



## **HANDLING RISK AND IRREVERSIBILITY OF TRANSPORT INTERVENTIONS**

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### **The mitigation of unintended effects ex-ante and ex-post**

While adverse effects of policy interventions can be reduced by:

- Adopting integrated policy combinations
- Appropriate methodologies, tools and models,

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# The outline of the presentation

1. Transport as a complex system
2. Ex-ante and ex-post mitigation of unintended effects
3. Risk, uncertainty and irreversibility
4. Integrating risk and uncertainty in policy design, ex-ante
5. 3 important policy areas
  1. Environmental policies
  2. Alternative fuel and vehicle technologies
  3. Infrastructure
6. Policy implications
7. Summary and conclusions

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# Transport sector is as a **socio-technical system or open and complex system**

**Socio-technical system:** Technologies affect and are an effect of their broader infrastructural, organisational, regulatory, and symbolic environments.

**Open and complex:** There are multiple interacting markets, with many types of increasing returns and many positive feedbacks mechanisms between these markets, with many non-linear relationships and the time delays and institutional settings as well as interactions with its surrounding markets and environment.

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## Transport sector is as a **socio-technical system or open and complex system**

**Risk** and **uncertainty** are highly pertinent to policy making in the transport sector, particularly at an EU level, where an extraordinarily diverse array of technologies, markets and political, institutional, ideological, socioeconomic and behavioural contexts are involved.

## **Ex-ante** mitigation of unintended effects

Favours **reversible and flexible options** acknowledging that decisions are made under risk and uncertainty.

➔ Keeping the cost of reversing the decisions as low as possible by incorporating risk management into the planning process.

With information, it is possible to reduce or eliminate risk and uncertainty and necessary adjustments in policy design can be made ex-post.



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## **Ex-post** mitigation of unintended effects


Adjustments in policy design requires information.

➡ **Collection of necessary data** is an important and necessary part of addressing possible unintended adverse effects ex-post

Expecting unintended effects ex-ante or detecting unintended effects ex-post only leads to improvements if there is **flexibility built in the policy processes**. It demands rethinking traditional approaches that assume a deterministic model of the world in which the future is predictable.

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## Risk and Irreversibility

Most policies share 3 important characteristics in varying degrees;

- i) they are partially or completely *irreversible*,
- ii) there is *uncertainty* over the future benefits of the policy and
- iii) there is *flexibility* about the *timing* of and *intensity* of the policy

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1. When return to the status quo is impossible or extremely difficult, at least on an appropriate timescale.
2. Irreversibility in terms of sunk cost, corresponding to the definition in economic literature on options .

There are “Irreversibilities” associated with environmental policy: with respect to environmental damage itself, and with respect to the costs of adopting policies to reduce the damage.

Irreversibility due to government regulation or institutional arrangements

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## **Risk and Uncertainty**

Irreversibility only matters if there is uncertainty.

Uncertainty can affect policy even if there is no irreversibility

There is almost always uncertainty over the future costs and benefits of adopting a particular policy.

Environmental problems can involve three compounding levels of uncertainty over:

1. the underlying physical or ecological processes
2. the economic (and social) impacts of environmental changes
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If future costs and benefits of the policy are uncertain, these sunk costs create an opportunity cost of adopting the policy, rather than waiting for more information about environmental impacts and their economic consequences. This implies that traditional cost-benefit analysis will be biased toward policy adoption

On the other hand, environmental damage can be partially or totally irreversible. For example, major greenhouse gases are well-mixed, and take many years to leave the atmosphere and, with additional emissions of GHG, results in high concentrations that are long lasting. And the damage to ecosystems from higher global temperatures can be permanent. This means that adopting a policy now rather than waiting has a sunk benefit, that is a negative opportunity cost. This implies that traditional cost-benefit analysis will be biased against policy adoption



## Risk and uncertainty

Uncertainties over benefits and costs are related to

- the parameter uncertainty
- over the shapes of the benefit and cost functions

Uncertainty over discount rate

- it makes that rate *lower* than any expected future discount rate

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are associated with both environmental problems and the transport policy arena and in particular those with longer time horizons.

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## Environmental policies

Uncertainties over benefits and costs can affect policy design in at least 3 fundamental ways.

