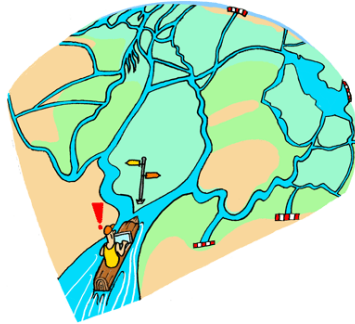


Anticipating change by exploring adaptation pathways for the Rhine delta



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Ad Jeuken, Judith ter Maat, Hans
Middelkoop, Eelco van Beek,
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*Deltares, Utrecht University,
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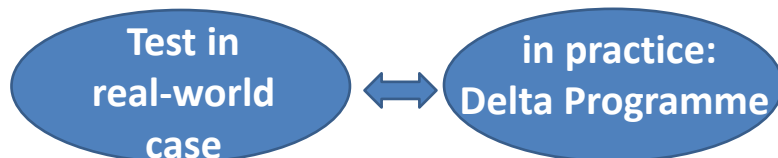
How much *exactly*? How *fast*? How will
environment and society *interact*?

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

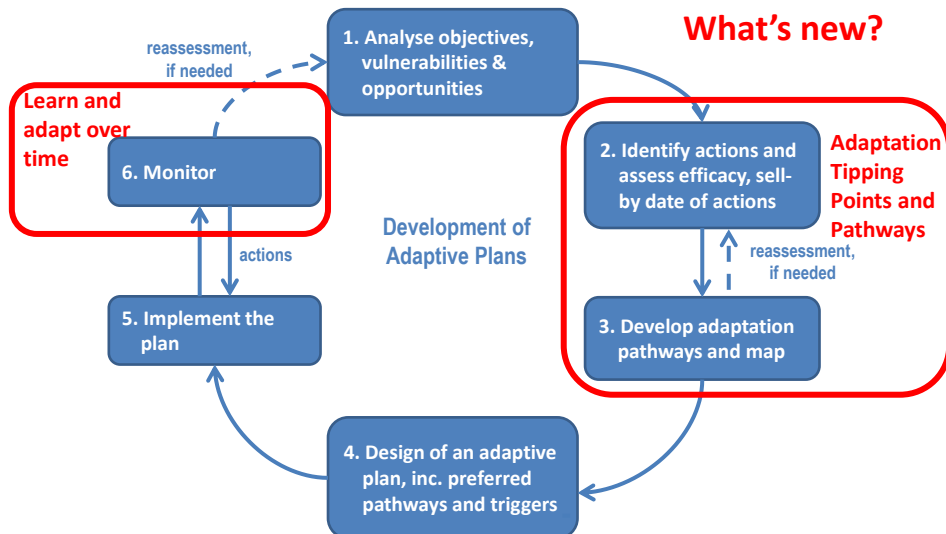


Need for an approach to support decision making under uncertainty that produces a dynamic, flexible plan that can be adapted as conditions change.

Dynamic Adaptive Policy Pathways



Dynamic Adaptive Policy Pathways

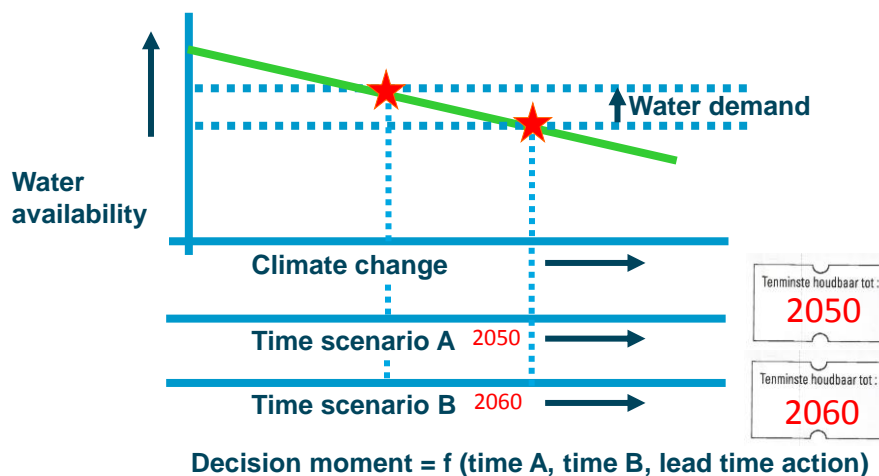


Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

Adaptation Tipping Point & Sell-by date of policy action

A stress test: **How much** (climate) change can we cope with?

