



European
Commission

Views on Reactor Safety Post-Fukushima

Feuilles de route Energie à
l'horizon 2050
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Energy

Energy Strategy 2020: Example Nuclear

- *"...The contribution of nuclear energy, which currently generates around one third of EU electricity and two thirds of its carbon-free electricity, must be assessed openly and objectively..."*
- Continuously improve safety and security
- Keep EU leadership in safe nuclear energy
- Contribute to its responsible use worldwide by promoting legally binding standards

11 March 2011 Tōhoku earthquake & tsunami

- Shutdown of 9.7 GW NUC capacity (=5.7% of national generation)
- Shutdown of 9.5 GW FOS capacity
- Loss of 30% of oil refining capacity
- Loss of 3% national oil reserves (storage facilities)
- Other: Gridlines, ports & marshalling yards, hydro-dams...?



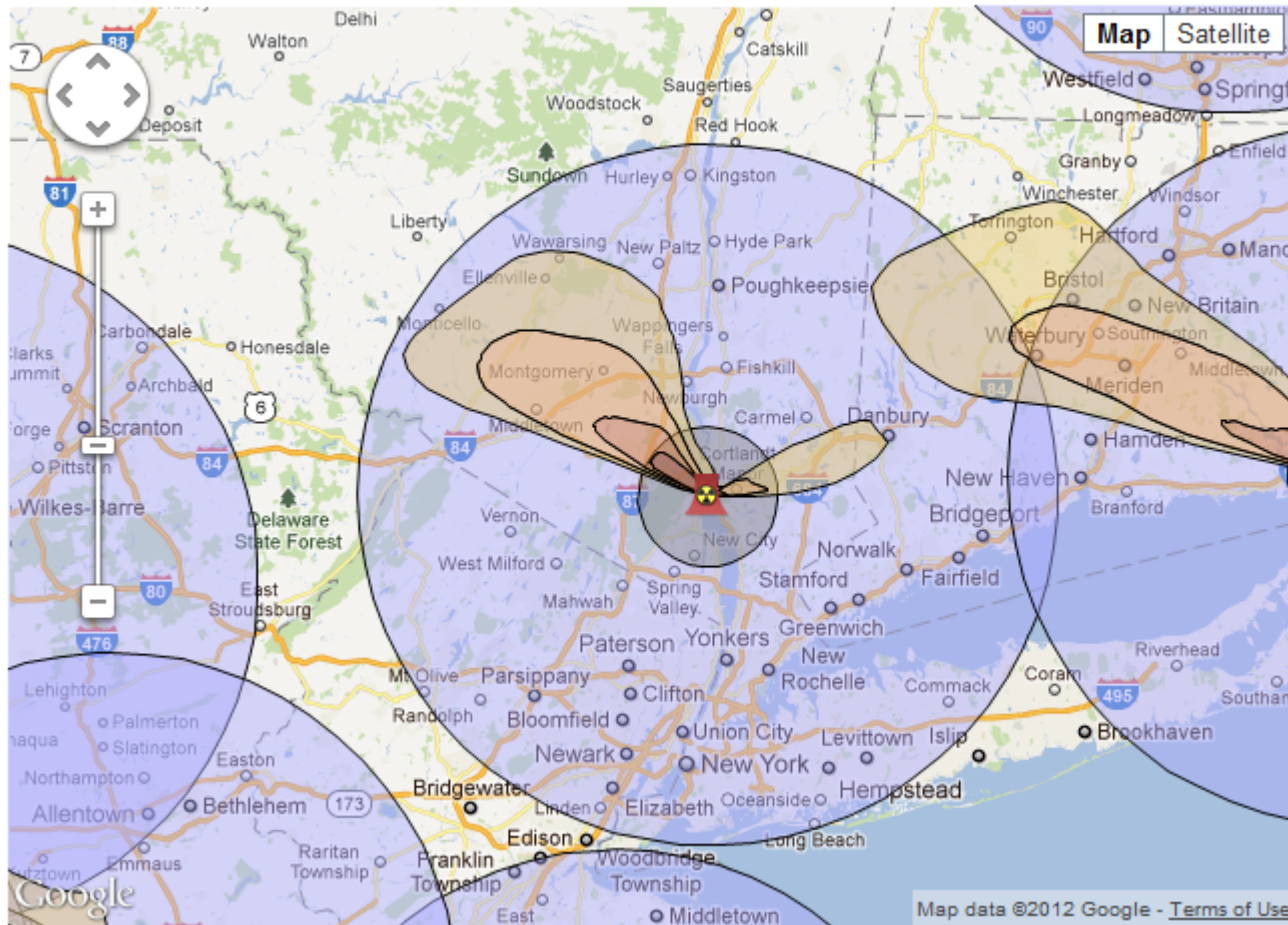
However, the enduring image for many people is:





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What if the Fukushima nuclear fallout crisis had happened here?



