

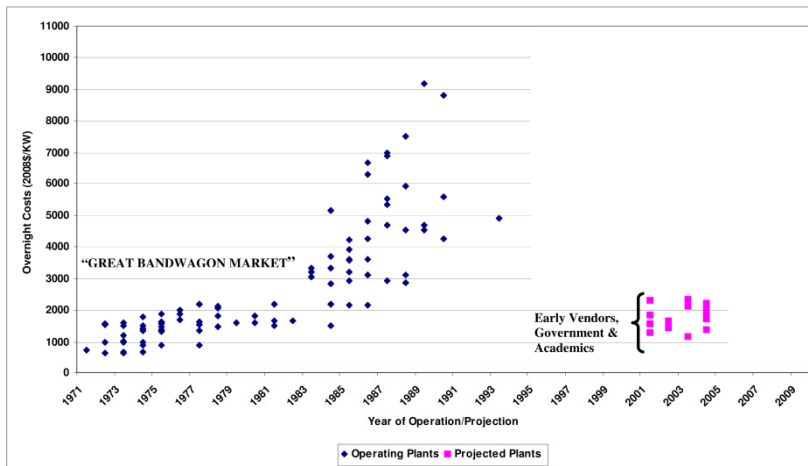
European Pressurized Reactor in Olkiluoto, Finland

- A new reactor model marketed by the French state nuclear industry, Areva and EdF

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Figure ES-1: Overnight Cost of Completed Nuclear Reactors Compared to Projected Costs of Future Reactors



Sources: Koomey and Hultman, 2007, Data Appendix; University of Chicago 2004, p. S-2, p. S-8; University of Chicago estimate, MIT, 2003, p. 42; Tennessee Valley Authority, 2005, p. 1-7; Klein, p. 14; Keystone Center, 2007, p.42; Kaplan, 2008 Appendix B for utility estimates, p. 39; Harding, 2007, p. 7; Lovins and Shiekh, 2008b, p. 2; Congressional Budget Office, 2008, p. 13; Lazard, 2008, Lazard, p. 2; Moody's, 2008, p. 15; Standard and Poor, 2008, p. 11; Severance, 2009, pp. 35-36; Schlissel and Biewald, 2008, p. 2; Energy Information Administration, 2009, p. 89; Harding, 2009. PPL, 2009; Deutch, et al., 2009, p. 6. See Bibliography for full citations.

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The flagship that wasn't

- First nuclear order in western countries after Chernobyl
- First "3rd generation" reactor
 - A "streamlined" design that was supposed to overcome licensing and construction hassles
- Still only "3rd gen" reactor model that there is construction experience of
- Nuclear industry's second chance after the financial meltdown and loss of investor confidence in the 80's

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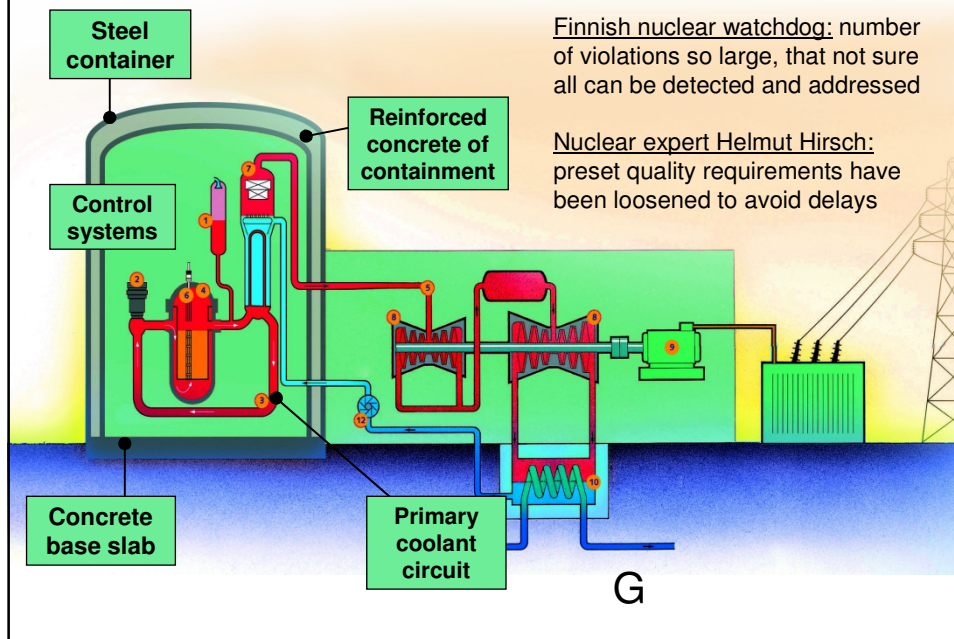
Quality violations

- Deliberate violations of regulation: ignoring deviations, building without required tests and blueprints
- Deliberate cover-ups
- Incompetent workers & subcontractors
- Complete failure of quality control by the companies, Finnish authorities cannot watch every step of the companies

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Examples of quality problems in Olkiluoto



Finnish nuclear watchdog: number of violations so large, that not sure all can be detected and addressed

Nuclear expert Helmut Hirsch: preset quality requirements have been loosened to avoid delays

Quotes from workers

- "Concrete came in truck after truck. And we pumped it. Even when the reinforcement was not finished. Concrete had to be pumped because it was waiting."