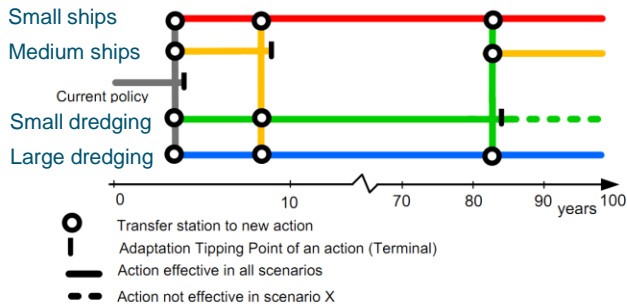
When do start to achieve missing our objectives?



Kwadijk, J.C.J. et al 2010 WIREs Climate Change DOI: 10.1002/wcc.64, Haasnoot et al 2012 Climatic Change

Adaptation Pathways

What are robust and flexible policy options/pathways?



Adaptive Plan: small dredging and switch to large scale dredging.
Implement corrective actions to mitigate negative side effects.
Monitor river discharges and transport developments.

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



MONITORING SYSTEM:

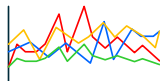
- Signposts and trigger values
- Are we still on track?
- Are corrective actions needed?
- Do we need to implement actions earlier or later?
- Is reassessment needed?



Dutch Delta Programme:
How can we protect the Dutch Delta against climate change and sea level rise and increase ecological value of the water system?

Approach

Ensemble transient scenarios

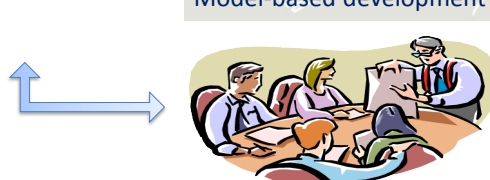
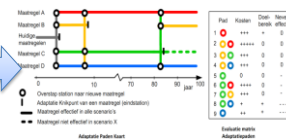


Set of actions

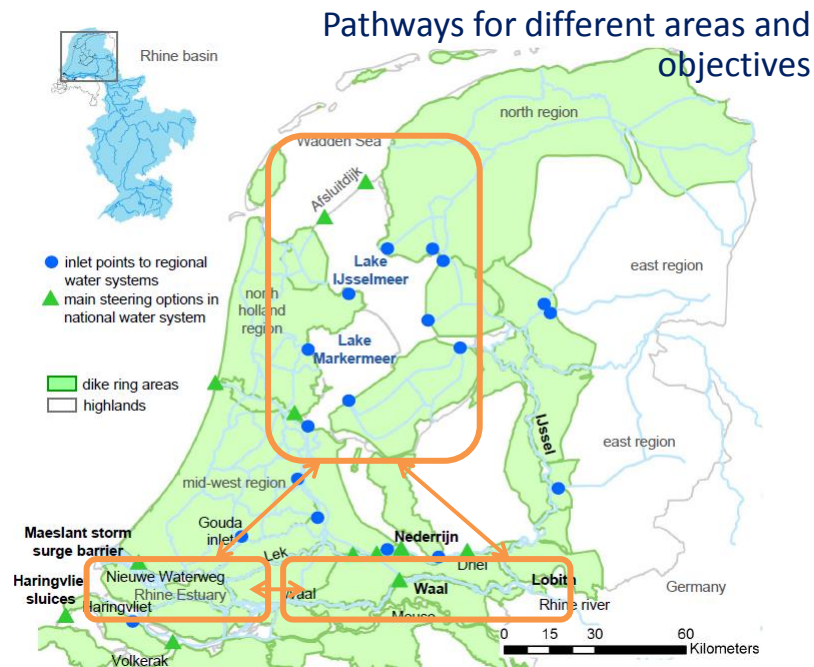
Action A ● Action C ●
 Action B ● Action D ●



