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Emission reductions when energy is good

CenSES Årskonferansen 2012

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Aim

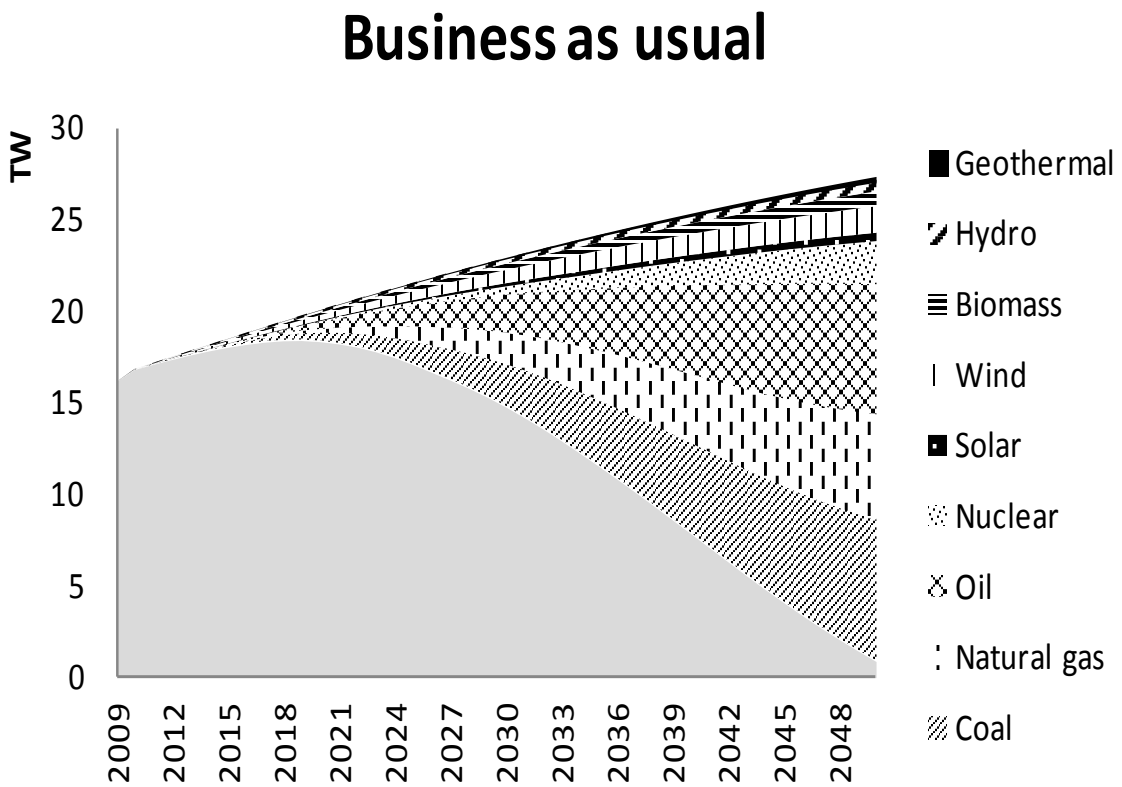
- Estimate the cost of future global energy supplies
  - Three scenarios (2009-2050)
  - Experience curve with diminishing learning rates

- Based (mostly) on existing literature for assumptions (future population, GDP, future energy needs)

Business as usual scenario

- Based on World Energy Outlook 2011 (until 2035)

- In 2050:
- Fossil: 70%
- Locked-in: 3%
- Nuclear: 7%
- RE: 20 %
  - Wind: 6%
  - Hydro: 4%
  - Geothermal: 4%
  - Bioenergy: 4%
  - Solar: 3%

