Global Technological Policy Making

Introduction to Class Work

1st December, 2014

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Classical Decision Theory

Cost Effectiveness Analysis

- Compare cost (in a broad term including risks) and outcomes (effect) of two or more courses of action

Choice under Uncertainty

- Identify all possible outcomes, determine their values (positive or negative) and the probabilities that will result from each course of action, and multiply the two to give an expected value.
- The action to be chosen should be the one that gives rise to the highest total expected value.

Too simple and naïve for a real problem!

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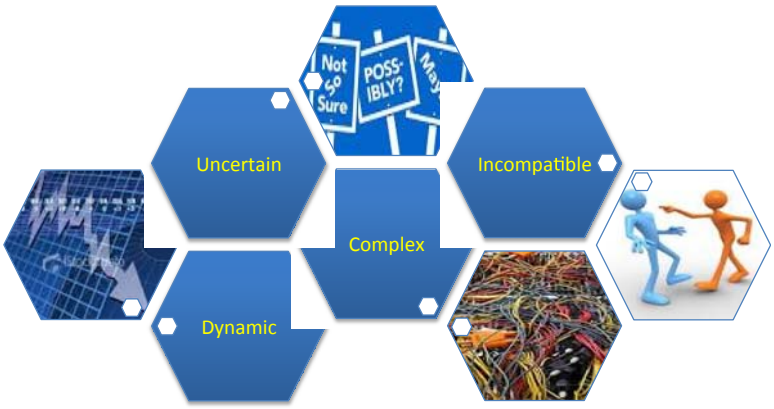
Problems in real world



Example for our class work:
" Should we restart nuclear power plants in Japan or not?"

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What happened at FDPP three years ago

Monday, 7 March 2011

- TEPCO submitted a report to Japan's nuclear safety agency which predicts the possibility of a tsunami up to 10.2 metres high at FDPP in the event of an earthquake similar to the one in 1896. TEPCO actually made this prediction in 2008 but delayed in submitting the report because they "did not feel the need to take prompt action on the estimates".

Friday, 11 March

- 15:46 : A 14-metre tsunami, unleashed by the earthquake, overtopped the seawall disabling the backup diesel generators.
- With the loss of all electrical power supply, most of the emergency core cooling system failed and problems began to cascade.

Saturday, 12 March

- 05:30: The decision was taken to vent some of the steam (which contained a small amount of radioactive material) into the air within the metal container building surrounding the unit.
- 06:50: The core of reactor 1 completely melted and fallen to the bottom of the reactor pressure vessel.
- 14:50: Fresh water injection into reactor 1 was halted.
- 15:36: A massive explosion in the outer structure of unit 1. The concrete building surrounding the steel reactor vessel collapsed four workers were injured.
- 19:00: Sea water injection into reactor 1 was started. TEPCO HQ ordered Daiichi to cease seawater injection at 19:25, but Daiichi plant boss Masao Yoshida ordered workers to continue with the seawater injection.

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Fukushima nuclear crisis estimated to cost ¥11 trillion

- The Fukushima nuclear accident will cost an estimated ¥11.08 trillion, almost double the government projection made at the end of 2011, according to a recent study by Japanese college professors, Kenichi Oshima, environmental economics professor at Ritsumeikan University in Kyoto, and Masafumi Yokemoto, professor of environmental policy at Osaka City University.
- The figure includes ¥4.91 trillion to compensate affected residents, ¥2.48 trillion for radiation cleanup work, ¥2.17 trillion to scrap the Fukushima No. 1 plant and ¥1.06 trillion to temporarily store radioactive soil and other waste generated by decontamination work, according to the study.
- Tepco is currently paying compensation to those affected by the Fukushima meltdowns using money provided by the Nuclear Damage Compensation and Decommissioning Facilitation Corp. The state-backed fund has raised the limit of its payout from ¥5 trillion to ¥9 trillion. Tepco is expected to reimburse that money in the future — meaning that electricity consumers will eventually have to bear the cost.
- The government of Prime Minister Shinzo Abe is pushing to revive the nuclear industry, with Kyushu Electric Power Co.'s Sendai plant in Kyushu possibly allowed to restart in the near future.
- "Nuclear plant operators would become less able to make a right business judgment under the situation where the state covers the costs of accidents, as they cannot recognize risks of nuclear power generation," said Oshima.

http://www.japantimes.co.jp/news/2014/08/27/national/fukushima-nuclear-crisis-estimated-to-cost-%C2%A511-trillion-study/ 5

Alternative view on probability of core meltdown

- Well-known nuclear engineers cite the US government's prediction that: (i) a core-melt accident in the 104 US reactors will occur only once every 1000 years (NRC, 2003); suggesting (ii) a core-melt accident will occur only once every 250 years for 442 global reactors.
- Yet, as listed below, (i) is doubtful because US reactors have had at least five core meltdowns in roughly 50 years—and not just one core melt in 1000 years; and (ii) is doubtful because global reactors have had at least 26 core melts in roughly 50 years—not four in 1000 years.