Adaptation pathways



Participatory/qualitative
 Workshop & storylines



IJsselmeer actions

Flood protection

1. Discharge under gravity
2. Increase pump capacity Afsluitdijk

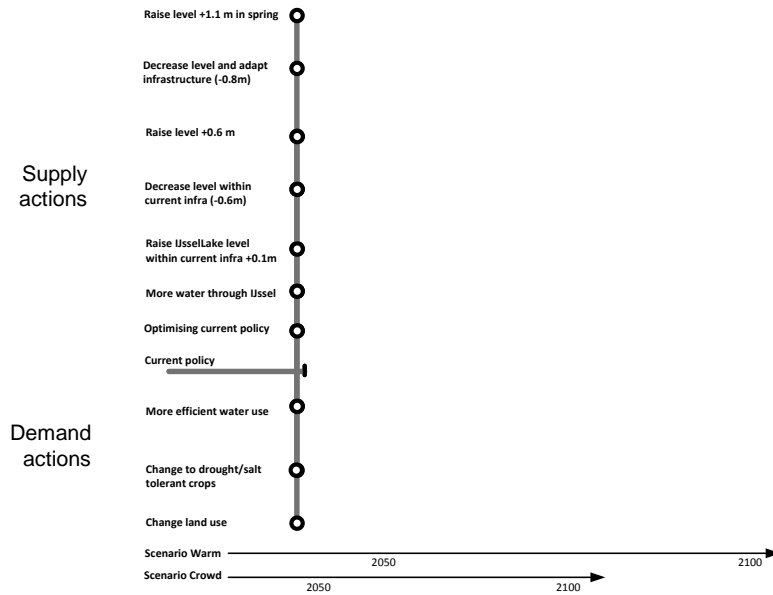
Water supply

Water availability

- Increase water level IJsselmeer and decrease in dry periods
- Decrease water level
- More water to the IJssel
- Efficient water use in regions

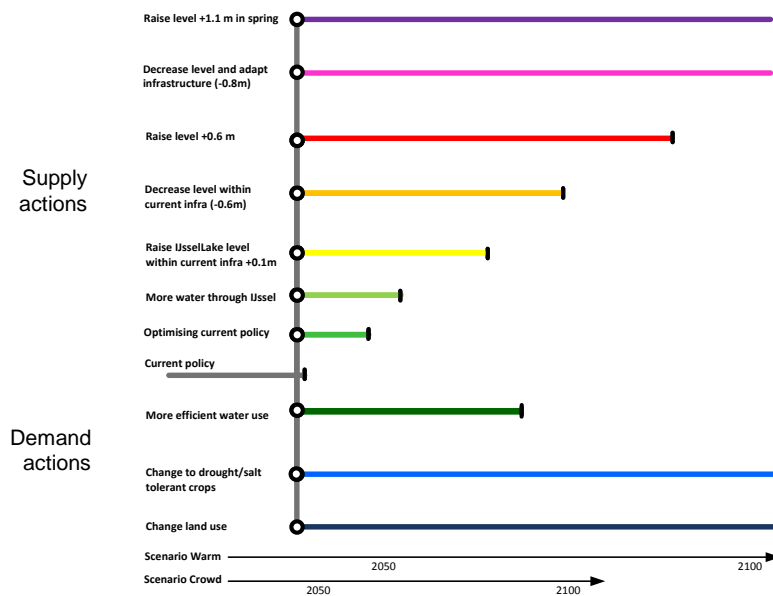
Water demand

- Salt/drought tolerant crops
- Move agricultural to areas with suitable environmental conditions