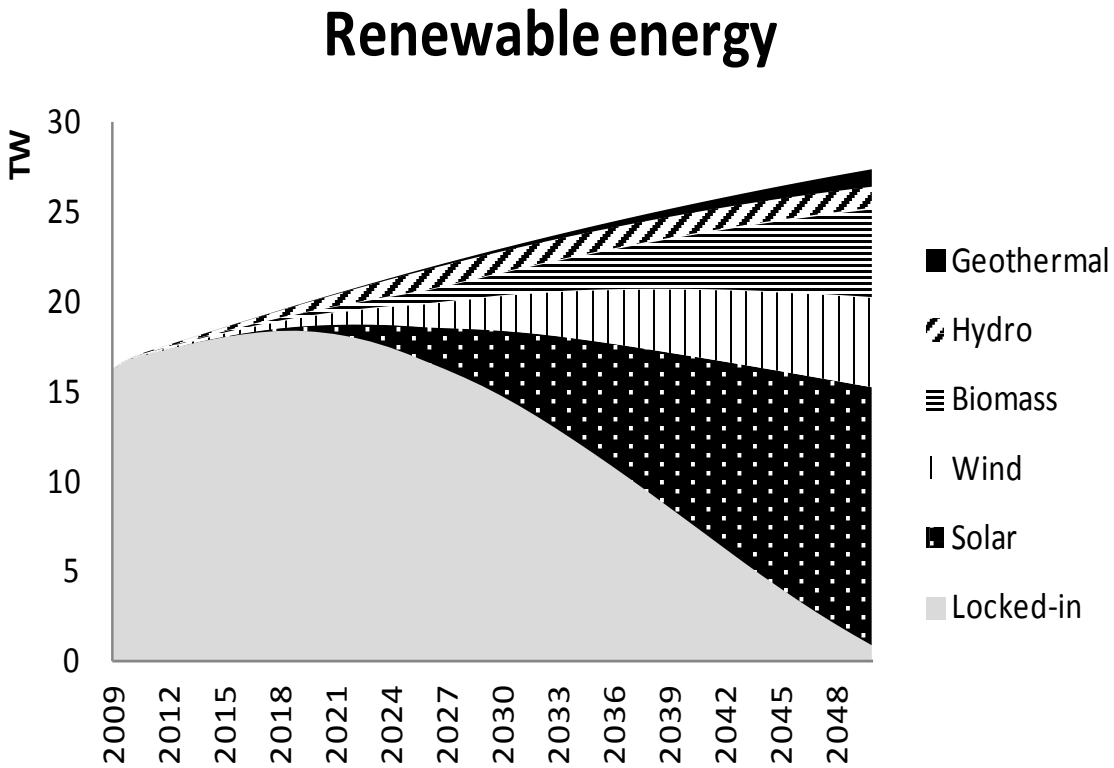


Renewable energy scenario

- Replace as much fossils with renewables as possible

- Potential in TW
  - Hydro: 1.5
  - Wind: 5
