

Nuclear power: A cheap option?

Aspetti finanziari ed economici dell'industria nucleare
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The Nuclear Renaissance

- Two elements: Orders for new designs in countries that had given up on nuclear (UK, USA, Germany, Italy etc)
- USA & UK key markets but orders still several years away
- 55 plants under construction/on order, 40 in China (21), India (6), Russia (7), Korea (6)
- 42 supplied by China (16), Russia (16), Korea (6) or India (4)

The Nuclear Renaissance

- Plant supplied by China is 70s French design
- Plant supplied by Russia based on 70s design
- Plant supplied by India 60s Canadian design
- 10 plants ordered before 1990
- Western vendors, Westinghouse (AP1000) Areva (EPR), have 8 orders: Olkiluoto, Flamanville (France) China (6 units)

Why do economics matter now?

- In the past, economics did not matter and financing nuclear easy because cost of any problems passed on to consumers
- So risk to utility and banks of nuclear investment very low
- Now, electricity markets competitive and companies with uneconomic plants go bust
- Banks will only lend if they are protected from this risk

What matters in project appraisals?

- Construction cost & time, & cost of capital
- Repaying fixed construction cost & interest accounts for 70% of the cost of power
- Reliability. The reliability, number of kWh of produced every year, determines how thinly fixed costs can be spread
- Utilities always assume new plants will be reliable. Not always true
- Price electricity sold for

What doesn't matter?

- Fuel. U mining, enrichment, manufacture & disposal - small part (5%) of generation cost
- Decommissioning & spent fuel disposal. Not large if estimates are accurate because money invested today is assumed to grow 10 fold before this is done
- But no experience of spent fuel disposal & little experience of decommissioning
- Is it wise to rely on funds staying intact and growing over such a long period?

What doesn't matter?



- Operations & maintenance cost. But British Energy went bust at cost of £10bn to UK taxpayers because it could not cover its operating costs.
- Insurance and liability cover. International treaties mean governments bear the main risk but even limited cover is expensive.

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Cost of capital



- Investment financed by a mix of debt (borrowing) and equity (delayed profits)
- Debt generally cheaper than equity
- If consumers guarantee to pay for the errors, risk to banks very low so cost of borrowing low - ~5% real
- Is this fair to consumers?
- Shareholders will be reluctant for money that could have been given to them to be spent on risky projects

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Cost of capital



- If electricity market competitive, extra costs not passed on, they come from profits
- If profits are reduced, shareholders and investment analysts are unhappy
- Credit rating agencies (S&P, Moody's, Fitch) may reduce credit rating of companies that choose to order nuclear because of the risk
- This will increase cost of borrowing and the cost of nuclear electricity

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Will banks lend for nuclear?



- If nuclear ordering is to be possible, banks must be protected from the risks
- Guarantees could be via consumers bearing the risk through cost pass-through, tax-payers via government credit guarantees, or vendors via turnkey contracts
- Are tax-payers, electricity consumers or vendors willing to take this risk?

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Construction costs



- 10 years ago forecasts \$1000/kW. 1600MW plant \$1.6bn
- 2004: Olkiluoto ~\$3000/kW
- 2007-08: US utility estimates ca \$5000/kW; E.ON estimated UK EPR €5-6bn (\$4200-5000/kW); South Africa bids \$6000/kW
- 2009: Ontario bids \$6700/kW, \$10000/kW; UAE successful bid \$3700/kW, Areva bid 70% higher
- Cost estimates always an under-estimate

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Olkiluoto



- Finnish nuclear plants have a reputation for reliability
- Areva NP desperate for EPR orders. Design said to be complete by 2000. Order needed to demonstrate technology
- Finnish utilities trying to get nuclear order since mid-80s
- Finland part of world's most competitive electric market
- A nuclear order seemed to prove nuclear power can survive in competitive markets. So, order for Finland a big boost for nuclear

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Olkiluoto: What were the original terms



