

Building with Nature

Hybrid coastal defenses and eco-engineering

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Imagine the result

Contents

- Introduction to basic principles of **Building with Nature**
(not just build a huge dike)
- Introduction to **hybrid/mixed coastal defenses**
(‘hard’ and ‘soft’ working together)
- Recent **examples** along the Holland Coast
(upcoming, in progress, finished)
- **Summary**
(past and present)



Eco-dynamic Design Principles

- Designing and building with and from nature
- Focus on ecological chances (dynamic not static)
- Based on sound system knowledge
- In short: use nature as “dynamic engine”
- Ecologists and hydraulic engineers work together (in all project phases)

Basically:

- *Not just build a massive dike system
but a robust sea defense*



Eco-dynamic Design Principles

All based on a knowledge break-through for:

- Natural system
- Technological system
- Governance system



Eco-dynamic Design Principles

Knowledge break-through - natural system:

- From status quo towards *dynamics*
- From descriptive towards *predictive**)
- From species towards *systems*
- From false securities towards living with *uncertainties*

*) “What we learn from history...is that we do not learn from history!”



Eco-dynamic Design Principles

Knowledge break-through - technological system:

- From engineering thinking towards *integral* thinking by taking more disciplines into consideration
- From mitigating negative effects towards *adaptation* to the natural system
- From re-active towards *pro-active*



Eco-dynamic Design Principles

Knowledge break-through – governance system:

- From controlling towards *managing*
- From threats towards *chances*
- From closed government domination towards *open multi-actor* processes

Examples in The Netherlands

Holland Coast

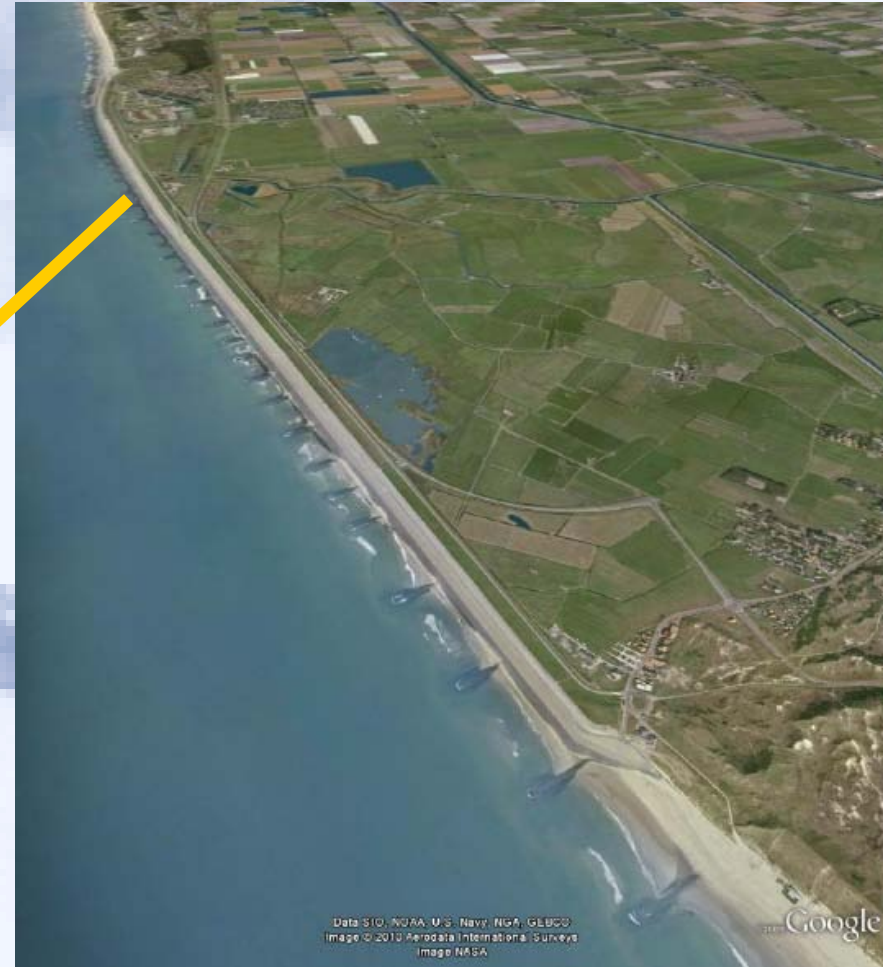
Lake Marken /
Lake IJssel

- 1) Hondsbossche & Pettemer Sea dike
- 2) Noordwijk
- 3) Scheveningen

South
westerly
Delta

HPZ Sea defense (upcoming)