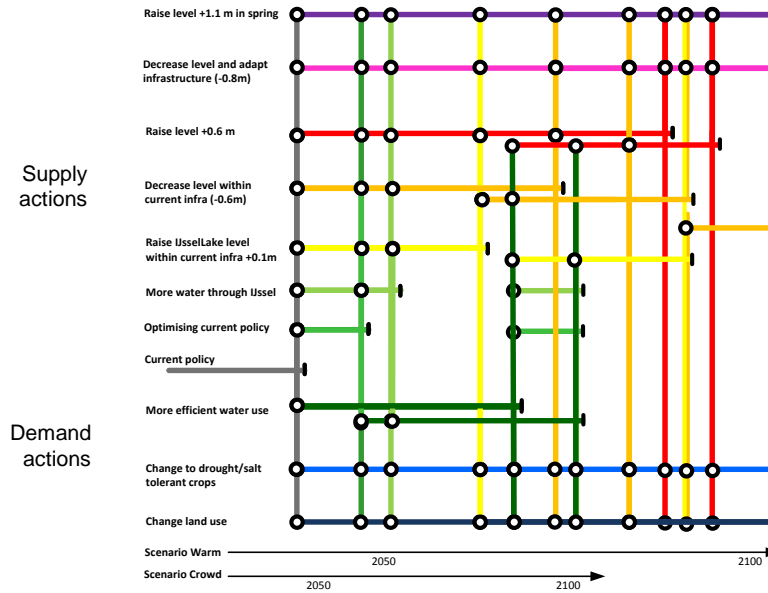
Identify **POLICY ACTIONS** based on problem analysis.

Source: Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006



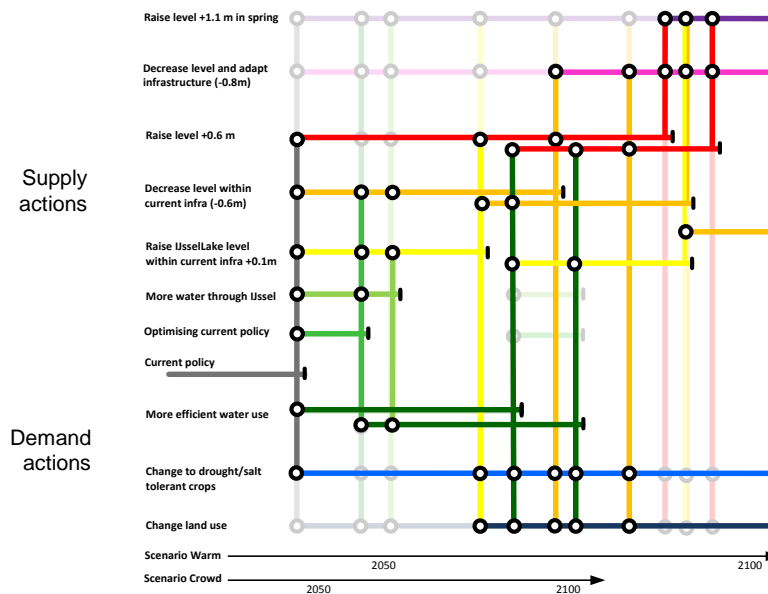
Assess **TIPPING POINTS** of policy actions with transient scenarios.

Source: Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006



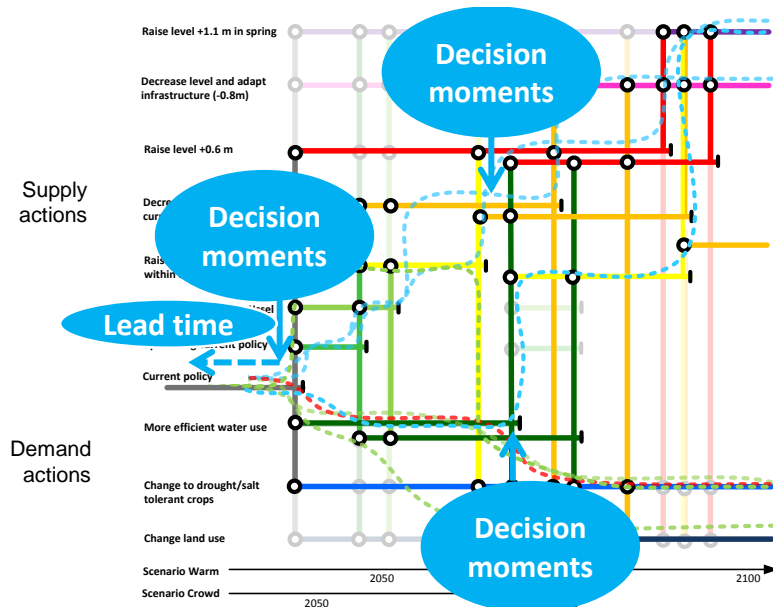
Evaluate policy actions and develop **PATHWAYS**.