  - Bioenergy: 5
  - Geothermal: 1

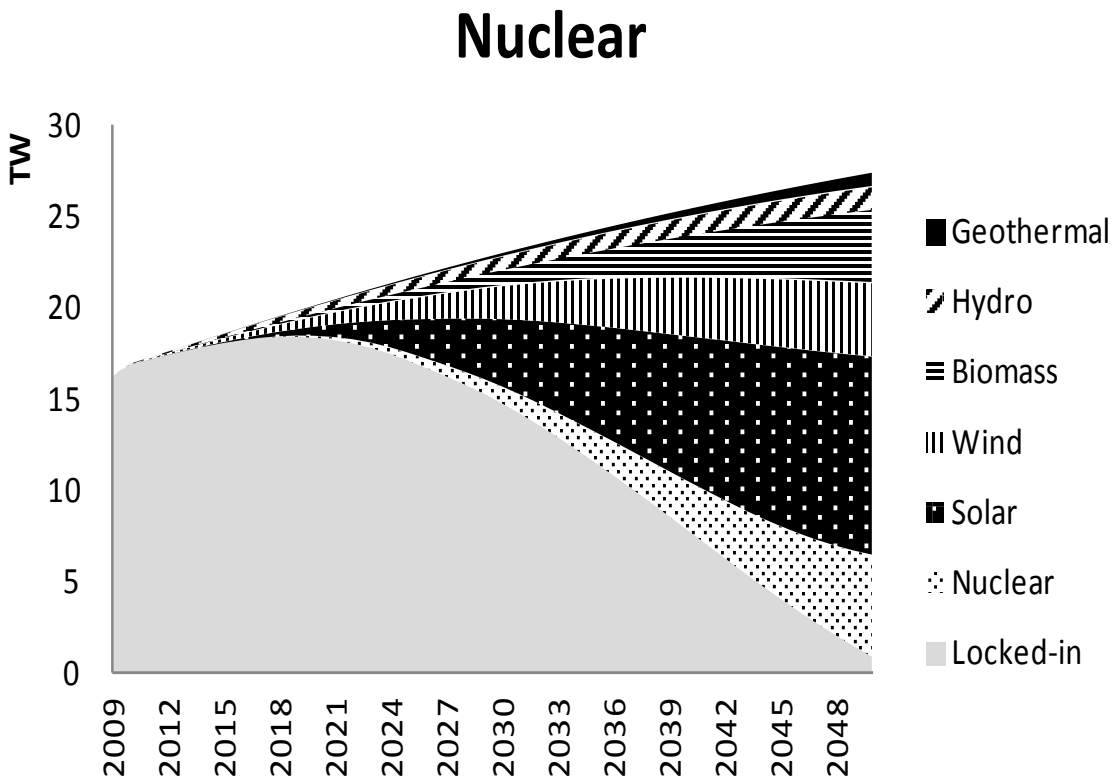
- Locked-in: 3%
- Renewables: 97%
  - Solar: 53%
  - Wind: 18%
  - Bioenergy: 18%



