount of energy).

Globally, about 1.5 billion people are without modern energy services.
Renewables dominate in investments in EU

Investments in electricity generation capacity in EU in 2009

- Wind energy: 39%
- Natural gas: 26%
- Solar: 16%
Environmental and social concerns related to energy sources
- all sources have some concerns in some cases

Fossil fuels
  - Greenhouse gases, particulate emissions etc.
  - Fluctuating oil and gas prices, security of supply

Nuclear
  - Radioactive wastes, risk of proliferation and accidents

Bioenergy
  - Land use changes with impacts on ghg emissions, water usage, food supply and biodiversity, particulate emissions

Hydro
  - Harm to fish migration, loss of biodiversity, human population displacement

Wind
  - Bird fatalities, visibility of wind turbines, noise

Direct solar
  - Water usage by CSP plants in arid areas, waste created in PV manufacture and disposal
External Costs can give a picture on relative importance

- Uncertainty range of external costs is large
- Decrease of emissions in the power system depends heavily on the system
Challenges

- Energy efficiency improvement and increase of the share of renewable energy have central role in the reduction of emissions (Both measures also improve energy security and contribute to sustainable development)

- Renewable energy potentials have great regional differences, regional information needed.

- Different renewable energy sources are in different state of technological maturity (Best deployment potential have hydro, biomass and wind, breakthrough of solar is coming. Geothermal and ocean energy are in developmental state.)

- Integration of renewable energy in existing and future energy systems is a central challenge.

- In the assessment of changes, several viewpoints are needed, e.g.: life-cycle, cost-efficiency and systems approach (Ghg emission reduction depends on the whole (energy) system, not only on the increase of renewables)

- Well designed policy measures are needed in the deployment of renewable energy sources
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