Core melts in US	Core melts outside US
• EBR-1 in Idaho, 1955. • Santa Susana in Los Angeles, 1959. • SL-1 in Idaho, 1960–1961. • Fermi 1 in Michigan, 1966. • Three Mile Island in Pennsylvania, 1979.	• Mulvihill Windscale in the UK, 1957. • Chalk River in Canada, 1958. • Lenin (ship) in Russia, 1966–67. • Chapelcross in Scotland, 1967. • Saint-Laurent in France, 1969. • Lucens in Switzerland, 1969. • Greifswald in Germany, 1975. • Saint-Laurent in France, 1980. • Eight in Soviet navy nuclear submarines K-19 (1961), K-11(1965), K-27 (1968), K-140 (1968), K-429(1970), K-222(1980), K-314 (1985), and K-431(1985). • Chernobyl in Ukraine, 1986. • Three in Fukushima, Japan 2011.

KRISTIN SHRADER-FRECHETTE, Fukushima, Flawed Epistemology, and Black-Swan Events, Ethics, Policy and Environment Vol. 14, No. 3, October 2011, 267–272 6

Fukushima, a black swan or blind spot?

- A black swan is characterised by Nassim Nicholas Taleb as an event which:
  1. Is a surprise (to the observer), an 'extreme outlier'
  2. Has a major impact
  3. Is rationalised by hindsight, as if it could have been expected
- Was the Fukushima nuclear accident a black swan?

The phrase 'black swan' was a common expression in 16th century London as a statement of impossibility, on the presumption that all swans must be white because all historical records of swans reported that they had white feathers. But black swans were then discovered in Western Australia in 1697.

1.Surprise? No

At up to 15m in height the tsunami was larger than the 'design basis event' of 3.1m, but over the last 100 years Japan's east coast has suffered a number of large tsunami (>10m) associated with earthquakes; with more than one locally over 15m.

2.Major impact? Yes

While no site workers or members of the public were killed by the nuclear release, an exclusion zone of 20km radius still exists around the reactor site and 100,000 people were displaced from their homes. Germany, Italy and Switzerland declared their intention to halt current nuclear programmes. The site is no longer operational.

3. Rationalised? Yes

IAEA identified that design basis tsunami for the Fukushima site underestimated the hazard, based on the accepted methods and the available data. The assumption that the site would definitely stay 'dry' (rather than be flooded) was not demonstrated, and represented a 'cliff edge' in terms of consequences. A series of 'Stress Tests' have subsequently been performed on all reactor sites across Europe, examining scenarios significantly beyond their design basis to determine the response to extreme events and identify if there is a 'cliff edge'. No fundamental weaknesses have been found.

http://www.risktec.co.uk/knowledge-bank/technical-articles/black-swan-or-blind-spot-the-duality-of-extreme-events.aspx 7

Fukushima film shows reality sinking in for 'nuclear refugees'

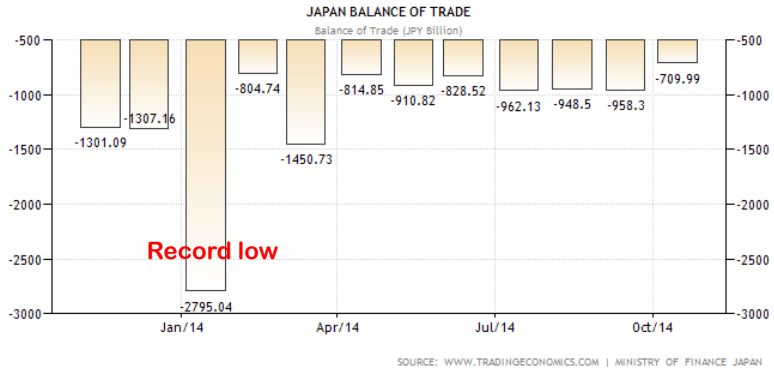
- Now, more than three years after the disaster, they remain stuck in cramped emergency housing facing the reality they will likely never go home, with Futaba set to become a storage site for contaminated soil, a new documentary film by Atsushi Funabashi shows.
- Some evacuees speak nostalgically about better days when the nuclear plant brought money into the town, creating jobs and helping businesses prosper. "For 40 years it was a godsend," an elderly woman said in the film. But a visit back into the exclusion zone set to the melancholy piano score reveals a ghost town with space being cleared for the storage of contaminated soil.
- Public mistrust of atomic power remains high, however, and Funahashi says he will keep making "Nuclear Nation" films to show the human side of the nuclear equation. "We are the ones who used the power from Fukushima Daiichi. I feel, as a filmmaker, responsible to keep making this film as long as the Futaba people's refugee life continues," he said.