- 5,5 km long
- Steep slope
- Crest above MSL+13 m

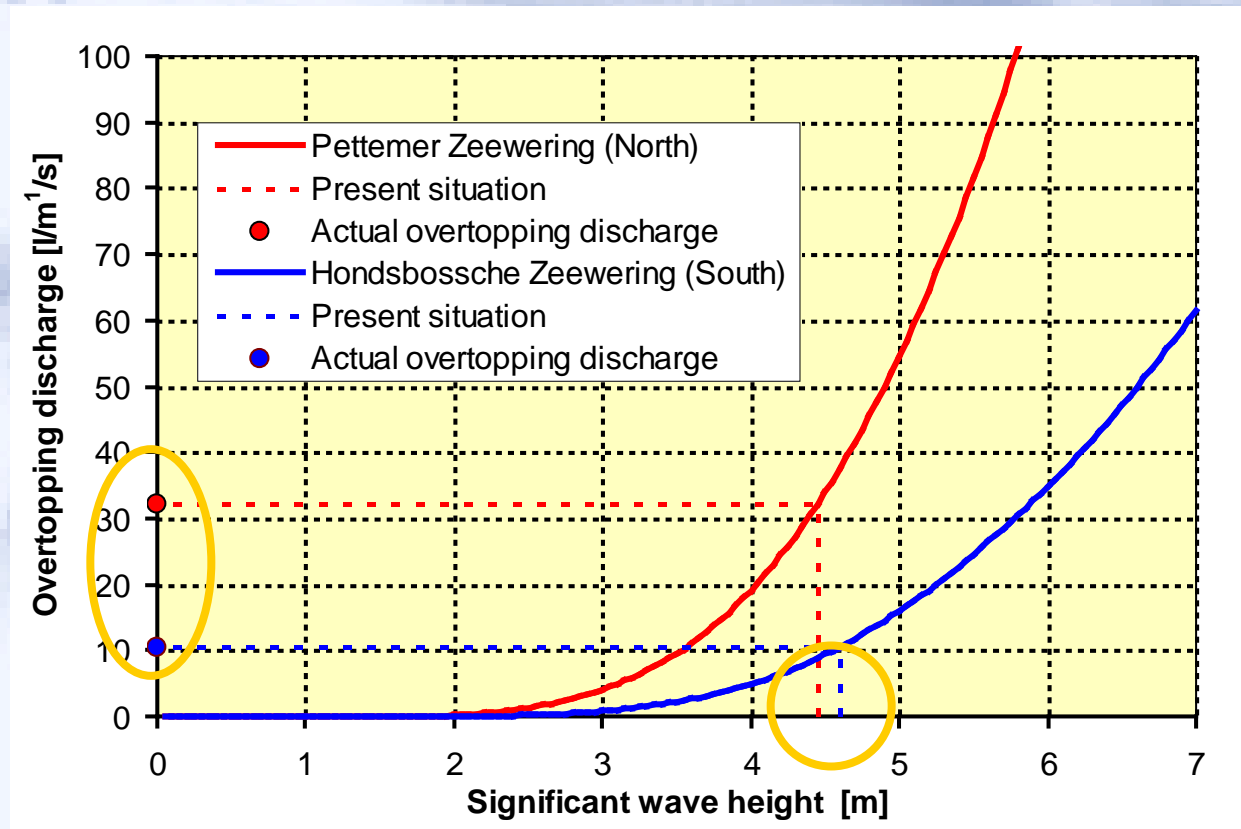


Problem: overtopping

Too much overtopping for both Northern and Southern section
($q \gg 1 \text{ l/m}^1/\text{s}$)

Due to:

- Steep slope (1 : 4 to 1 : 5)
- Wave attack ($H_{sig} = 4.6 \text{ m}$ and $T = 12 \text{ s}$)



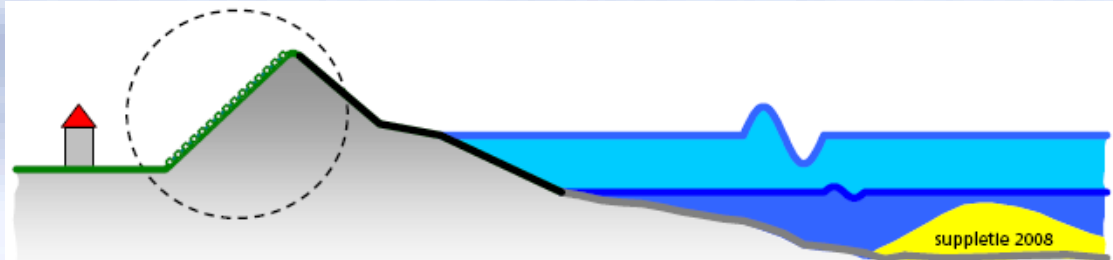
Objective: strengthen the water defense

- To deal with +50 year conditions (sea level rise)
- To combine this with 'spatial quality'
(so not only safety!)