--Andrzej Miciak

- "Bouygues inspectors gave an order to cover up clear defects in a safety classified structure. We did and the authorities did not find them."

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Quotes from workers

- "If there were major mistakes, they found them, but these smaller ones... just leave them."
- "The welders did not know how to weld because there were no specifications. It was like a bakery without recipes. And yet it is a nuclear power plant that can affect the lives of millions."

-- Tapio Kettunen, welding engineer

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18.10.2006



**No single
welding
method
approved**

8.11.2007



**First weld tests
carried out**

Electronic control systems

- Systems that monitor&control everything in the reactor
- Areva still has no design that would conform to "basic principles of nuclear safety"
- Insufficient separation & diversity
- STUK: 'Evident design errors are not corrected' because of 'the attitude or lack of professional knowledge' of Areva personnel

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Overall impact of violations?

- Defects have increased the probability of a severe accident
- No way to know how many defective components have passed inspections and how large the deviations are
 - Overall impact impossible to quantify
- Largest risk: unforeseen chains of causation
 - When something goes wrong in a reactor, it is rarely an accident sequence that was included in the risk assessments

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Nuclear ”super waste”

- Olkiluoto 3 EPR is designed to burn up uranium much more intensely than operating utility reactors
- As a result, the waste is twice as hot, up to 12 times as radiotoxic, harder to contain and more likely to lose integrity
- Cooling time after discharge twice as long
- Increased health & environmental risks in all phases of reactor operation and spent fuel management, by a factor of up to seven

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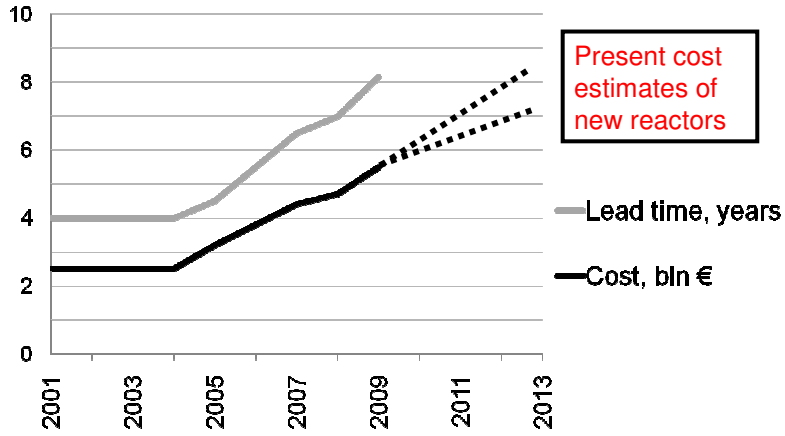
Systematic abuse of migrant workers

- At least several millions of € in unpaid taxes & fees
- Social & health insurance fees not paid; ex-workers denied health care
- Rampant illegal firing, e.g. because of injury at work or trade union membership
- Cheating workers with double contracts
- etc. etc.

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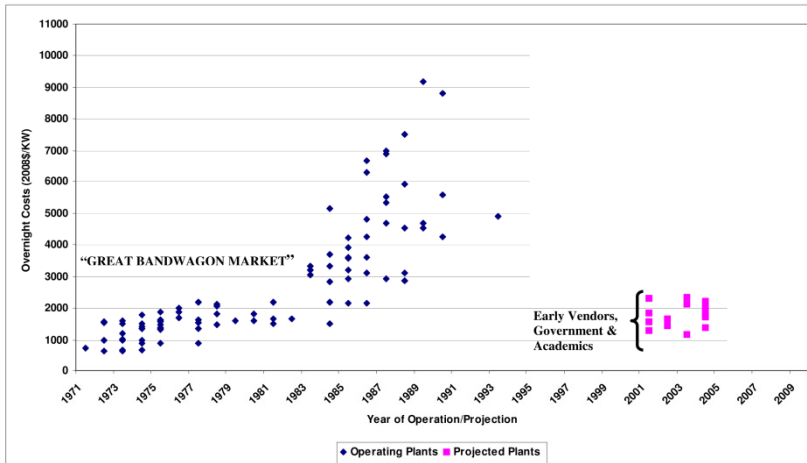
Olkiluoto 3: cost & lead time