<http://www.nrdc.org/nuclear/fallout/>



Costs of Severe Accidents

- TMI (1979): 6.5 bio USD (US only)
- Chernobyl (1986): 250-500 bio USD over 25 y (across Europe)
- Fukushima (2012): 100-500(?) bio USD (Japan only)

~2-10% of Japan's annual GDP

~1-2 EUR-cents / kWh addition to Japan's electricity prices for decades



→ EU Stress Tests

- **Objective:** To assess NPPs' capabilities to prevent and mitigate severe accidents:
 - *Extreme external initiating events* → *Loss of safety functions* → *Severe accident management*
- **Voluntary participation** from 17 countries:
 - All 14 EU Member States operating NPPs, + Lithuania, Switzerland and Ukraine
- **Schedule:**
 - **Mandate:** 24-25 March 2011 European Council
 - **Common EU-wide methodology** drafted by WENRA in April, agreed by ENSREG in May 2011, published on 25 May 2011 by ENSREG and the Commission
 - **Start:** 1 June 2011
 - **Operators:** self-assessments until 08/2011
 - **Regulators:** national progress reports (09/2011)
 - **EC Interim Report to Council** (12/2011)
 - **Regulators:** final national reports (by 31 Dec 2011)
 - **Peer Reviews of the final national reports:**
 - **Experts from nuclear and non-nuclear MS** + EC (ENER, JRC)
 - **Topical Reviews:** 2 weeks during 02/2012 in Luxembourg
 - **Country Reviews:** 3 weeks during 03/2012 in the 17 countries
 - **ENSREG Peer Reviews Report published on 26 April 2012**
 - **EC Final Report to Council (autumn 2012)**





Fukushima & EU Stress Tests

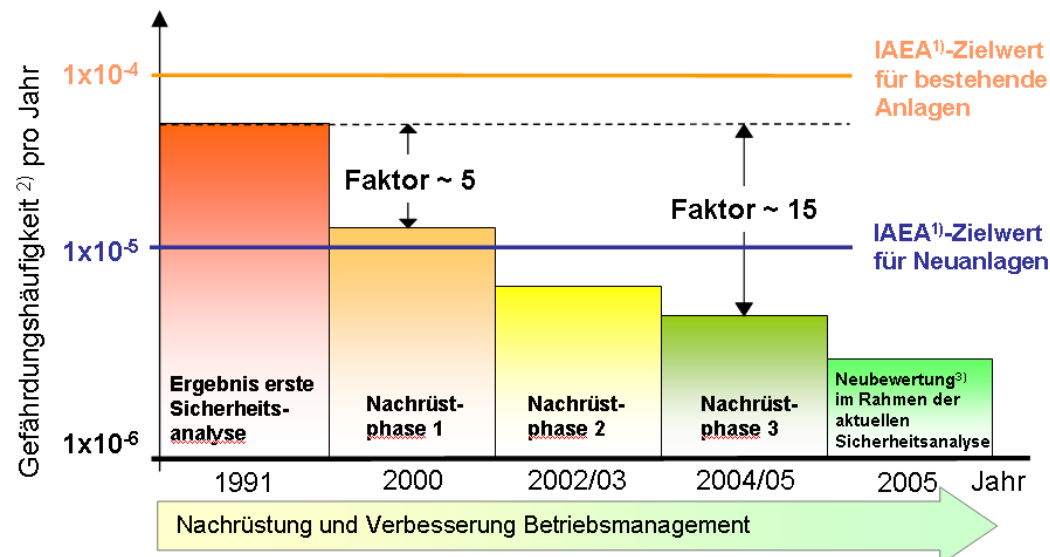
- **Fukushima:**
 - **Deficiencies of the NPP's Design Basis caused the accident**
 - **However, the tsunami was not an unforeseeable event (≠"Restrisiko"):**
 - Catastrophic tsunamis strike Japan every ~40 years
 - i.e., recurrence frequency <100 years
- **One result from the EU Stress Tests:**
 - **If quantified at all(!), EU-NPP safety cases for external event hazards are mostly based on 10^{-4} (or 10^{-3}) per annum levels (i.e. **10.000** (or 1000) years recurrence frequencies)**

Stress tests: follow-up

- Implementation of STs-recommendations and concrete measures are a **national responsibility**
- Expected to **provide a basis for EU-wide legislative or non-legislative proposals** that the EC may put forward
- **Revision of the EU safety framework:**
 - **End 2012: Commission proposals**
 - Main areas for legislative improvements:
 - technical safety requirements
 - nuclear safety governance
 - emergency preparedness and response
 - nuclear liability regimes
 - scientific and technological competence