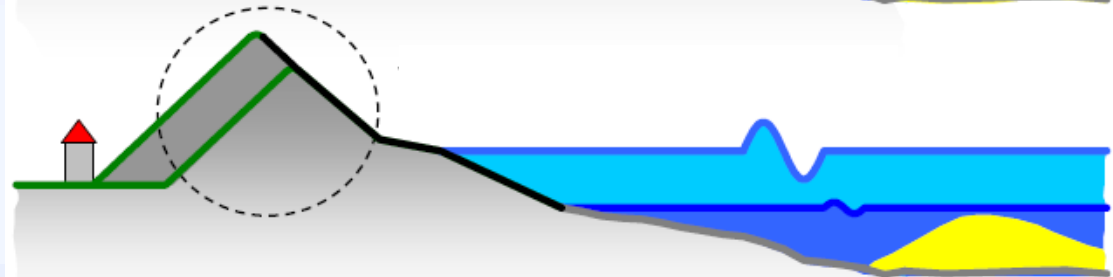


Alternatives considered

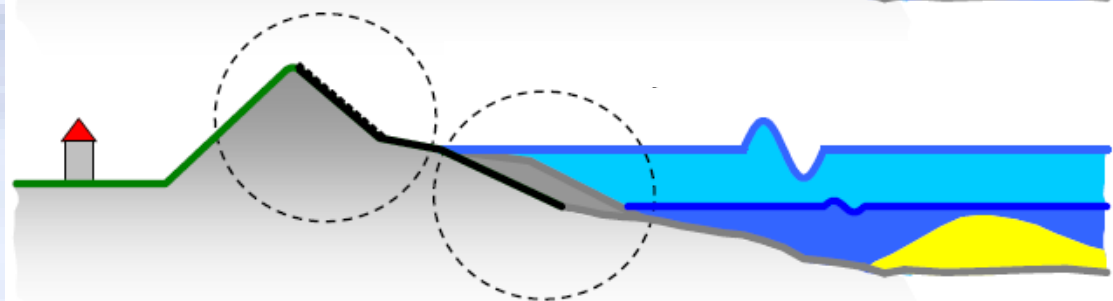
Modifying inner slope



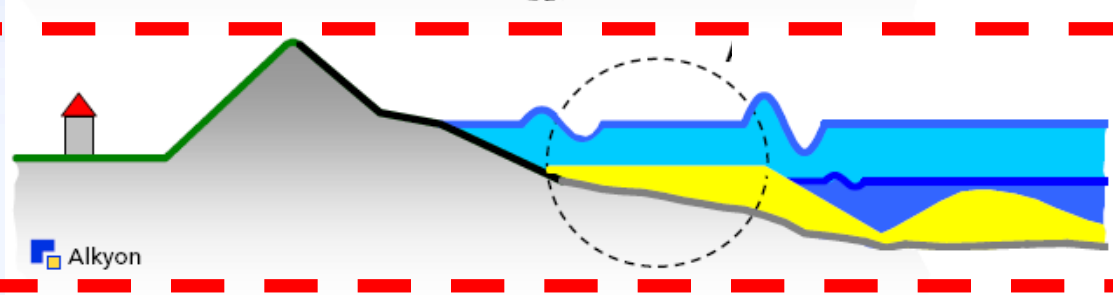
Increasing crest level



Modifying outer slope



Adding protective berm to reduce wave attack!

