IEA-ENEL Workshop

Sectoral Approaches for Greenhouse Gas Mitigation in the Power Sector

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Session 1 – Stage-setting: electricity generation and climate change

electricity generation and climate change

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Key messages

1. **Electricity is one means to reduce CO_2 emissions: the technologies exist; R&D is preparing the next generation**

2. **Heavy reliance on best available technologies can contribute to a twofold reduction of CO_2 emissions worldwide by 2050 (fourfold reduction in the OECD)**

3. **Need to be thoroughly familiar with technologies: appraise pros and cons; evaluate industrial and economic maturities; move in time with investment schedules (new capacities and replacement)**

4. **Demand-side management of electricity: uncoupling from economic growth is one of the main challenges of the next 40 years**

5. **Public policy will be the decisive factor**
   - **Ensuring that instruments are complementary and consistent**
   - **Efficiency of each instrument is linked to its specific design which must be consistent with its purpose (the devil is in the details)**
   - **Ensuring consistency between competitiveness and environmental protection**

1. Electricity as a way to reduce CO2 emissions via investment (demand & supply)

- **Climate change is key for the electricity sector**
  - Electricity contributes 40% of CO2 emissions (transport: 20%)
- **Electricity is an energy vector**
  - The choice of primary energy sources impacts CO2 emissions as illustrated by countries with a large share of CO2-free power generation

Impact of electricity mix on CO_2 emissions		Denmark	Germany	France	Sweden
Emissions from energy in tCO2/capita		9.4 t	10.3 t	6.2 t	5.8 t
Structure of power generation	coal	46%	50%	5%	1%
	nuclear, hydro & other renewables	25%	38%	91%	97%

source IEA data 2004

- **Low-carbon and CO2-free technologies exist**
  - Some are already on the market: compact fluorescent lamps, insulation techniques, nuclear, renewable energies; use of coal and gas BAT can boost efficiency and reduce emissions
  - Others will be here by 2030-2040 if we take the necessary steps today (R&D, industrial demonstrators): CCS, G4 nuclear, photovoltaic, electricity storage…)

2. Use of best available technologies could allow global emissions to be halved by 2050

IEA 2050 and LCES: same method of using BAT while respecting natural replacement rate for existing facilities

- **Massive use by 2030**
  - Demand-side: building insulation, compact fluorescent lamps…
  - Moderate use of gas and coal with better outputs
  - Nuclear, hydro and some other renewables (not far from being competitive: wind power and biomass)
- **By 2030-2050**
  - Coal with CCS; Nuclear Generations 3 and 4; renewables and demand-side management

Electricity Generation	total	structure					coal with CCS	CO2 emissions (elec) /2003
		coal	gas +oil	nucl.	hydro	Other renew.		
2003	16 700 TWh	40%	26%	16%	16%	2%	0%	
IEA baseline 2050	46 600 TWh	47%	31%	7%	9%	6%	0%	x 2,6
IEA ACT Map 2050	31 800 TWh	27%	25%	17%	15%	16%	53%	-26%
IEA TECH+ 2050	32 900 TWh	21%	22%	22%	15%	20%	73%	-49%
LCES 2050	32 000 TWh	23%	11%	31%	24%	11%	54%	-61%

3. Sharing knowledge and skills regarding technologies: maximise advantages and minimise drawbacks, evaluate industrial and economic maturities (3 examples)

i. Maximise advantages and minimise drawbacks

- **Nuclear power**
  - Sufficient uranium supply for global third generation installed base 3-4 times the current size
  - Acceptability of nuclear: safety, waste management, non-proliferation and economics
  - Economics: draw lessons from examples of success in France and Belgium… and of failure in the US and UK; selection of efficient design; clear and consistent licensing and authorisation procedures; industrial organisation and standardisation
- **Hydro power**
  - Economic potential: 3-4 times current worldwide installed base
  - In the market but capital-intensive: financing in developing countries?
  - Limit impact on population displacement, biodiversity; and take into account other water uses

ii. Industrial and economic maturities: paying attention to timescales

Carbon Capture and Storage

- Each of the different steps (capture-transport-storage) has been mastered technically
- Capture is 2-3 times too expensive (doubling the overall cost of coal generation); need to test the reliability of groundwater; transport distances must remain reasonable
- Set up CO2 transport system to implement large-scale rollout; organise concertation and debates with stakeholders