- Optimal choice of *policy instrument* (e.g., an emissions tax or an emissions quota).
- Optimal *policy intensity* (e.g. size of the tax or the optimal level of abatement).
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## Choice of policy instrument

With cost uncertainty, the **relative slopes of the marginal benefit function and marginal cost function** determine the choice of instrument (Weitzman, 1974).

Policies that combine both instruments (hybrid) are generally more efficient than a single instrument. The optimal design depends also on the nature and extent of the uncertainties.

Mandell (2010) argues that in an EU context the optimal design will depend on the relative cost structures within and outside the transport sector and that the optimal regime for the transport sector is a hybrid system, combining a cap-and-trade and an emission tax.

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## Policy intensity and timing

- Uncertainties over benefits and costs affect the optimal policy intensity, i.e., the size of an emissions tax or the size of abatement . Without irreversibility, uncertainty usually leads to *lower* policy intensity.
- Uncertainty also affects the optimal timing of policy implementation when there are sunk costs associated with implementing the policy, and/or irreversibility is associated with environmental damage.
- Depending on a particular situation, it may be optimal to postpone implementation of a policy until there is more information on benefits and costs, or to accelerate the implementation to avoid irreversible damage.



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A self-sustaining market for AFV is very costly for society. It involves consumers, many industries, institutions and considerable investments including those related to the supporting infrastructures.

“Irreversibility” is considerable in this process.

Different stakeholders in these different interacting markets face decisions under uncertainty, including in their relation to governments’ policies.

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## **Transport Infrastructure**

There is a growing concern about the inadequacy of the traditional approach to the problem of transport infrastructure investment policies.

Increasing recognition that the scope of project evaluation should be extended to account for risk, uncertainty, irreversibility and path dependency in particular in response to the challenges of environmentally sustainable development.

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## Transport Infrastructure

Provisions of transport infrastructures in the complex urban environment have many rebound effects that are long lasting and reinforce the “lock in effect”.

A move to another equilibrium that is potentially more efficient than the present might require substantial effort.

An example public transport and road are substitutes to a degree. Each mode is self reinforcing in that the more it is used the more funds become available for investment and improvements that attracts even further users. Then one mode may achieve dominance at the expense of the other. Changing the situation may require substantial subsidy and capital investments

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Inherent biases in the selection processes for infrastructure investments lead to excessive energy intensity in such investments. The potential reasons for the bias include systematic under-valuation of future energy costs; failures to incorporate true (current and future) social carbon emissions costs; and excessive discounting.

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The overriding idea is that achieving a society with low GHG emissions (necessary for efficiency in the long run) requires a high concern for the design of current infrastructure investments.

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## Implications for policy design and implementation

- With uncertainty and irreversibility, it might be desirable to delay action and wait for new information.
- With uncertainties and irreversibility, there is a leeway about the intensity and the timing of policy adoption with significant effect on the optimal policy adoption path.
- How important are irreversibilities? It depend on the nature and extent of the uncertainties over costs and benefits, and how those uncertainties are likely to get resolved over time.
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## **Implications for policy design and implementation**

- The compounding set of risk and uncertainties in the policy arena implies that policies and investment decisions are based on imperfect and incomplete knowledge.
- While ex-ante integration of risk and uncertainty in the designs of policy interventions is important, equally important is to collect the necessary information to intervene ex-post for the necessary policy adjustments.



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## Summary and conclusions

Policymakers in the transport sector are often required to make decisions in the face of risk and uncertainty.

- lack of information concerning a particular transport problem,
- inability of existing modelling tools
- intractable nature of the policy process itself

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## **Summary and conclusions**

Risks and uncertainties are highly pertinent to policy making in the transport sector, particularly at an EU level, where an extraordinarily diverse array of technologies, markets and political, institutional, ideological, socioeconomic and behavioural contexts are involved.

The contemporary European transport systems may thus be considered to represent complex socio-technical systems, prone to conditions of path-dependency and lock-in effects.

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## **SUMMARY AND CONCLUSIONS**

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Given the strong emphasis placed upon *ex-ante* and *ex-post* activities it is acknowledged that we advocate a particularly comprehensive, challenging and resource-intensive policy-making process.

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