

Economic Evaluation of Adaptation Pathways

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How, how much and when should investments be made, given the very large uncertainties that are generally associated with projections of future?

Source picture: <http://www.ideachampions.com>

The future is uncertain

To deal with an uncertain future, a long term water management strategy should be:

ROBUST and/or **FLEXIBLE**



As this will lead to a sustainable strategy

Objective - economic evaluation of pathways

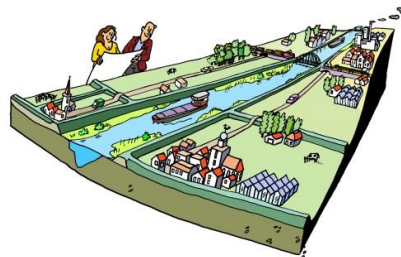
NEW policy approach of **dynamic adaptive policy pathways** (Marjolijn Haasnoot) with **adaptation tipping points** and **pathways** developed to deal with uncertainty. Current approaches mostly static, few include sequence of options and none include timing over actions

Key objective of this research

Assessing different economic evaluation methods for the evaluation of adaptation pathways. What are the effects of different economic evaluation methods on pathway preferences? What would be new economic evaluation approaches?

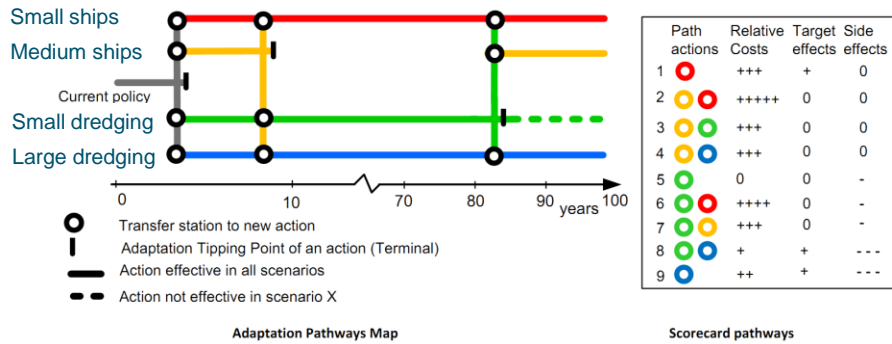
Waas

The evaluations are applied on a hypothetical case, inspired by a river reach in the Rhine Delta in the Netherlands

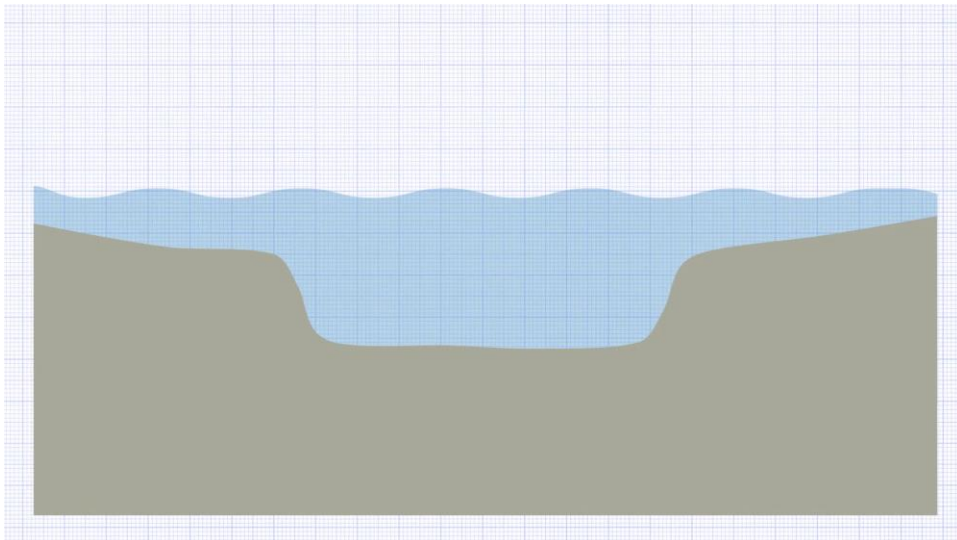


Dynamic Adaptive Policy Pathways

What are robust and flexible policy options/pathways?



Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006



Approach on economic analyses of adaptation pathways

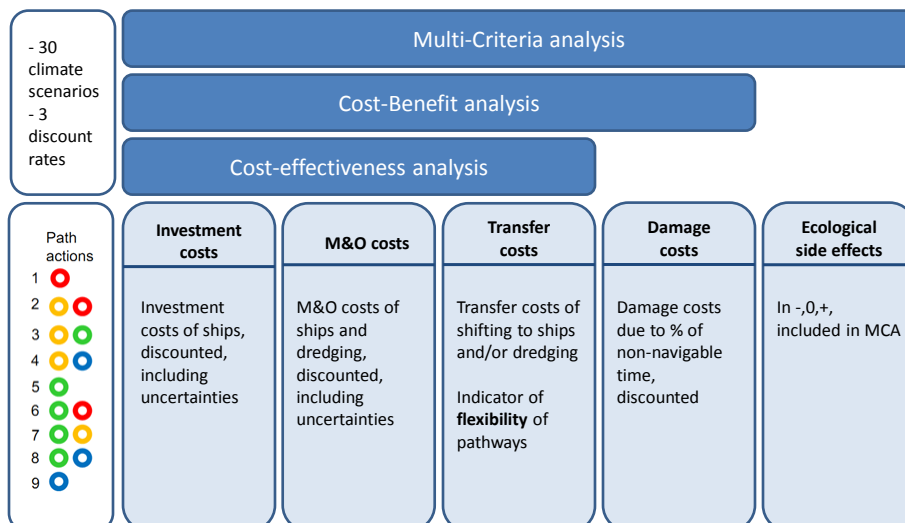
Evaluate economic methods for adaptation pathways

- Ranking of pathways through cost-effectiveness, cost-benefit and multi-criteria analysis
 - considering different uncertainties, 30 transient scenarios, different discount rates, costs & damages
 - For different time periods, 10,20,50, 100 years

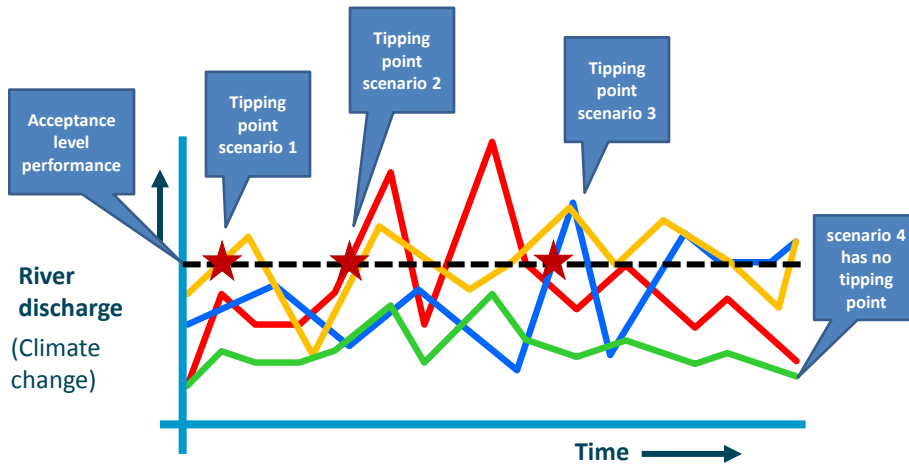
Addressing level of uncertainties of pathways

- Ranking of pathways on “economic robustness”
 - Economic robustness: how much do the costs and benefits deviate between the different scenarios
- Ranking of pathways on flexibility