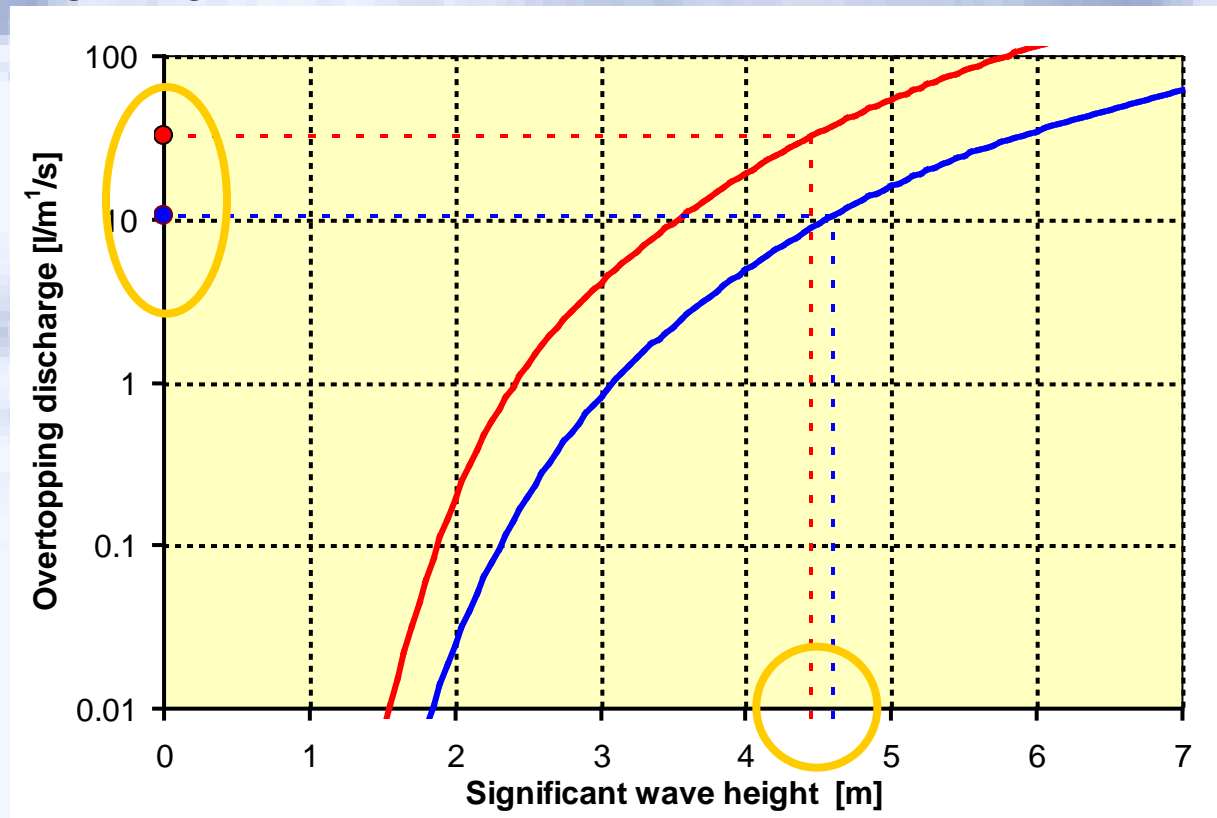


Alkyon

Reduction of wave attack

Present situation:

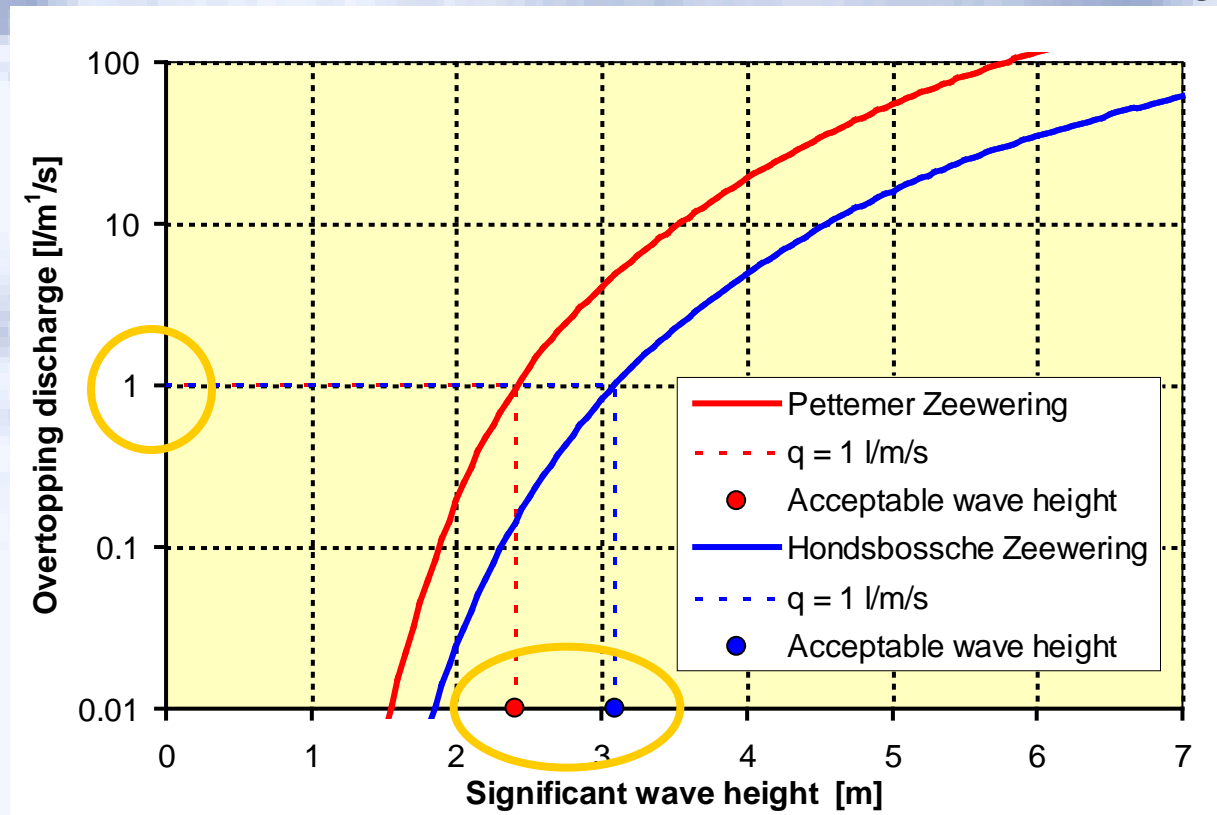
→ Overtopping for given wave attack (*as before*)