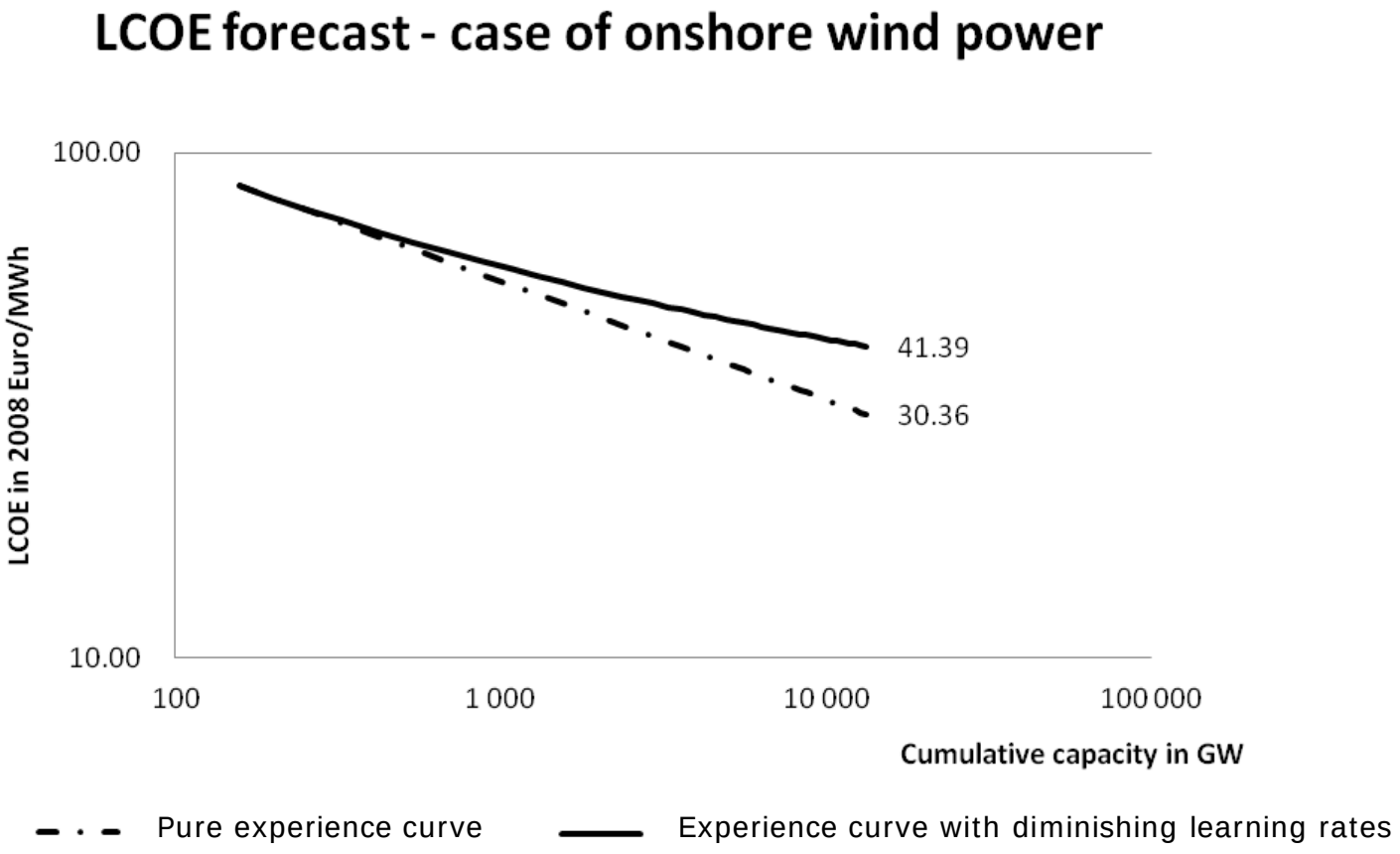
Nuclear scenario

- Some nuclear, rest is renewables

- Nuclear: 22%
- Renewables: 75%
  - Solar: 34% (most costly)