Economic evaluation of adaptation pathways

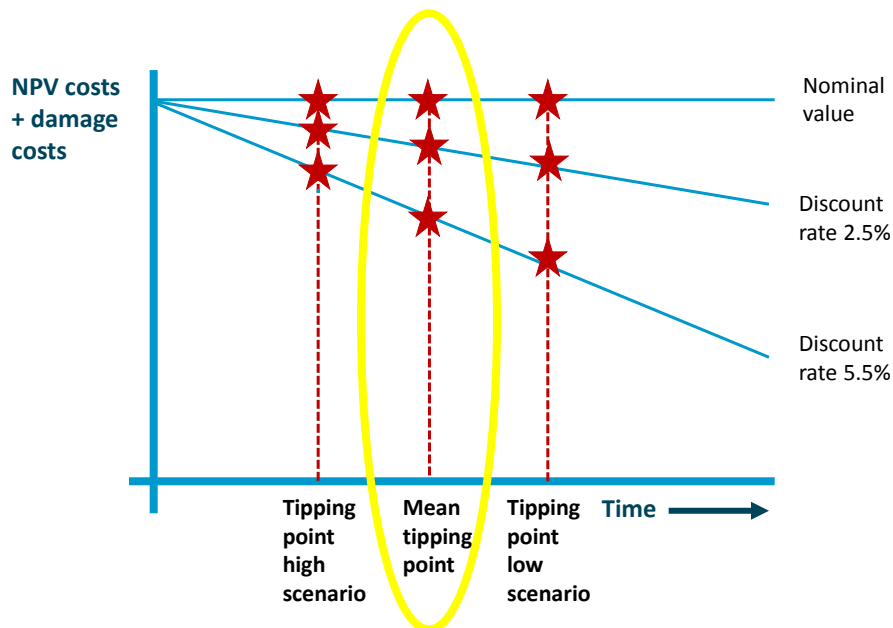


Different tipping points lead to...



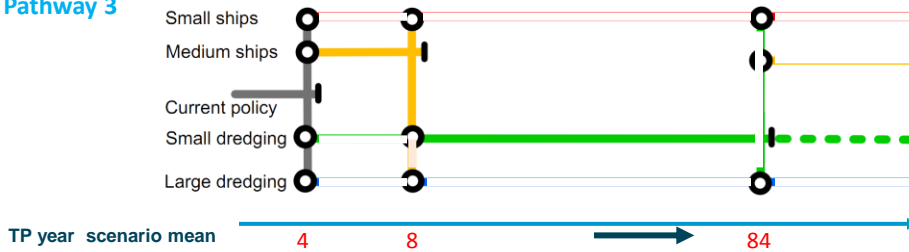
Transient scenarios: time series of possible futures that describe a gradual change

Different economic costs and benefits

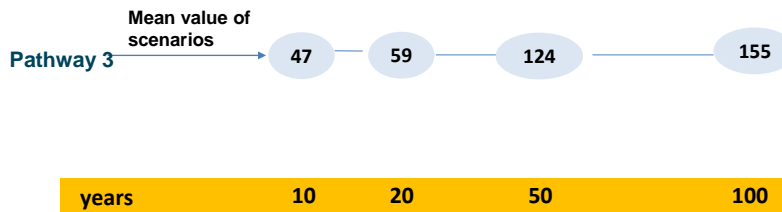


From policy actions to economic evaluation of pathways

Pathway 3



Economic costs & damages
r: 2.5%, € mln



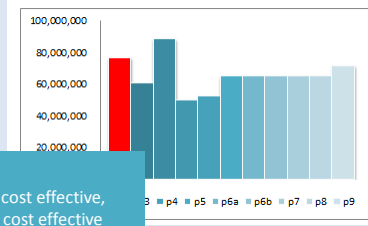
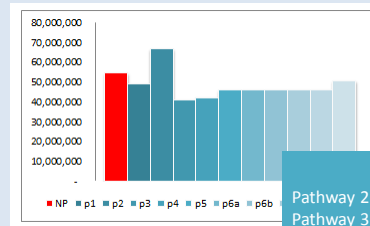
Economic evaluation of adaptation pathways

