Demonstrating nuclear's competitive advantage

Name – Serge Gorlin
Position – Head of Industry Cooperation

Atomexpo
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“New Economics” of nuclear power

2005 WNA Report: *The New Economics of Nuclear Power*

- High capital costs but….
  - Low fuel and operating costs
  - High capacity factors
  - 60-year + lifetimes
  - Rising fossil fuel prices
  - Premium on carbon

Nuclear very competitive with other sources

Challenges to model

- Capital cost escalation for nuclear new build globally
- Impact of renewables on baseload electricity suppliers in terms of price (liberalized markets) and capacity factors
- Arrival of cheap natural gas (including shale)
- Fukushima effects in terms of increased production costs (safety upgrades) and insurance

Capital costs

- Evidence of escalation comes from relatively small number of projects, largely in N. America and Europe.
- Here, construction has come after long hiatus: inevitable loss of experience
- Inflation of nuclear-specific commodities and labour due to 'bottle-necks' caused by the increase of demand following the hiatus
- Globalization of the nuclear supply chain has not penetrated very deeply in many existing nuclear countries and thus there has been only a limited internationalization of prices
- Projects have been FOAK (see D'haeseleer study for EC)
- No evidence of great capital cost increase in China, Korea and Japan

Capital costs in Japan and S. Korea

IEA/NEA, *Projected Costs of Generation Electricity*, 1998, 2005, 2010, US dollar values for 1996, 2003 and 2008 (assumed).

Overnight Capital Costs (US $/kW)		
Year of publication	**Japan (ABWR)**	**South Korea (OPR 1000)**
1998	2 521	1 637
2005	2 510	1 208/1 074
2010	3 009	1 876

Construction times

New Reactors Connected to the Grid (number) and Median Construction Time (months)

1981-1985		1986-1990		1991-1995		1996-2000		2001-2005		2006-2010		2011-2012		2013	
No.	Mths	No.	Mths	No.	Mths	No.	Mths	No.	Mths.	No.	Mths.	No.	Mths.	No.	Mths
131	84	85	93	29	82	23	121	20	59	12	77	10	62	4	68

[1] IAEA, *Nuclear Power Reactors in the World, Reference Data Series No.2,* 2014 Edition

Five-year construction periods being achieved in some countries

Challenge from renewables

- If the current rate of renewables construction is maintained, with subsidies and priority grid access, the load factors of all other generators will be depressed with impacts on profitability.
- Renewables - very low operating costs but system costs and the need for back-up capacity mean that this is misleading from the viewpoint of end-user costs
  - According to the Minister for Energy and Environment (Feb 2013) Energiewende will consume one trillion euros by the end of the 2030s in terms of Feed-in Tariffs and grid restructuring.
  - Morgan Stanley has estimated that investors in a 800 MWe gas plant providing for intermittent generation would require payments of €80 million per year

Challenge from gas

- Ongoing low gas prices cannot be assumed, and in several projections they increase within the time frame of building new nuclear plants.
- NPP life extension is the cheapest way of providing power over a 20-year period, even compared with CCGT generation at long-term gas prices as low as $ 5/mBTUs
  - Typical figure of less than $ 1 000/kW for life extension for nuclear
- Externalities from gas:
  - Carbon
  - Pollution
  - Security of supply

Fukushima effects

- €11b for Fukushima-related safety upgrades across the French fleet (58 units); comparable to US
- Nuclear liability is a complex issue but:
  - Special liability regime for nuclear (strict liability of operator etc.)
  - Comparable to hydro and some other industrial sectors in that government expected to assume some risk for worst-case scenario
  - Compensation bears little relation to the actual radiation-related health and environmental impacts
  - Costs less significant when averaged over 60 years of nuclear generation

