Third NEA Stakeholder Involvement Workshop on Optimisation in Decision-making

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Challenges of using cost-benefit analysis

and other approaches within the nuclear sector

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Introduction

- What's our collective goal? How do our acts affect it? What is good?
  - Social welfare, multidimensional utility;
  - Cost-benefit analysis and asset valuation (discounting).
- How do we take account of uncertain costs and benefits in CBA?
- 40 years of asset pricing literature.
  - Risk premium associated to acts that raise the collective risk;
  - Option value for acts that leave open more options for the future (not developed here).

Outline

1. Value, cost and benefit, decision under certainty.

   - Examples: Spanish tomatoes, speed limits on highways.

2. How do we treat uncertainty in economics and finance?

   - Example: Nuclear waste.

3. Deep uncertainties

CBA of energy transition: Tomatoes

- Decarbonization yields sacrifices (purchasing power, discomfort) and benefits (emission reduction, energy independence, other co-benefits).

- Example: Spanish tomatoes in France.
  - The Spanish tomato is less costly to produce, but must be brought to France by trucks emitting CO_2.

- Should we prefer French tomatoes, in spite of their higher cost/price, but because they induce less CO_2 emissions?

- How do we value the social benefit?
  - Select a Carbon Value.
  - Value of life, landscape, time,…

Speed limit reduced from 130 to 110 km/h in France
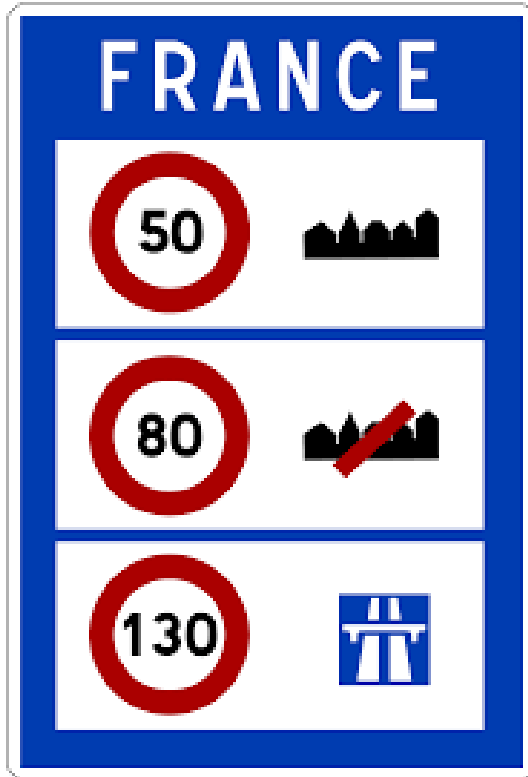
- Per 1000 km, reducing speed from 130 km/h to 110 km/h has the following impacts:
  - Time lost: 1.4h for an average of 2.2 passengers = 3.1 hours
  - Fuel saving: 11.4 liters of gasoline.
  - CO_2 saving: 28.4 kg of CO_2.

- Is the net societal impact positive?

- What is the value of this impact?
  - 1 hour lost = 17 euros
  - 1 liter of gasoline = 0.81 euro (pre-tax price of gasoline)
  - 1 kg of CO_2 = 0.015 euro (150€/tCO_2).

- The net cost of 17x3.1=52€ is larger than the net benefit 11.4x0.81 + 28.4x0.015 = 13.5€.

- The net societal impact is negative, and the reform should not be implemented.

- The cost per tCO_2 saved would equal to 1500€ if the reform would be implemented.

CBA under uncertainty

- Social benefits should be discounted at a rate that is increasing in their « social beta », i.e., in the income-elasticity of these social benefits.

- Example in France: $\text{Discount rate} = 1.2\% + \beta \times 2\%$

- Beta of railways infrastructure =2: $\Rightarrow DR = 5.2\%$

- Beta of health infrastructure =-0.5: $\Rightarrow DR = 0.2\%$

- Beta of electricity infrastructure is increasing in its LCOE: Larger DR for gas than for nuclear.

- Climate beta?

Nuclear waste storage facility (Cigéo)

- The DR is key to determine the relative merit of different waste storage strategies.

- Simple socio-economic evaluation of Cigéo (€25bn in the next 20 years) versus permanent surface storage (€0.1bn per year forever):
  - The DR should be smaller than 0.4% to recommend Cigéo.

- But Cigéo provides an insurance against potentially large health and environmental damages in chaotic evolution of our civilisation.
  - Counter-evaluation for ANDRA (2021) supports Cigéo on this basis.

Deep uncertainties

- Measuring the social cost of nuclear kwh is made complex because of the ambiguity surrounding the true probability of a nuclear accident.

- Should we use the mean probability to perform CBA?

- Human beings seem to value lotteries A and B differently:
  - Lottery A: earn 100€ with probability 0.5;
  - Lottery B: earn 100€ with an uncertain probability with mean 0.5.

- Ambiguity aversion.
  - Existing literature in Decision Theory, but with little operational recommendations.

Conclusion

- Risk management is a key ingredient in the evaluation of policies and strategies.

- Valuing them requires estimating costs and benefits, and to account for the uncertainties surrounding them.

- Assuming risk neutrality is not an option.