A picture frame and water marks are seen over the wall of a kindergarten destroyed by the earthquake and tsunami in Ishinomaki, northern Japan, April 7, 2011.
CREDIT: REUTERS/CARLOS BARRIA

http://www.reuters.com/article/2014/10/21/us-film-fukushima-idUSKCN0IA0J220141021 8

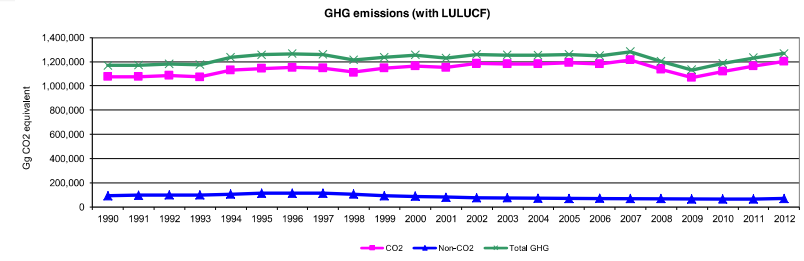
Japan Balance of Trade

- Japan had been recording consistent annual trade surpluses from 1970 to 2010. However, since 2011, the country has been posting trade deficits as costs for imports have surged due to the weakening of the Japanese yen and increased purchases of fossil fuels and gas to make up for the loss of nuclear power following the March 2011 earthquake and tsunami.
- In 2013, the biggest trade deficits were recorded with: China, Saudi Arabia, United Arab Emirates, Australia and Qatar.

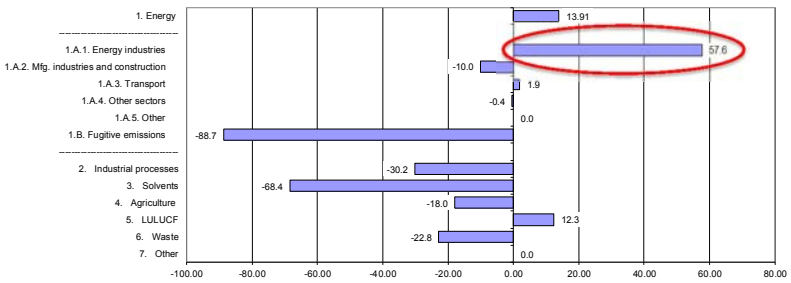


http://www.tradingeconomics.com/japan/balance-of-trade

Summary of GHG Emissions for Japan



Change in GHG emissions/removals from 1990 to 2012, %



https://unfccc.int/files/ghg_emissions_data/application/pdf/jpn_ghg_profile.pdf#search='co2+emissions+in+Japan'

Renewable energy after Fukushima incident

- Traumatized by the world's worst nuclear disaster since Chernobyl and encouraged by the highest rates for renewable energy in the world, Japan has been undergoing a green boom. It's now rapidly turning into a fiasco as the cost proves prohibitive and utilities anticipate putting some nuclear reactors, shuttered since the March 2011 Fukushima disaster, back online. The unfolding green glut in Japan echoes similar experiences in Germany and Spain.

- If all the planned solar panels in Japan were installed, their capacity would equal 8 percent of overall energy demand. At the 32 yen tariff, a whopping 3 trillion yen ($30 billion) would be added to electricity bills. Experts debating policy at a government committee are pushing for an immediate end to the guaranteed rates for solar power.
- Japan's energy policy, rewritten after the Fukushima crisis, set a goal for renewable energy including solar, wind, water and geothermal power to provide about 20 percent of energy needs by 2030.
- In Germany, as a result of green policies that began about 2010, and its decision to scale back its dependence on nuclear power after Fukushima in 2011, electricity bills skyrocketed and some people had their power turned off because they couldn't afford to pay.

http://www.cbsnews.com/news/after-fukushima-a-glut-of-green-energy-in-japan/ 11

Class Work
Multi-Stakeholder Consensus Building

Consensus building is a way to structure and facilitate the process of multi-stakeholder, multi- issue negotiation, using several steps and tools:

1. Identifying stakeholders, assessing their interests, capacities, and potential for reaching consensus-based agreements;
2. Using joint fact finding to resolve technical and factual questions and help the group focus on the development of feasible options;
3. Managing the process of deliberation among those stakeholders to maximize the chances for reaching agreements that are technically sound and politically acceptable;
4. Promoting consensus agreements where possible, and enabling near-consensus alternatives when full consensus is not possible.

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Homework by 8th December

2 groups of students for restart of nuclear power plants in Japan

- PowerPoint presentation addressing the following questions:
  - What are the benefits of restarting NPP's?
  - Can we make sure that a core melt will not happen again?
  - Can we gain acceptance of local people in the areas of NPP's?
- List conditions with which you may accept decision of not restarting NPP's.

2 groups of students against restart of nuclear power plants in Japan

- PowerPoint presentation addressing the following questions:
  - What are the benefits of not restarting NPP's?
  - Can we find alternative energy sources without excessive cost or jeopardizing national energy security?
  - Can we meet goal of reducing CO2 emissions without NPP's?
- List conditions with which you may accept decision of restarting NPP's.

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Plan for the next lecture

- Presentation by each group (15 min. x 4)
- Joint fact finding to resolve technical and factual questions (30 min.)

Break

- Brief lecture on consensus building (20 min.)
- Deliberation towards promotion of consensus agreements (30 - 50 min.)
- Presentation of outcome (20 min.)

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