Time horizon

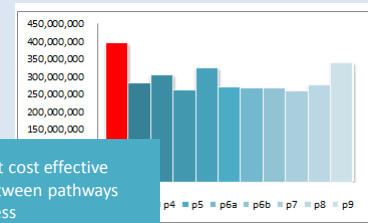
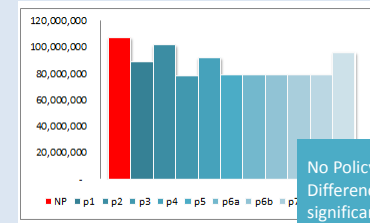
Costs incl damage, discount rate: 5.5%

Costs incl damage, 1% discount rate

0-10 years

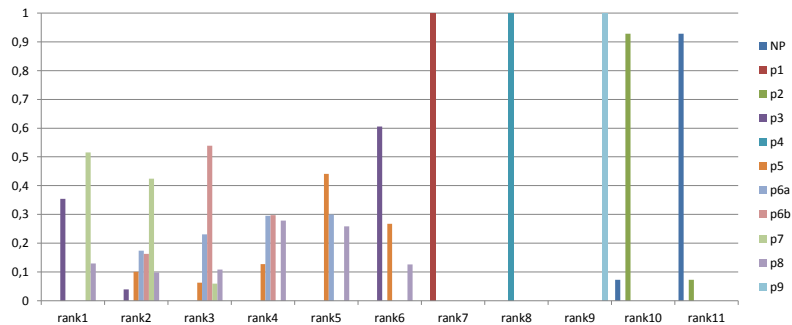


0-100 years



Ranking probability for CBA

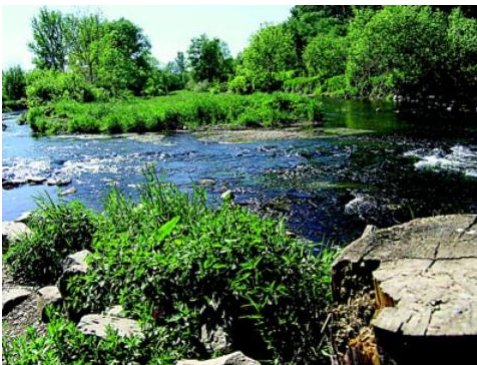
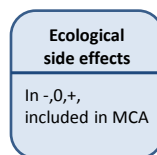
(over 100 years, discount rate 5.5%)



- Over all 30 scenarios **p7** (1st small dredge, 2nd medium ships) has a probability of around 50% to be on 1st rank, and >40% to be on 2nd rank
- **p3** (1st small dredge, 2nd medium ships) also has a relatively high probability to be on 1st rank (around 36%), but in around 60% of all scenarios it is only on rank 6.
(i.e. it is not that *robust* against different climate scenarios)

Source: Primate, UFZ

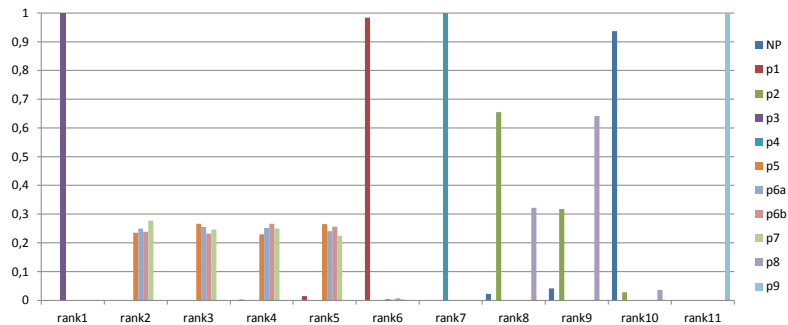
Side effects included in Multi-criteria Analysis