Experience curve



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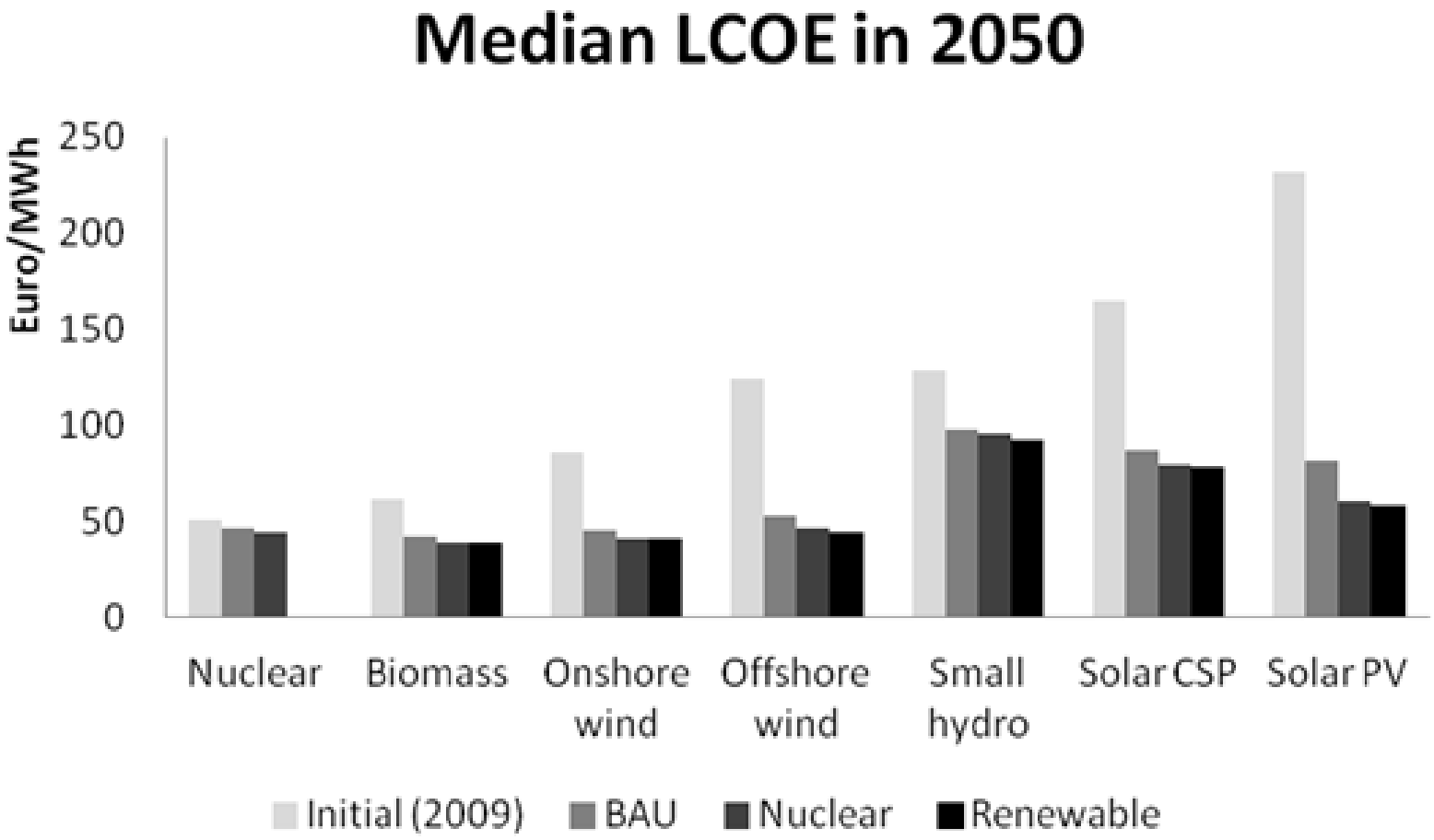
Technology cost in 2009 and 2050 (Euro / MWh)



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Final costs

	Business as usual		Nuclear		Renewable energy	
Technology	Cost	Share 2050 TPES	Cost	Share 2050 TPES	Cost	Share 2050 TPES
Coal	1.3%	33.1%	-	-	-	-
Crude oil	1.0%	17.1%	-	-	-	-
Natural gas	1.1%	19.7%	-	-	-	-
Nuclear	0.3%	7.1%	0.8%	21.8%	-	-
Large hydro	0.2%	3.0%	0.2%	3.0%	0.2%	3.0%
Small hydro	0.2%	1.0%	0.3%	1.4%	0.3%	1.4%
Biomass	0.2%	3.9%	0.7%	18.1%	0.7%	18.1%
Geothermal	0.1%	3.6%	0.1%	3.6%	0.1%	3.6%
Solar PV	0.2%	1.5%	1.7%	21.9%	2.2%	32.5%
Solar CSP	0.1%	1.2%	0.8%	12.2%	1.2%	20%
Onshore wind power	0.4%	5.0%	0.7%	11.0%	0.7%	11%
Offshore wind power	<0.1%	0.7%	0.2%	3.8%	0.3%	7.3%
Total	5.09%	96.78%	5.35%	96.78%	5.68%	96.78%

Let's discuss…

- Possible peak oil (fossil)?
- Rate at which LR diminishes overtime (all scenarios)?
- Using sensitivity analyses, cost of switching to renewables will be between 0.6% and 2.4% of cumulated GDP
  - Climate change (fossil)?
  - Air pollution (fossil)?
  - Cost of adapting supply side (RE + nuclear)?