↳ Uncertainties remain about volumes that can be treated in the future

↳ Significant development from 2030, provided that industrial demonstrators are started quickly and that implicit CO2 costs are limited to $20-25/tCO2

4. Demand-side management of electricity: uncoupling from GDP growth possible but must be gradual

- **Global demand could be one third lower than the baseline scenario in 2050 (doubled instead of trebled)**
  - Energy-saving lamps, building insulation, appliance energy consumption in standby mode, heat pumps, solar water heaters…
- **We can set ambitious targets for uncoupling electricity use from GDP growth by 2050, bearing in mind that the shift will necessarily be gradual judging from past experience, even recent**

% change/year		past trends			trends to 2030				IEA Perspectives 2050			
		GDP	energy	elec.	2002-30	GDP	energy	elec.	2003-2050	GDP	energy	elec.
world	1971-2002	3.3%	2.0%	3.6%	WEO 04 ref	3.2%	1.7%	2.5%	baseline	2.9%	1.6%	2.2%
	1990-2004	3.4%	1.5%	2.8%	WEO altern.	3.2%	1.3%	1.6%	Map ACT	2.9%	1.0%	1.4%
EU-15	1973-2004	2.2%	0.9%	2.4%	2000-30	2.3%	0.6%	1.3%				
	1990-2004	2.1%	1.1%	1.9%	(EU Green Paper 2006, baseline)							

➯ Be realistic about potential: taking into account the rebound effect and leaving time for BAT to be integrated as facilities are replaced … and implement effective public policy tools to tackle "transaction costs" issues

- **Economic and environmental benefits (climate change) of substitution of low-carbon electricity**
  - HV heat pumps, electric hybrid vehicles …

5. Effective energy policies

i. **Complementary instruments**
   - Public-private partnership for R&D and industrial demonstrators (CCS, G4 nuclear, photovoltaic, zero-energy homes…)
   - CO_2 prices over the next 30 years that encourage investment in technologies that are mature or almost mature economically and industrially
   - Demand-side management: balance labels, standards and regulations with tax credits and "energy prices"

ii. **Efficiency of each instrument linked to consistency of specific design (the devil is in the details): e.g. emissions trading scheme**
   - Provide long-term visibility on market rules and the proper incentives
     - Avoid quota renegotiations every five years
     - New plants should pay for own emissions permits (SO_2 experience in US)

iii. **Balance between competitiveness and environmental protection**
   - For the electricity industry, high CO_2 short-term prices have little or no impact on the environment (leakage effect) and may have a negative effect on competitiveness
   - On the other hand, we can afford to be ambitious for the long term (15-20 years): long-term CO_2 prices should have positive impact on the environment (investments required) and a limited impact on competitiveness if prices in other geographic areas move into line

Additional slide on Europe

2.4 Scenario set out in EU Green Paper

- Is the scenario sustainable? Despite highly ambitious penetration of renewables (10% wind power and 8% biomass in electricity sector), dependence on gas doubles, and CO_2 emissions increase by 10% against 2000

EU Green Paper	Fossil	o/w			Nuclear	Renew.	o/w		
		Coal	Oil	Gas			Hydro	Wind	Biomass
2000	**55%**	31%	6%	17%	**32%**	**13%**	12%	1%	2%
2030 baseline	**55%**	28%	< 2%	25%	**19%**	**27%**	9%	10%	8%

- Greater reliance on demand-side management is possible but not easy; the baseline scenario already calls for significant uncoupling of growth in electricity use (1.5% a year) and GDP growth (2.0% a year)
- Share of nuclear could remain at least at current level (just over 30%), enabling Europe to truly take the lead with a low-carbon and competitive energy mix