Reduction of wave attack (cont.)

New situation:

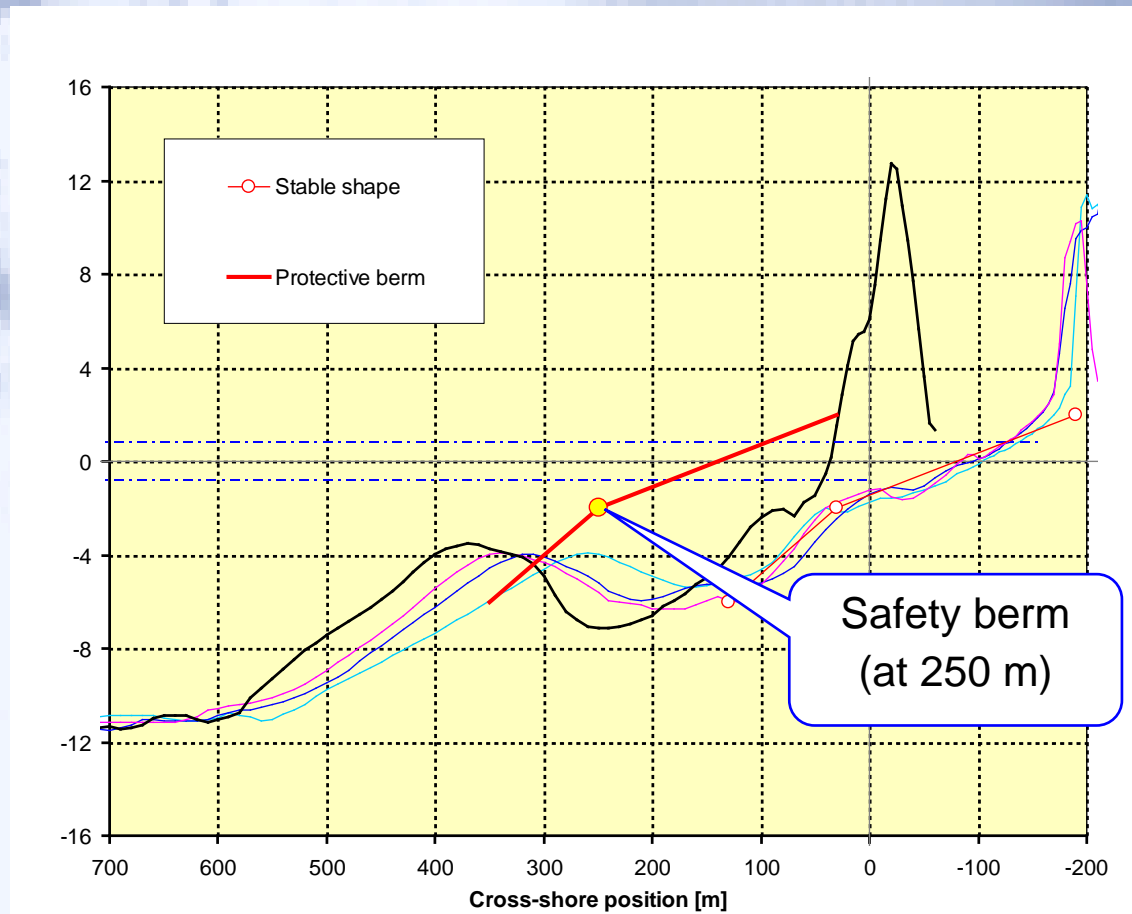
→ maximum wave attack derived from acceptable overtopping