Implications of EU Stress Tests

- **Recognise reality of risks: Neither zero risk nor 100% risk attitudes can longer be maintained**
- **Need for a number of new NPP safety improvement measures:**
 - **COSTS of these measures are likely to be significant**
 - **Safety Prioritisation of these measures???**



(Example: Biblis NPP, Germany)

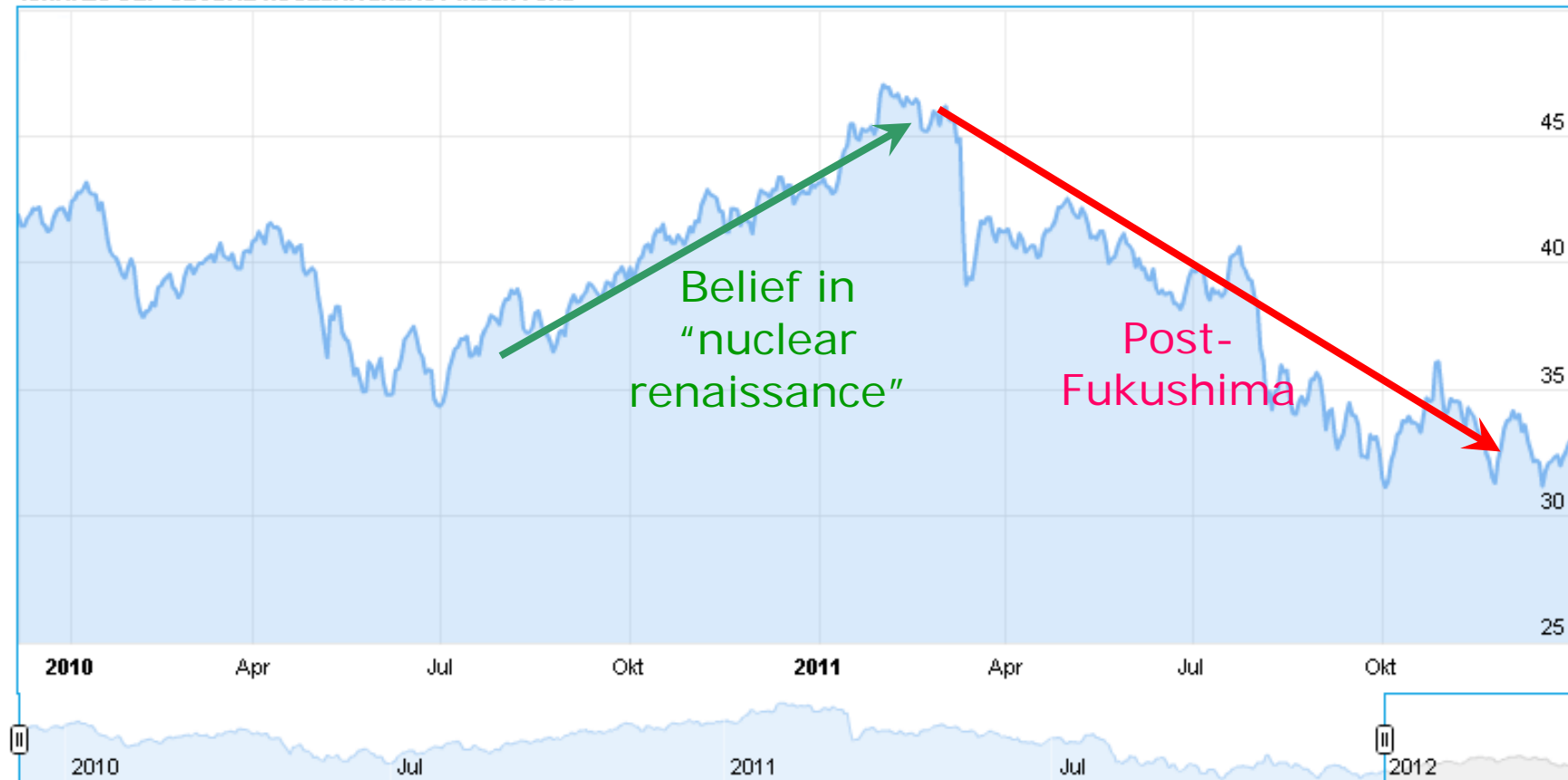
Possible Implications of EU Stress Tests

- **Need for Objective Prioritisation of Recommendations:**
 - Relative risk categories rather than categoric decisions/exclusions
 - Risk-informed decision making
- **However, relative risk also in the choice of technologies:**
 - All low-carbon technologies
 - Relative risk in the light of catastrophic climate change, e.g.:
 - Gen-II (current) NPPs: 10^{-2} fatalities per GWe-year
 - Gen-III (e.g. EPR) NPPs: 10^{-5} fatalities per GWe-year
 - Coal generation: 10^{-1} fatalities per GWe-year
 - Hydro generation: 10^{-3} fatalities per GWe-year

Long-term
operation
OR New nuclear
build?