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Cost & lead time

- Planned start of operation was May 2009
 - Without additional delays, plant could be completed early 2013
 - Commercial operation earliest beginning of 2014
- Contracted price was €3 billion
 - Expected cost without additional troubles about €5.5 billion
 - Reciprocal claims of €2.4 billion disputed in an international arbitration procedure
 - Bill will be footed by either French or Finnish state-owned companies

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Cost of nuclear dependency

- Dependency on the failed project costs Finnish and other Nordic ratepayers an estimated €3 billion

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Is it out of the woods?

- Electronic controls: design missing
- Installation of heavy components: installation plans lacking
- Testing & operation license: very optimistic timetable, lots of open questions
- Safety culture:
 - Latest inspection report (Q3/2009) by Finnish nuclear watchdog confirms that problems persist
 - No common language between workers&superiors
 - Lack of training etc. etc.

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Root causes & lessons

- Unrealistic cost&timetable estimates will only get worse: no turnkey contracts
- Project structures will be just as complex
 - Over 2000 subcontracts from over 30 countries
 - Olkiluoto control chain: STUK – TVO – Areva – Bouygues – Subcontractor – Supplier
- Manufacturing bottlenecks will get much worse
- Lack of qualified personnel will get worse

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First-of-a-kind factor?

- Finns were not supposed to be buying an experimental design
- AREVA in 2005:
 - "The EPR is the direct descendant of the well proven N4 and KONVOI reactors"
 - "risks linked to design, licensing, construction and operation of the EPR are minimized"

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First-of-a-kind factor?

- Cutting corners with tests & planning is a major issue
- For decades, every new reactor will be first-of-a-kind or among few-of-a-kind
 - Many designs, few orders
 - Adopting even the same design to a different country involves a major first-of-a-kind factor
 - The incentive to cut corners will increase as the resources of reactor suppliers are spread more thinly
 - OL3 was the second chance for the industry and Flam3 was the third.

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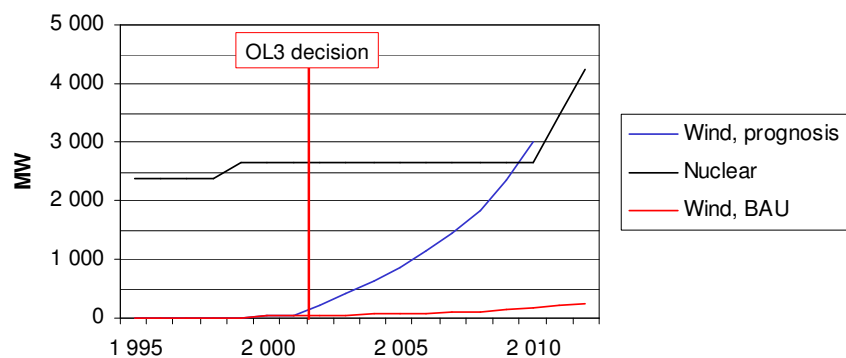
Olkiluoto 3 & Finnish energy policy: failed promises

- No emission reductions during Kyoto target period
 - Annual emission reductions after commissioning a fraction of promises
- Dependency on Russia has increased because of a failure to invest in energy efficiency
- Pulp&paper industry in crisis
- 10 years lost for investment in renewables&efficiency

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Nuclear killed wind in Finland



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Extra slides

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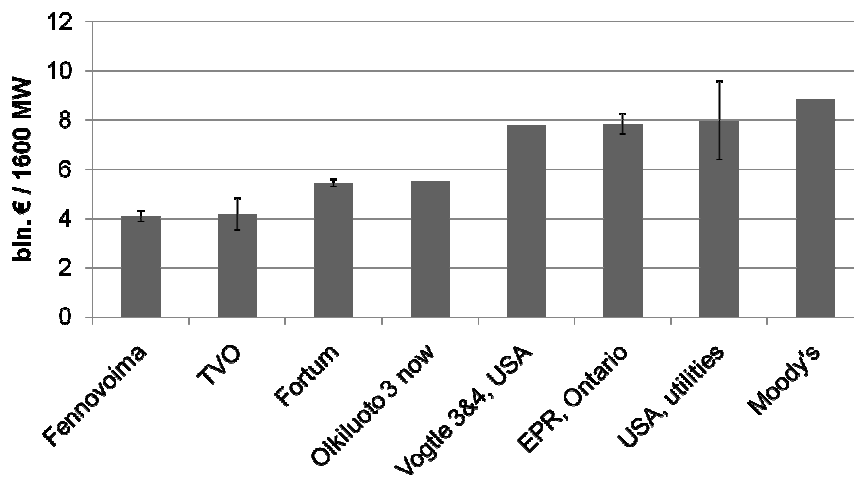
Situation now