Adding a safety berm

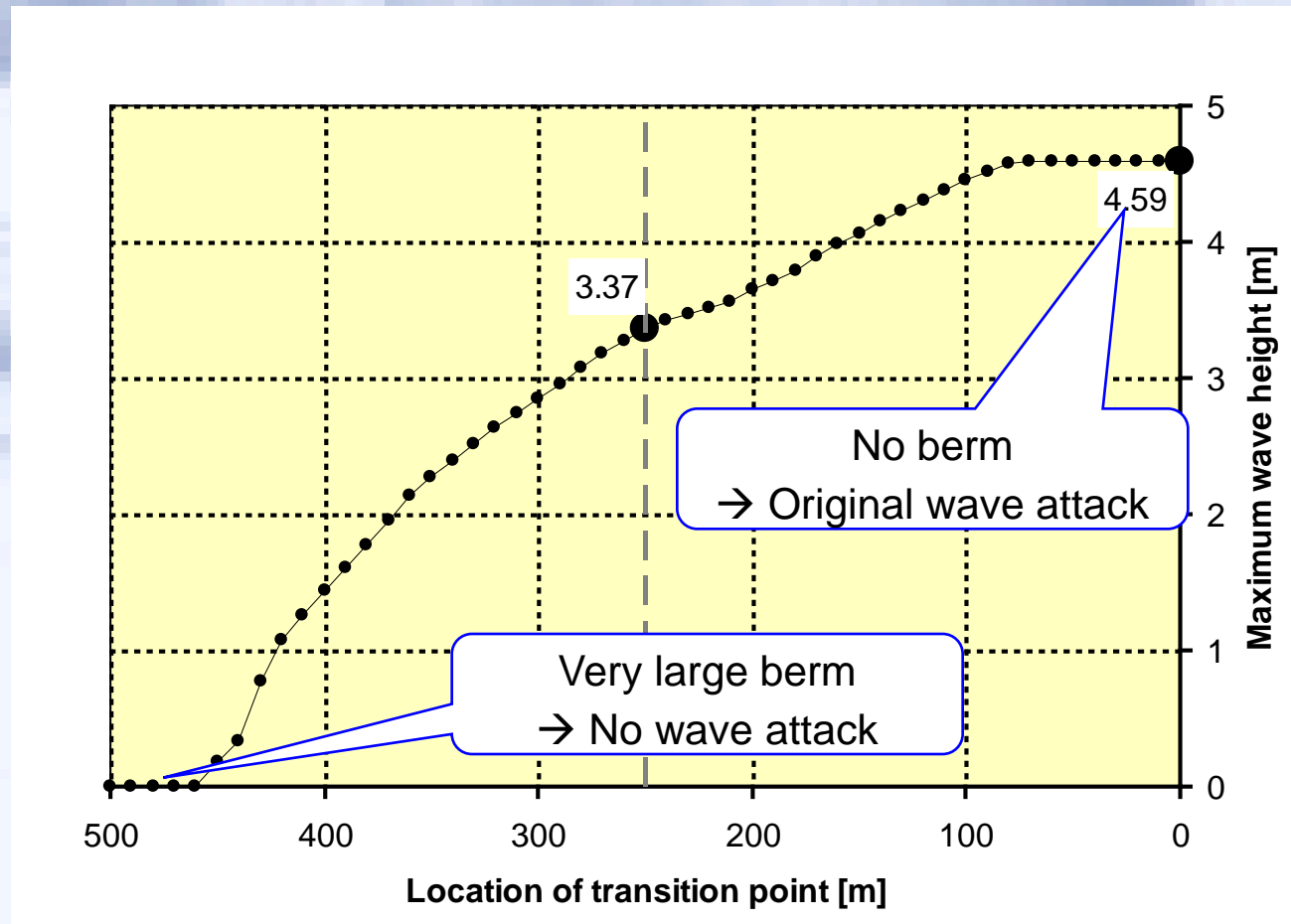
Required extent:

→ depends on position / volume



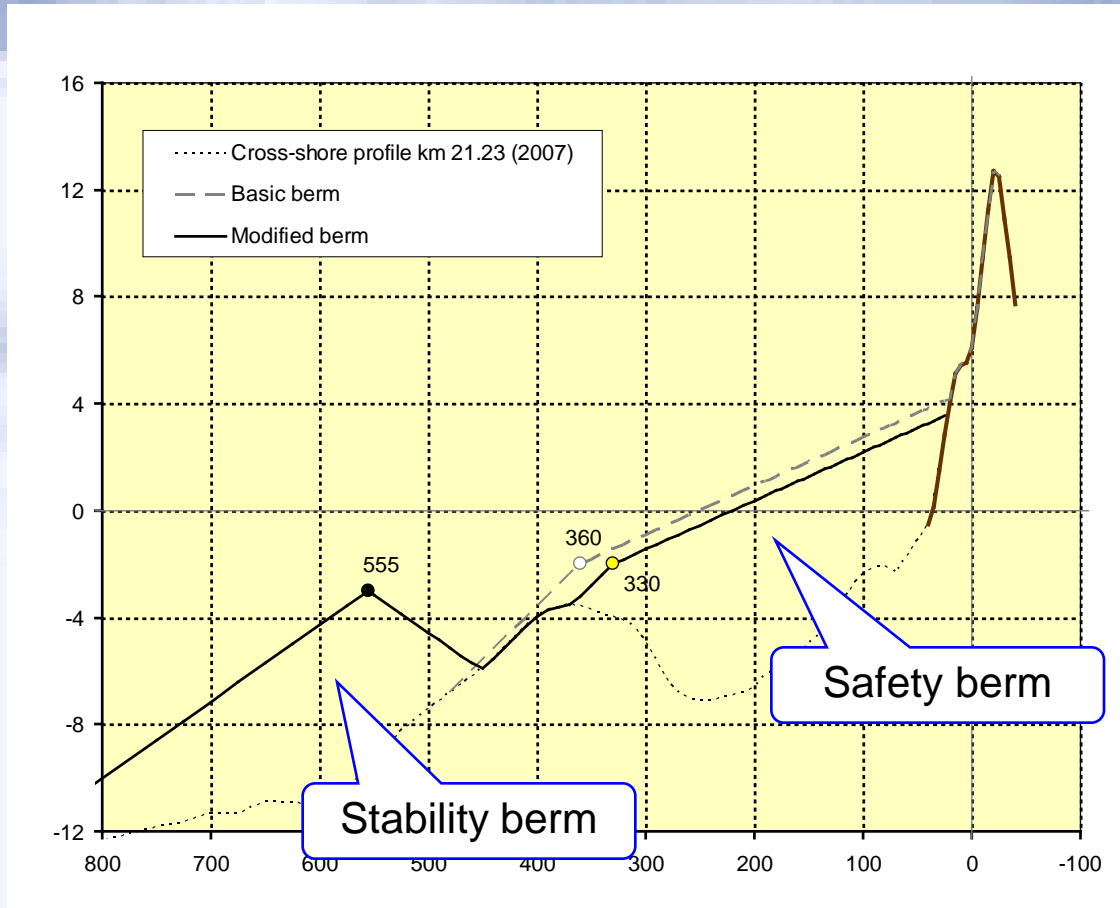
Effect of a safety berm

Wave height reduction as a function of the berm extent



Final conceptual design

Safety berm combined with a stability berm



Characteristics of sandy protection

- Requires no landward activities
- Is 'easy' to install
- Is easy to re-enforce to adjust to future threats
- Provides excellent opportunities for other activities and functions (recreation, nature, ...)



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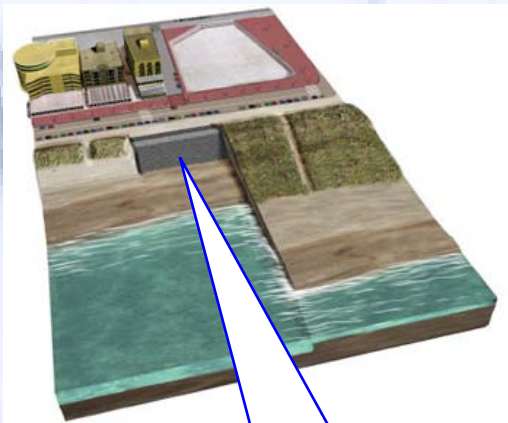
Characteristics of sandy protection (cont.)

- Requires no landward activities
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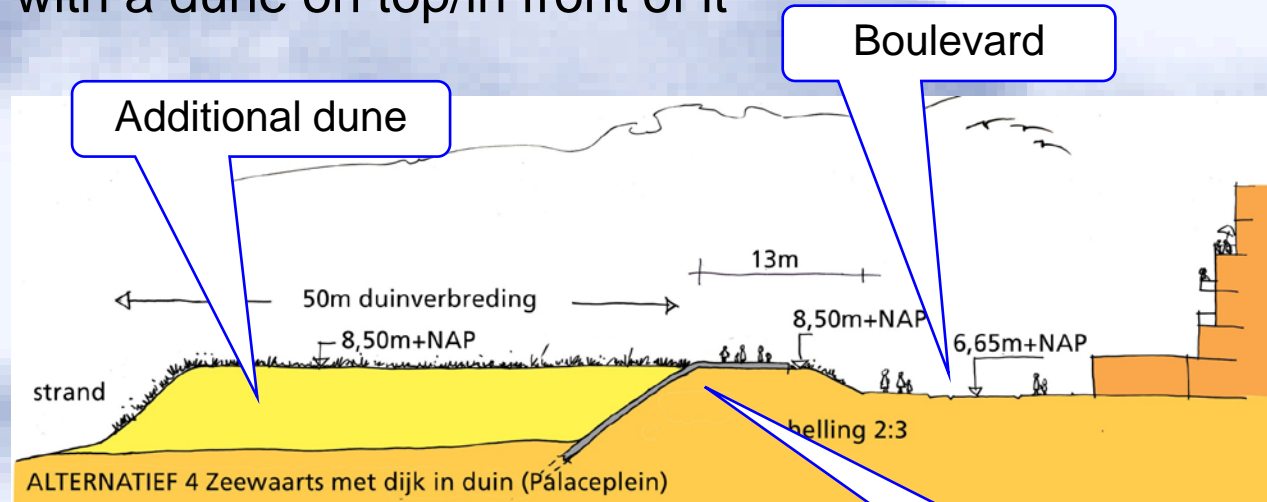