What you should remember

- Remember that going fully renewable…

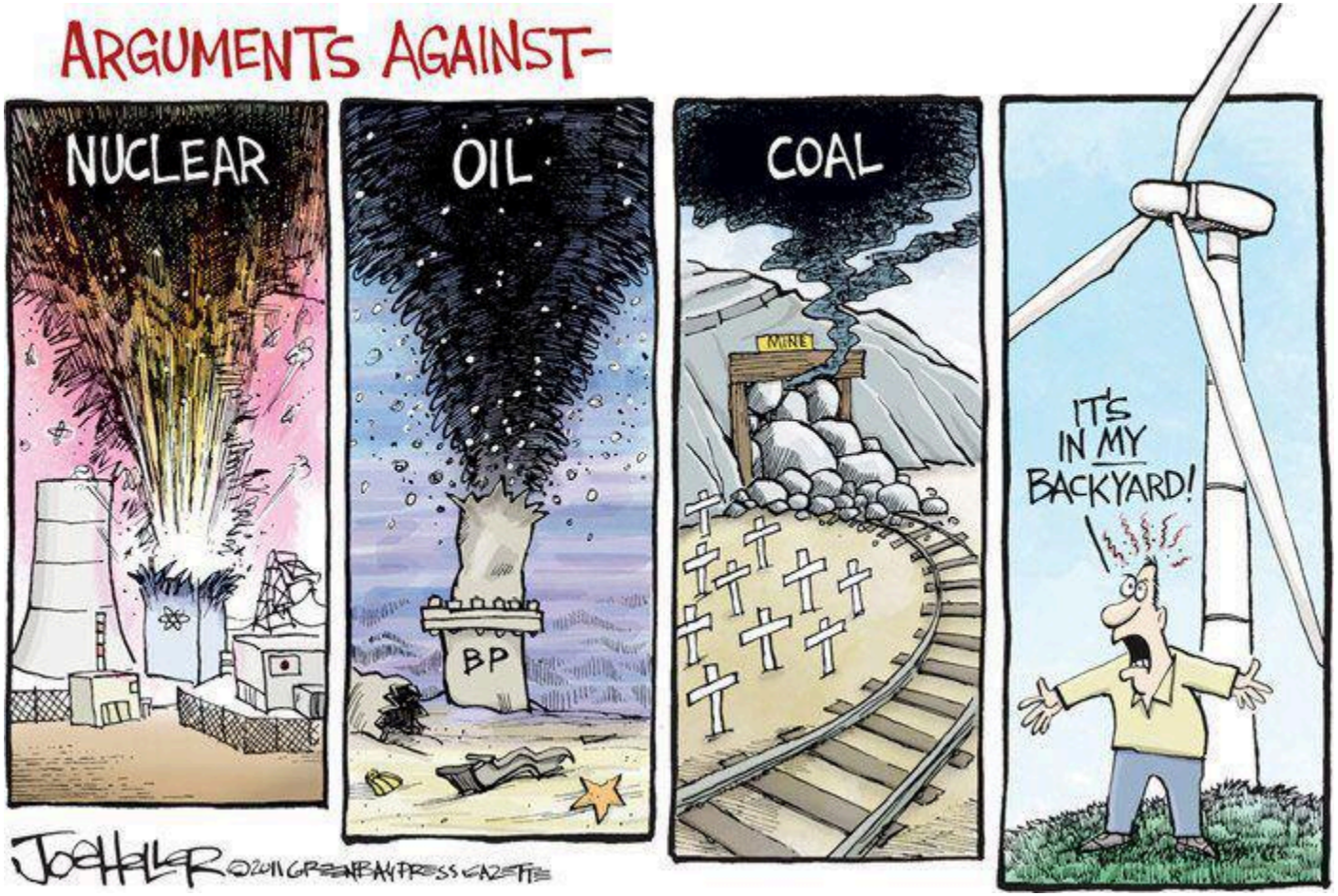
…is possible…

…though it will likely come at a cost…

…which is not out of reach…

…but other elements will make the way to get there challenging…

…although nuclear can ease the burden.



Working paper available:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2180493