Source: Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006



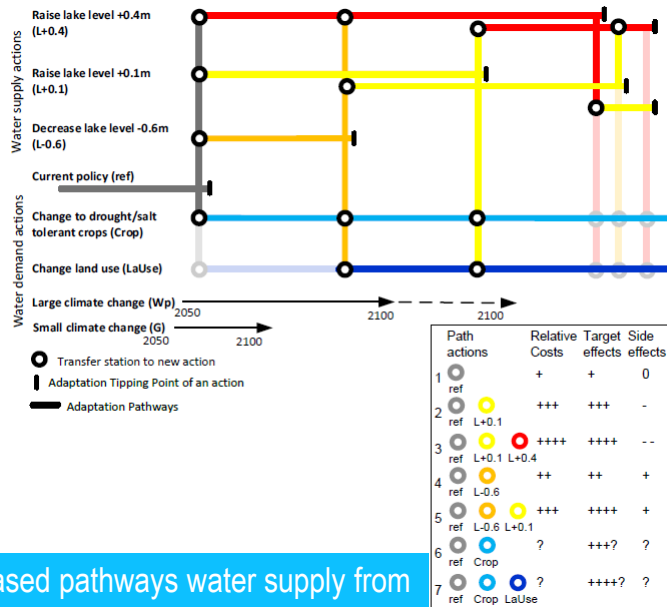
Evaluate policy actions and develop **PATHWAYS**.

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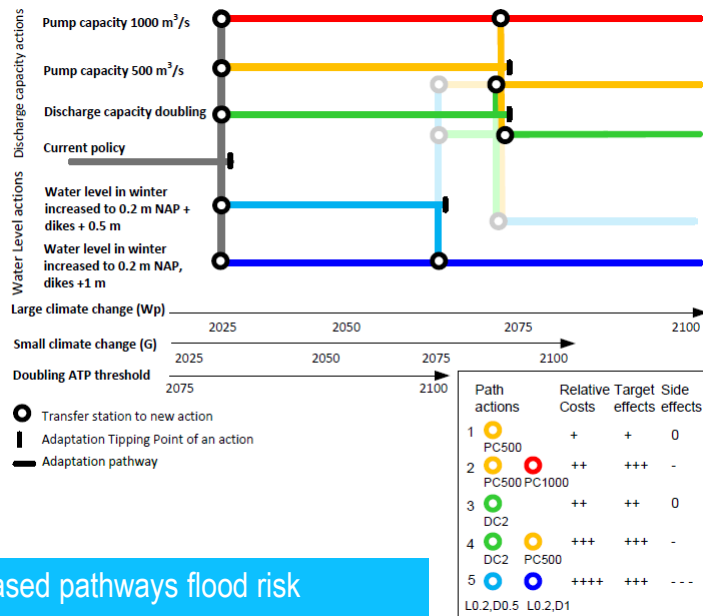


Design preferred pathways for each PERSPECTIVE.