Path	Side actions	effects
1	●	0
2	● ●	0
3	● ●	0
4	● ●	0
5	●	-
6	● ●	-
7	● ●	-
8	● ●	---
9	●	---

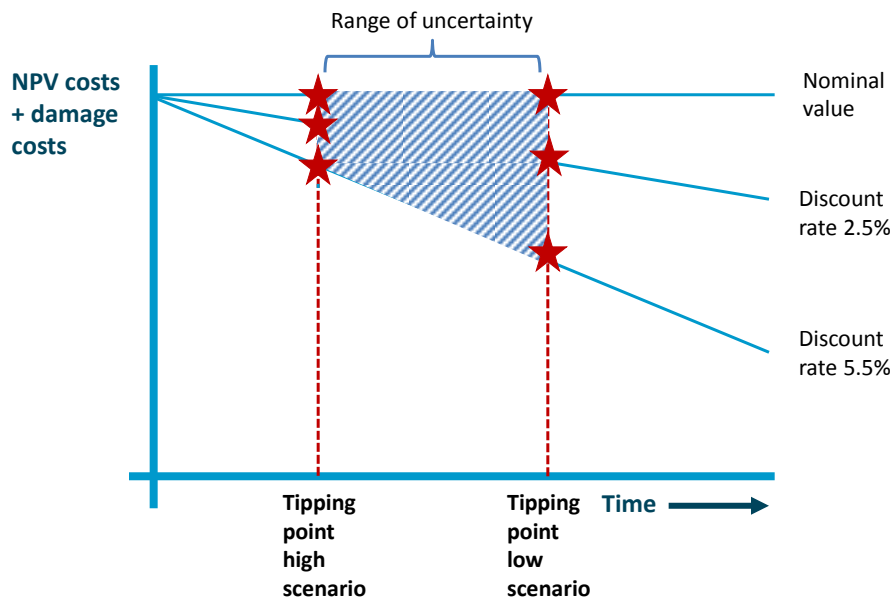
Ranking probability for MCA

(incl. side effects with a weight of 20%)

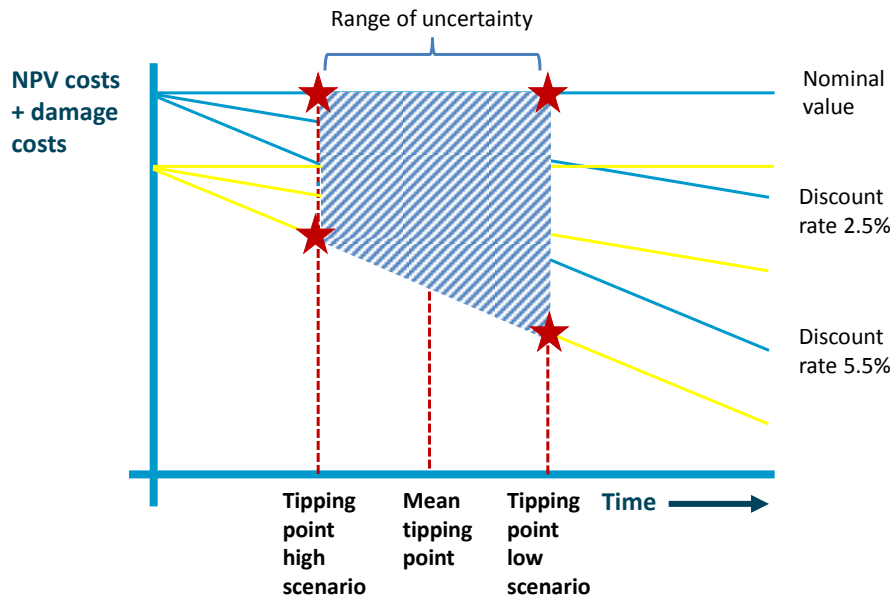


- Now **P3** (1st small dredge, 2nd medium ships) is clearly ranked first (no negative side effects)
- Pathways with negative side effects (in particular **P8** & **P9**) are on a lower rank than before, and the other way round (NP, P1-4)