- Construction cost: €3bn (\$2800/kW) fixed price contract, construction time 4.5 years
- Deadweight losses for late completion up to 10% of cost (0.3% of contract cost per week)
- 2/3 of cost (€1.95bn) provided by loan at 2.6% interest. Rest self-financed
- Export credit guarantee provided by French (€650m) & Swedish (€110m) governments
- Main customer, TVO, not-for-profit utility owned by Finnish heavy industry. Output contracted to consumers for life of plant at whatever cost incurred
- If things went wrong, it seemed consumers, (French) taxpayers & the vendor would be at risk, not the banks

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Experience at Olkiluoto



- Everything has gone wrong.
- Plant expected to take 4 years, but after 4 years, nearly 4 years of construction
- Costs now expected to be 75% (€2.3bn) more than contract price. Who will pay?
- Turnkey contract is under dispute in court: TVO suing Areva for €1.4bn, Areva countersuing TVO for €2bn
- Safety regulator threatening not to license plant if issues with Instrumentation & Control system not sorted out
- French regulator (ASN) and UK regulator (NII) also unwilling to accept current design

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Experience at Olkiluoto



- TVO's consumers must now buy from the market for 4 years at potentially high prices
- Electricity intensive industry payment of (need to buy high price) power. Will TVO default?
- If it does, banks will lose money, French and Swedish taxpayers will lose money and Finnish industry will suffer
- Olkiluoto is clear warning to consumers, vendors & taxpayers of the risk of nuclear
- Olkiluoto shows that fixed price contracts are a risk vendors cannot afford to take
- Is Olkiluoto isolated failure or general warning?

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Flamanville



- EDF has built three times as many nuclear plants as any other utility (~60)
- But last 4 plants completed in 1990s went badly wrong
- Flamanville construction started Dec 2007
- After a year of construction, Flamanville, >20% over budget
- After 2 years construction, reports that construction is at least 2 years late

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US Initiative: Nuclear Power 2010



- The 2002 Bush 2010 programme was aimed at getting a new reactor online by 2010
- Loan guarantee programme for nuclear power plants without subsidies
- Now orders will require loan guarantees for up to 80% of the cost and 1.8c/kWh subsidy
- Two units (Vogtle) given \$8.3bn loan guarantees Feb 2010 for 70% of cost (\$5000/kW).
- State regulator allowing utility to recover costs from consumers in regulated tariffs already
- Consumers and taxpayers taking the risk
- NRC will not give safety approval for the designs before 2012 so construction start unlikely before 2013

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UK Programme



- UK government stated (2009) there is 'need' for 16GW of new nuclear, but has said it will provide no subsidies
- UK has announced a new energy market framework, based on carbon price and a nuclear surcharge
- Entire wholesale electricity market may be abandoned
- Ofgem: the current system is not working: there was 'reasonable doubt' Britain has enough energy to fulfil demand past 2015: staying with the current market model was not an option
- Miliband: We need: 'capacity payments to guarantee returns to developers of low-carbon sources of power [nuclear & renewables]'
- Back to the old system of consumers bearing the risk

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Can nuclear fight global warming?



- If global warming is major threat & nuclear power the only option, we must learn from mistakes & manage the program
- In EU27, electricity is 23% of the energy used & nuclear provides 28% of electricity - i.e., nuclear is 6% of energy
- If EU27 doubled electricity's share & doubled nuclear's contribution to electricity, nuclear would still only give 25% of our energy
- Increasing nuclear this much means building hundreds of nuclear plants, switching to electric cars, replacing gas boilers with electricity etc: Technically feasible but economically ruinous

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Conclusions



- Olkiluoto is a warning to consumers, vendors, taxpayers, banks, regulators of the risks of nuclear
- Construction cost estimates increased in 10 years from \$1000/kW to \$6000/kW. No sign that costs are stabilising
- Getting safety approval from regulators more time-consuming and problematic than expected. Turnkey orders are too great a risk for vendors to take
- Banks will lend only if utilities have loan guarantees and guaranteed cost recovery from consumers

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Conclusions



- Cost-reducing factors - learning, technical change, scale & number economies - have had little impact on nuclear costs so far. Why?
- Skills in the nuclear area are eroding fast & forgetting is more likely than learning
- Major bottlenecks in manufacturing large components
- Waste & decommissioning costs are unimportant in project appraisals but costs are just guesses and could leave future generations with huge liabilities

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