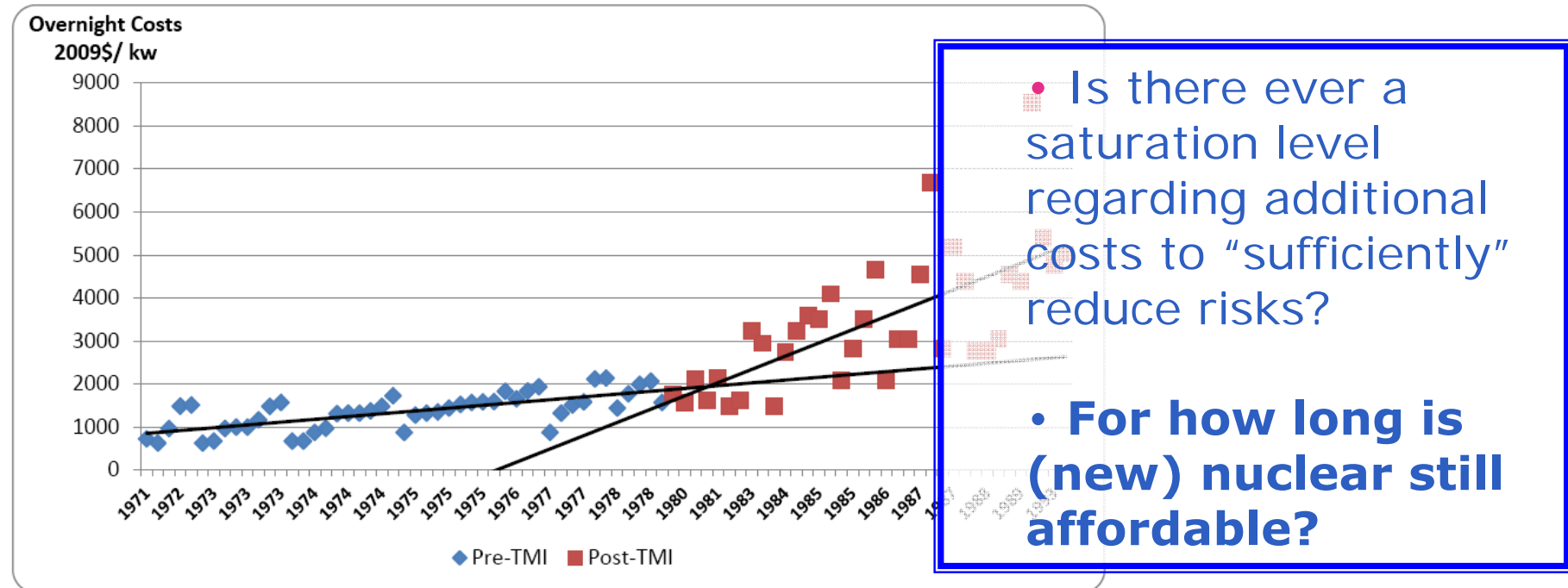
Nuclear Economics: Another Impact of Fukushima...

ISHARES S&P GLOBAL NUCLEAR ENERGY INDEX FUND



Effect of the last-to-last Severe Nuclear Accident (TMI-1979)

EXHIBIT 1: NUCLEAR CONSTRUCTION COST ESCALATION: REACTORS COMPLETED BEFORE AND AFTER TMI



Source: Mark Cooper, Policy Challenges of Nuclear Reactor Construction: Cost Escalation and Crowding Out Alternatives, Institute for Energy and the Environment, Vermont Law School, September, 2010



Energy Roadmap 2050 – Example nuclear

- *“Nuclear has a significant role in decarbonisation in Member States where it is accepted, in all scenarios besides Low nuclear and High RES, with the highest penetration in case of CCS delay.”*
- Under decarbonisation scenarios, **highest penetration of nuclear** comes in *“Delayed CCS”* and *“Diversified supply technologies”* scenarios which **show the lowest total energy costs**.
- **Further nuclear development is contingent on:**
 - sufficient level of nuclear safety & security
 - public acceptance
- **130-160 GW nuclear capacity in the EU 2050 means:**
 - Most NPPs go into long term operation of up to 60 y **(SAFETY?)**
 - ≥ 100 new NPPs

However, a high amount of nuclear requires:

- ✓ **Installation Safety** (*→ EU Directive → EU Stress Tests → possible new (non)legislative measures*)
- ✓ **Waste Management** (*→ EU Directive*)
- ✓ **Acceptance** (*Transparency*)
- ✓ **Stress Tests for continuous EU-wide nuclear safety improvements**
- ❖ **General: Nuclear drive more about energy rather than (foreign) policy**