Economic Robustness of policy actions

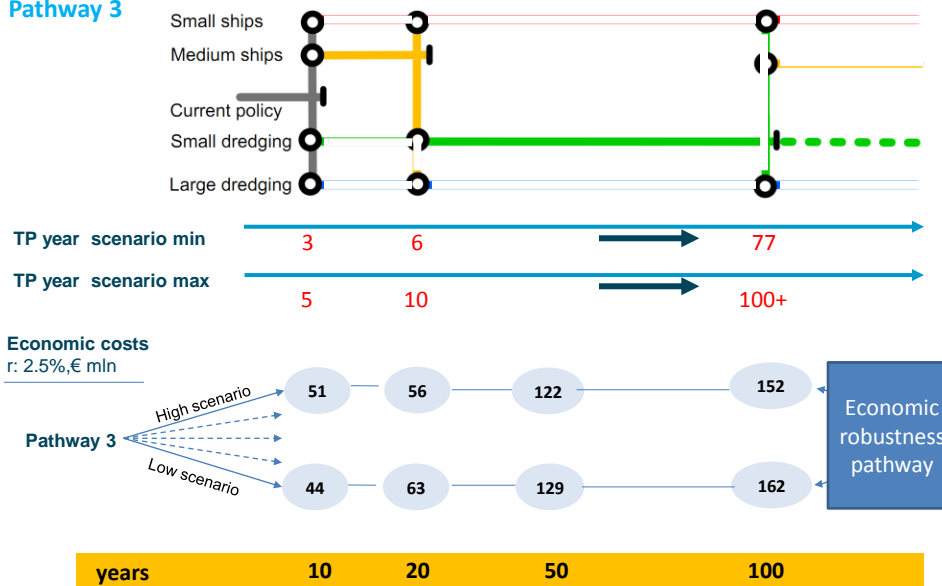


Economic Robustness of policy actions



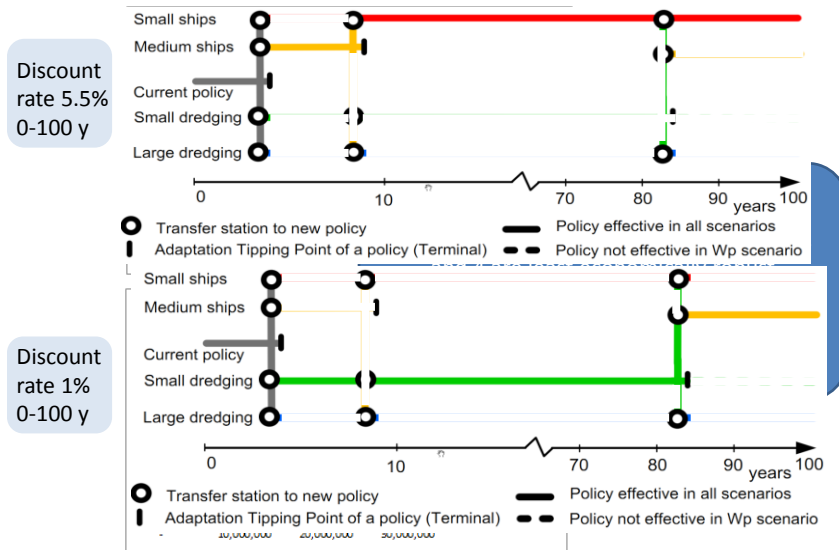
From policy actions to economic robustness of pathways

Pathway 3



Economic robustness of pathways

Economic robustness: how uncertain are the pathways in terms of costs and benefits, eg. what is the deviation between the different scenarios