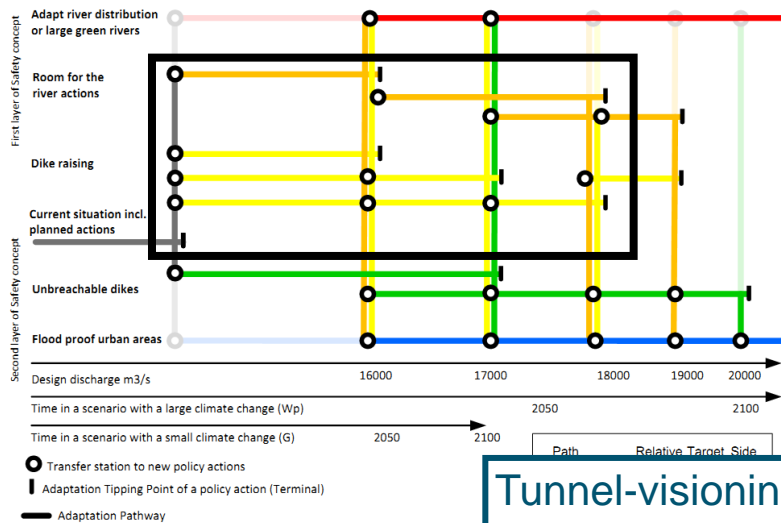
Source: Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006



Model based pathways water supply from IJsselmeer



Model based pathways flood risk IJsselmeer



Tunnel-visioning?
Lock-in?

Practitioners' pathways

Pathways for flood risk management rivers.

From pathways to an adaptive plan

Promising policy options include '**No-Regret**' actions that have additional benefits or have an acceptable performance in multiple scenarios (robust), and '**Avoid Regret**' that enable flexibility against low costs.

Flood risk and fresh water supply IJsselmeer:

- **Pump** and optional a second pump. Drainage under gravity may have ATP before end of lifetime.
- **Flexible water levels**. Increase summer level to 0.1m.

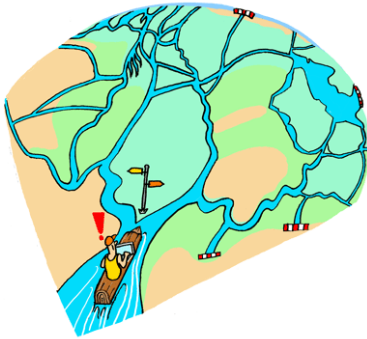
Flood risk rivers:

- Storylines: paths including dike raising actions or combinations of room for the river and dike raising have more preference.
- **Load-bearing assumptions**: water distribution at peak flows & peak inflow.
- **Spatial planning rules** to keep options open for future room for the river. Or start with room for the river.
- 'Monitor and Adapt' may be difficult for flood risk. Large range timing ATP. To act or not to act.

Signposts: land use, crops, sea level rise, upstream activities, and possibly low flows

Enter reality: some first observations from Delta Programme

- Delta Programme (2012a): *"Development pathways or adaptation pathways offer a strong approach to show which **options** are needed and **when** they should be implemented and how long-term objectives influence short-term decisions."*
- Iterative participatory process reduced the number of **pathways** → only preferred strategies including some options for the future (but not so much and not the one for high-end conditions).
- **No Adaptation Tipping Points**. No vulnerability assessment and only one or two time slices for impact assessment. Timing is presented in terms of short, mid, long term actions.
- The plan includes **preparatory** actions (e.g. study on river water distribution, spatial planning rules IJsselmeer).
- Strategic decisions have been presented, **next step is monitoring and learning system**.



We were able to apply the DAPP approach to a real-world case. Parts have already been used in practice. Assessment over time is still limited.

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)
- Haasnoot, M., Kwakkel, J.H., Walker, W.E. et al. 2013. Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. Global Environmental Change 23, 485-498 [10.1016/j.gloenvcha.2012.12.006](https://doi.org/10.1016/j.gloenvcha.2012.12.006)
- Kwadijk, J., M. Haasnoot et al. (2010). Using adaptation tipping points to prepare for climate change and sea level rise: a case study in the Netherlands. WIREs: Climate Change. [10.1002/wcc.64](https://doi.org/10.1002/wcc.64)
- Ranger, N., Reeder, T., Lowe, J., 2013. Addressing deep uncertainty over long term climate in major infrastructure projects: four innovations of the Thames Estuary 2100 Project. EURO J. on Decision Processes, 10.1007/s40070-013-0014-5
- 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)