

Coping with Uncertainties About Climate Change in Infrastructure Planning: An Adaptive Policymaking Approach*

Warren Walker, Vincent Marchau, and Adnan Rahman

*Background study for: 'Witte Zwanen Zwarte Zwanen', advice on proactive adaptation on climate change, Advisory Council for Transport, Public Works and Water Management, 2009.



Outline

- Some specific impacts of climate change for the Netherlands
- Problems with the use of scenarios in policymaking
- A new approach: dynamic adaptive policies
- Conclusions

Some specific impacts of climate change for the Netherlands

- Increases in very hot days and heat waves
- Higher temperatures
- Rise in sea level
- Shortages of fresh water
- Shortages of sand
- Increased wind speeds and storm intensity
- Increased water discharge through Rhine and Maas rivers

Source: *Samenwerken met water*, bevindingen van de Deltacommissie, 2008

3

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4

Different scenarios for sea-level rise in Netherlands

- **Royal Dutch Meteorological Institute (KNMI):** 35 – 85 cm
- **IPCC WGI Fourth Assessment Report:** Global 18 – 59 cm
- **Al Gore Greenland scenario:** 150 cm is possible based on past warm periods

Huge differences in sea-level rise estimates; what does this mean for policy?:

- Choose a policy for a specific scenario (who is God?)
- Choose a policy for the worst case, or find a robust solution (static, may be very costly, may not be needed)
- Find a new approach to deal with the uncertainties

5

Delta Commission report, 2008

- Recommends raising flood protection levels (e.g., with new and/or higher dikes) based on worst case KNMI and IPCC scenarios
- Estimates that average costs **per year** for policy actions will be :
 - €1.2 to 1.9 billion from 2010 – 2050
 - €0.9 to 1.8 billion from 2050 – 2100

6

Assumptions behind this scenario-based policy

- We know all the forces driving structural change for the (water, transport, etc.) system, and climate change is the most important one
- We know all the factors affecting climate change and the rate of climate change
- We know the magnitude of the factors driving climate change
- We know how climate change will affect the system
- We know how stakeholders will value these effects

Implies that the KNMI and IPCC have a crystal ball

7

Policy is driven by the same thinking that led to the recent global economic meltdown

- **Mr. Greenspan:** I found a flaw in the model that I perceived is the critical functioning structure that defines how the world works.
- **Chairman Waxman:** In other words, you found that your view of the world was not right, it was not working.
- **Mr. Greenspan:** Precisely. That's precisely the reason I was shocked, because I had been going for 40 years or more with very considerable evidence that it was working exceptionally well.

--House of Representatives, Committee on Oversight and Government Reform,
October 23, 2008

[i.e., faith in predictive models, faith in stability in the world, belief that there are no "Black Swans"]

8

Some conclusions about the use of scenarios in policymaking

- Scenarios are useful and serve an analytic purpose
- But they have some limitations for decisionmaking, and are not being used properly:
 - Scenarios cannot bound uncertainty
 - Scenarios are often extrapolations (don't deal with 'deep uncertainty'¹ properly)
 - Planners "choose" a scenario to make a plan/policy -- this is wrong!!
- With 'deep uncertainty'¹, the uncertainties cannot be bounded, thus policymakers must retain flexibility
- Monitoring and adaptation become essential

¹ Deep uncertainty: situations in which "decisionmakers, analysts, and experts do not know or cannot agree on: 1) the system models, 2) the prior probability distributions for inputs to the system model(s) and their interdependencies, and/or 3) the value system(s) used to rank alternatives" (Lempert et al., 2006)

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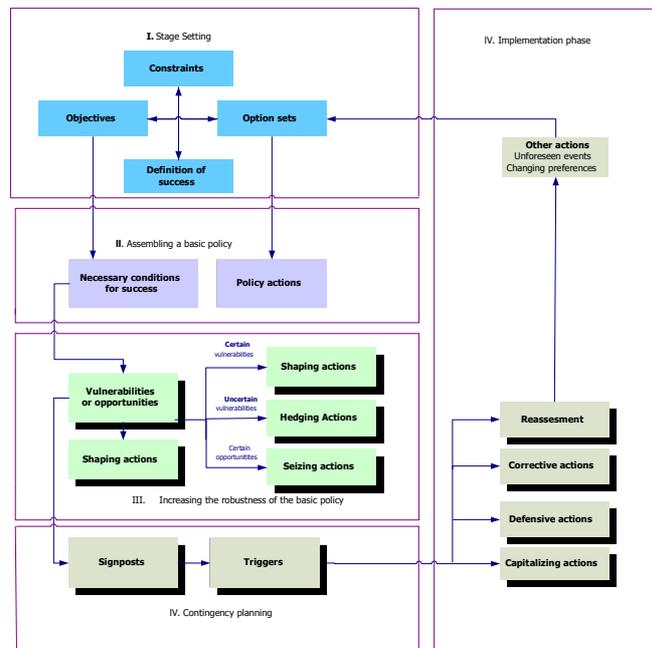
Dynamic adaptive policies