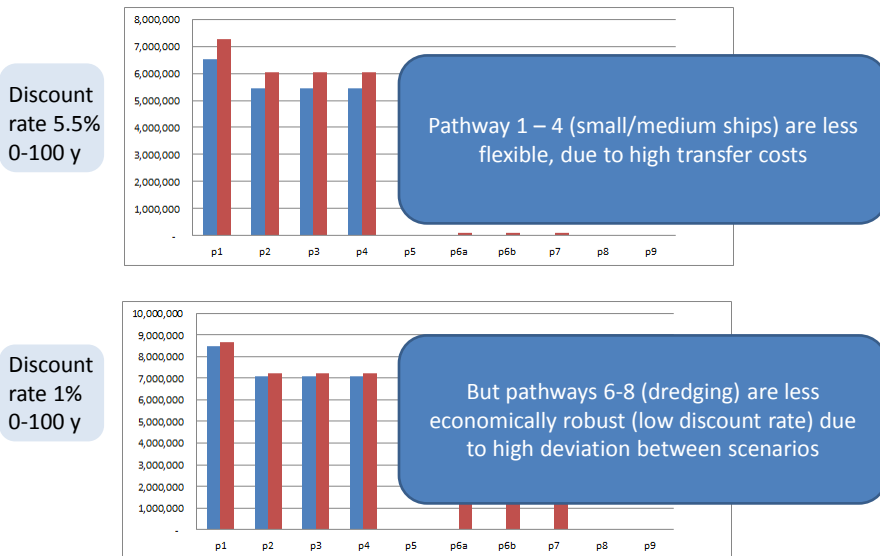


Flexibility of pathways

Investment costs	M&O costs	Transfer costs
Investment costs of ships, discounted, including uncertainties	M&O costs of ships and dredging, discounted, including uncertainties	Transfer costs of shifting to ships and/or dredging

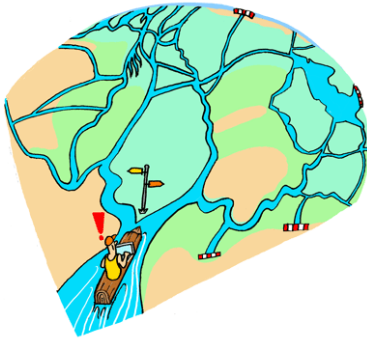
- **Transfer or switching costs** : costs for switching from one policy to another policy
- Include costs such as adjustments to infrastructure, lead time costs
- A proxy of **flexibility** of pathway

Flexibility of pathways



Key findings and future work

- **Ranking of pathways** differs significantly when using different economic methods and other criteria (such as discount rate)
 - Identification of the “**economic robustness**” and **flexibility** of pathways give a more informed overview of the uncertainties per pathway
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- Vary with acceptable performance of actions (tipping points)
 - Include wider benefits and different stakeholders weights (MCA)
 - Use **avoided damage** as tipping point instead of performance
 - Further explore “economic robustness” and flexibility



Thank you!

- Delta Programme. <http://www.deltacommissaris.nl/english>
- Haasnoot, M. (2013) Anticipating change: sustainable water policy pathways for an uncertain future. [10.3990/1.9789036535595](https://doi.org/10.3990/1.9789036535595)
- Haasnoot, M., Middelkoop, H. et al., 2012. Exploring pathways for sustainable water management in river deltas in a changing environment. Climatic Change 114, 795-819. [10.1007/s10584-012-0444-2](https://doi.org/10.1007/s10584-012-0444-2)
- Walker et al. 2013. Walker, W.E., M. Haasnoot, J .H. Kwakkel (2013). Adapt or Perish: A Review of Planning Approaches for Adaptation Under Deep Uncertainty. Sustainability 2013, 5, 955-979. [10.3390/su5030955](https://doi.org/10.3390/su5030955)