- Olkiluoto 3 under construction
- 3 utilities have applied for a new reactor
 - The sole motivation for the plans is the export of electricity
- Over 50% of population against, a third wants one more and a tenth wants two or more

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Price of an OL3 size reactor, estimates



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Financing package

- Electricity not sold to the market but to shareholders at a price set to cover all production costs → remove risk from the company
- Very low fixed price offered by Areva-Siemens → cost overruns borne by their owners, especially French taxpayers
- Most of the investment made by the public sector

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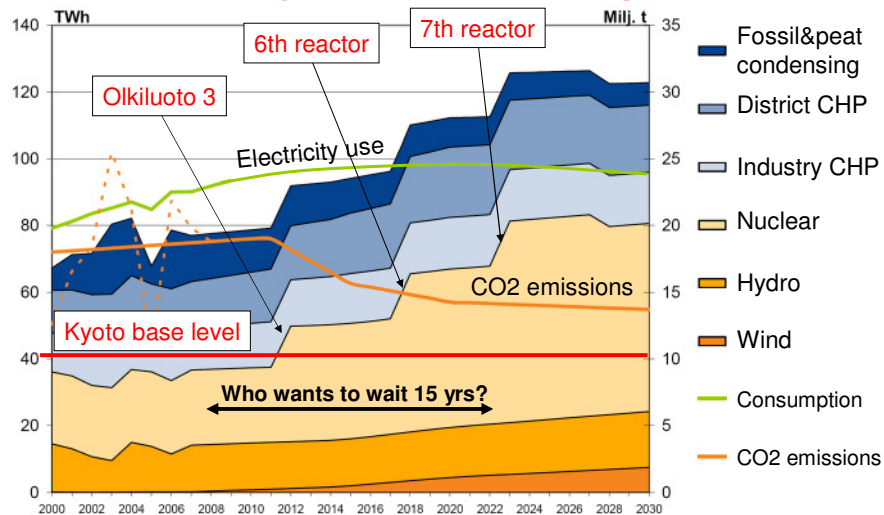
Financing package

- Export credit guarantees from France
 - Extremely cheap loan (0.5% margin!) from a coalition of banks headed by Bayerische Landesbank

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Nuclear lobby has no climate plan



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Greenpeace model achieves by 2020

- 35 % reduction in greenhouse gases from 1990 levels (43% from present levels)
- Share of domestic energy sources from a third to a half.
- Electricity generation capacity exceeds peak load demand – end reliance on Russia.
- Start a nuclear phase-out. One of the four operating reactors is closed.
- Same total costs as government strategy in 2009-2020 – cost savings thereafter.

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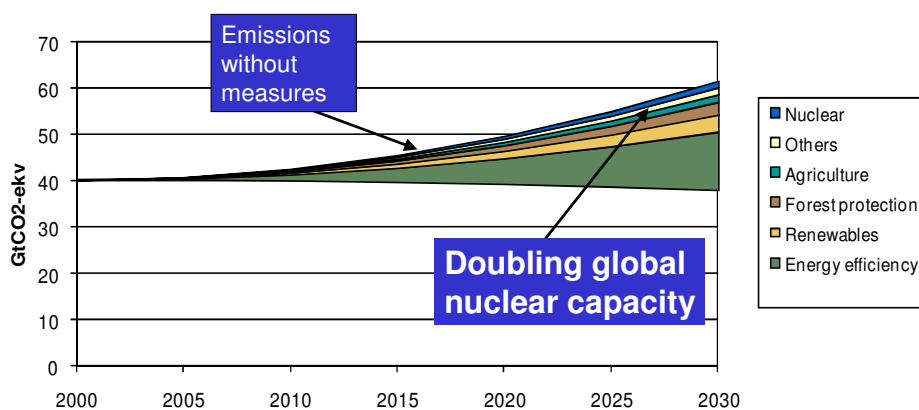
Why nuclear? - The battle over new capacity

- Coalition of large electricity companies and heavy industry pushing for nuclear
 - Large electricity companies don't want competition, cannot compete in new renewables
 - Heavy industry is afraid of energy efficiency & climate policies
- 6000 MW of wind projects, few thousand MW of bioenergy lined up
 - Needs initial support from government, cost competitive by 2015

• Both of these cannot be realized

Emission reduction potentials in 2030

With a price €70/tCO₂ = 16 c/liter of gasoline



Source: IPCC

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