Fatalities from electricity generation

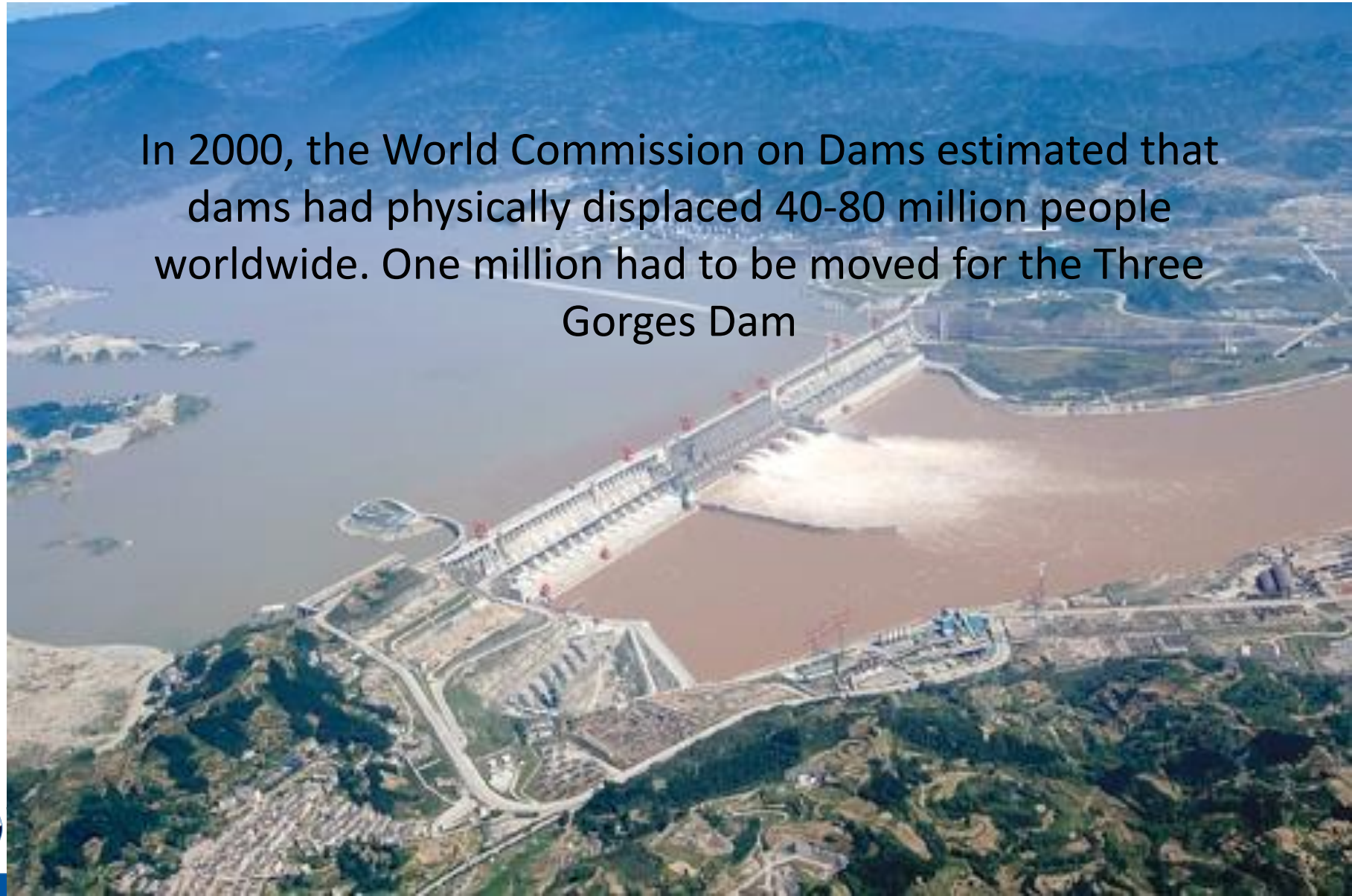
	OECD		Non-OECD	
Energy chain	Fatalities	Fatalities/TWy	Fatalities	Fatalities/TWy
Coal	2259	157	18,000	597
Natural gas	1043	85	1000	111
Hydro	14	3	30,000	10,285
Nuclear	0	0	31	48

Summary of severe* accidents in energy chains for electricity 1969-2000

Data from Paul Scherrer Institut, in OECD 2010 *Comparing Nuclear Accident Risks*

*severe = more than five fatalities

Three Gorges dam: China, 18 GWe



New build today

- There are currently 16 commercial civil nuclear reactors under construction in OECD countries, another fifty under construction in non-OECD countries; except for Finland, all of these projects are taking place in *regulated* electricity markets
- In these projects the electricity market regulator allows the utility to factor into the sale price of electricity an element to fund or amortise capital investment.

Conclusion

- Nuclear power very competitive when you take into account system costs and externalities of other forms of energy
- Governments must intervene in liberalised energy markets to provide the right conditions for long-term investment in reliable, affordable, carbon-free energy