- Policy includes mechanisms for
 - Validating ‘laboratory’ assumptions
 - Hedging against negative outcomes and other uncertain events
 - Steering toward positive outcomes/valuation of outcomes
 - Adapting to changing situations
- One possible adaptive approach: based on
 - Determining a set of goals
 - Identifying a basic policy and conditions for success
 - Identifying vulnerabilities of the policy and ways of protecting it
 - Monitoring progress toward the goals
 - Adapting the policy as exogenous and endogenous conditions change

11

The Adaptive Approach

[W.E. Walker, S.A. Rahman, J. Cave (2001). “Adaptive policies, policy analysis, and policymaking”, *European Journal of Operational Research* 128 : 282-289]



12

Illustrative Case: An adaptive policy for sea-level rise in the Netherlands

13

Step 1: Setting the Stage

Identify objectives, constraints, available policy options, and definition of success, :

- **Objective:** protection of vulnerable areas against sea rise until 2100, including ports and airports, bridges, economic and residential centers, etc.
- **Constraints:** public costs, environmental stress, public acceptance
- **Policy options:**
 - Preventive: Raise dikes
 - Detective: Sea level monitoring, temperature monitoring, arctic developments
 - Responsive: Space for flooding, evacuation plans
- **Definition of success:** Country does not drown, few societal losses

14

Step 2: Assembling a Basic Policy

- Specify a promising, basic policy
 - Fix current dikes to existing standard
 - Develop standards based on alternative sea-level rise scenarios (already exist)
 - Implement incentives for climate change friendly behavior (mitigation)
- Identify conditions for the success of the basic policy
 - Financial support for implementation
 - Basic support of crucial actors (government, users, constructors, companies)
 - Range of sea-level rise scenarios is sufficient to capture real developments
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15

Steps 3 & 4: Identify Vulnerabilities of Basic Policy, and Adaptive Responses

- Vulnerability 1 (uncertain): financial support for implementation
 - Hedging actions: enable private funding for construction and operation
 - Signpost/Trigger: Monitor expenditures; in case of cost overruns, implement defensive (e.g. explain cause to the public) or corrective (e.g. adapt tax scheme to increase revenues) actions
- Vulnerability 2 (certain): Basic support of crucial actors (government, public, companies)
 - Mitigating actions: Educate public on sea-level rise threats

16

Steps 3 & 4 (continued)

- **Vulnerability 3 (uncertain): Sea-level rise may not develop as forecast (scenarios insufficient)**
 - Hedging actions:
 - Provide insurance in case of flooding
 - Develop evacuation plans in case of flood disaster
 - Signpost/Trigger: Monitor sea-level rise; in case the level of rise is too high (trigger), i.e. above scenario range, implement corrective actions (e.g. standard goes up)
- **Opportunity 1 (uncertain): Sea-level rise may not develop as forecast (scenarios overly pessimistic)**
 - Seizing actions: develop flexible dikes which can be easily adjusted
 - Signpost/Trigger: Monitor sea-level rise; in case the level of rise too slow(trigger), i.e. below scenario range, seize opportunity and reduce standard

17

Step 5: Implementing the Policy

- Basic policy, vulnerabilities, opportunities, and adaptive responses are agreed upon
- Basic policy is implemented and monitoring system is established
- Events unfold and signpost information is collected
- When a trigger event occurs, adapt the basic policy
 - If original objectives/constraints remain in place, take defensive/corrective actions: e.g. in case of cost overruns implement corrective action: adapt tax scheme to increase revenues
 - If event causes re-thinking of objectives/constraints, perform reassessment. E.g., intense storm causing heavy flooding; reassess entire policy; new policy learns from previous experiences

18

Note: Scenarios play an important (but different) role in the adaptive framework

- Step 2: assembling the basic policy
 - Identifying the conditions for success
- Step 3: specifying the policy and the monitoring mechanism
 - Identifying vulnerabilities
 - Signposts
 - Triggers

19

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20

Conclusions

- Problem of policymaking in response to climate change:
 - Uncertainties about climate change are huge but require urgent actions
- Challenge: To develop innovative approaches for handling these uncertainties
- Dynamic adaptive policies
 - Get implementation under way
 - Allow adaptations of policy over time as knowledge about innovative solutions proceeds and critical events in implementation take place, values change, and other external events take place
 - Enable learning from experience over time

21

Conclusions (continued)

- Many research challenges remain
 - Structured ways of identifying vulnerabilities, opportunities, signposts, triggers, etc.
 - Benefits vs. costs of an adaptive policy
 - Institutional changes required to implement an adaptive policy

22