Noordwijk: 'Dike-in-Dune' concept

- A new dike with a dune on top/in front of it



Hidden dike

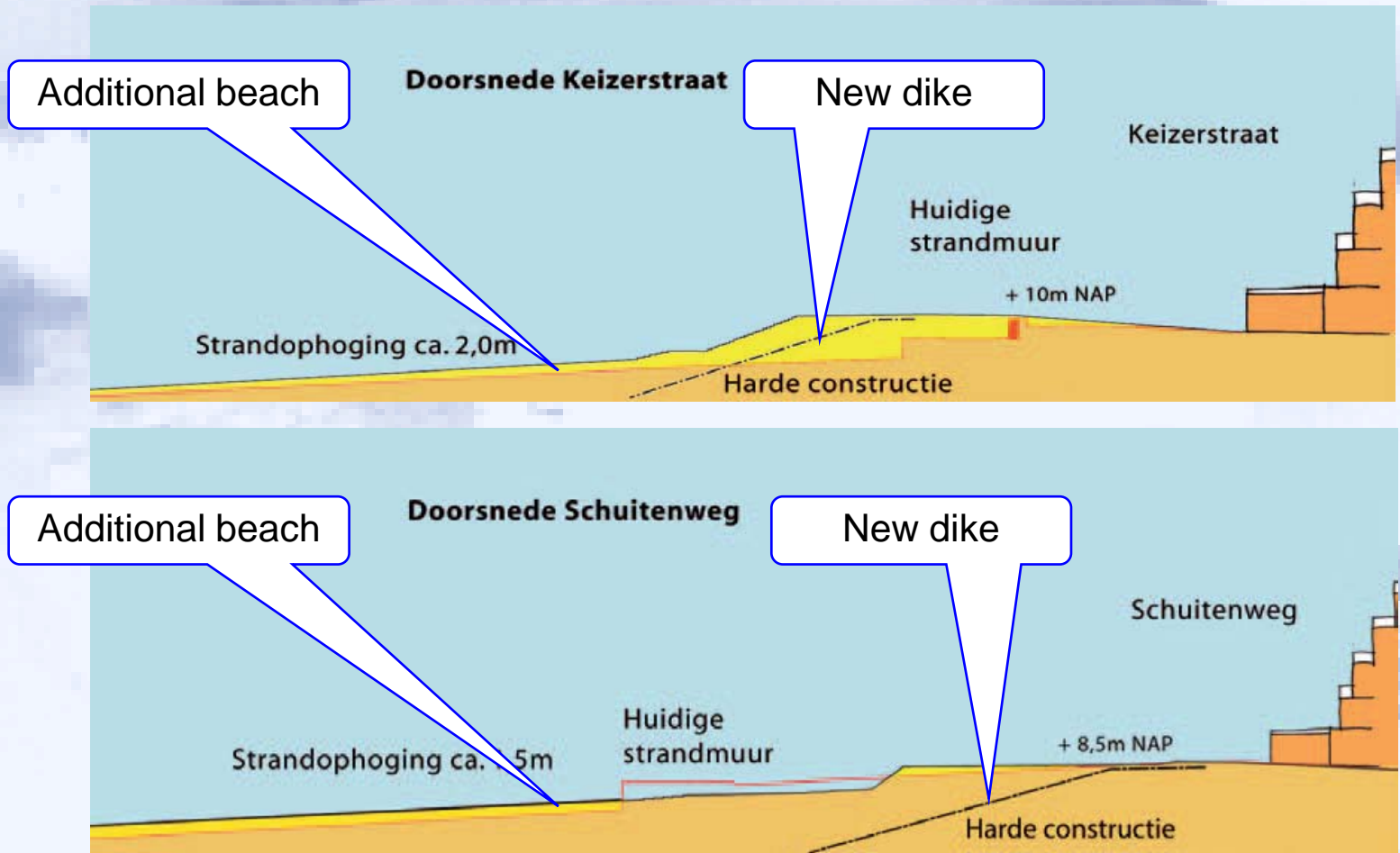


New dike

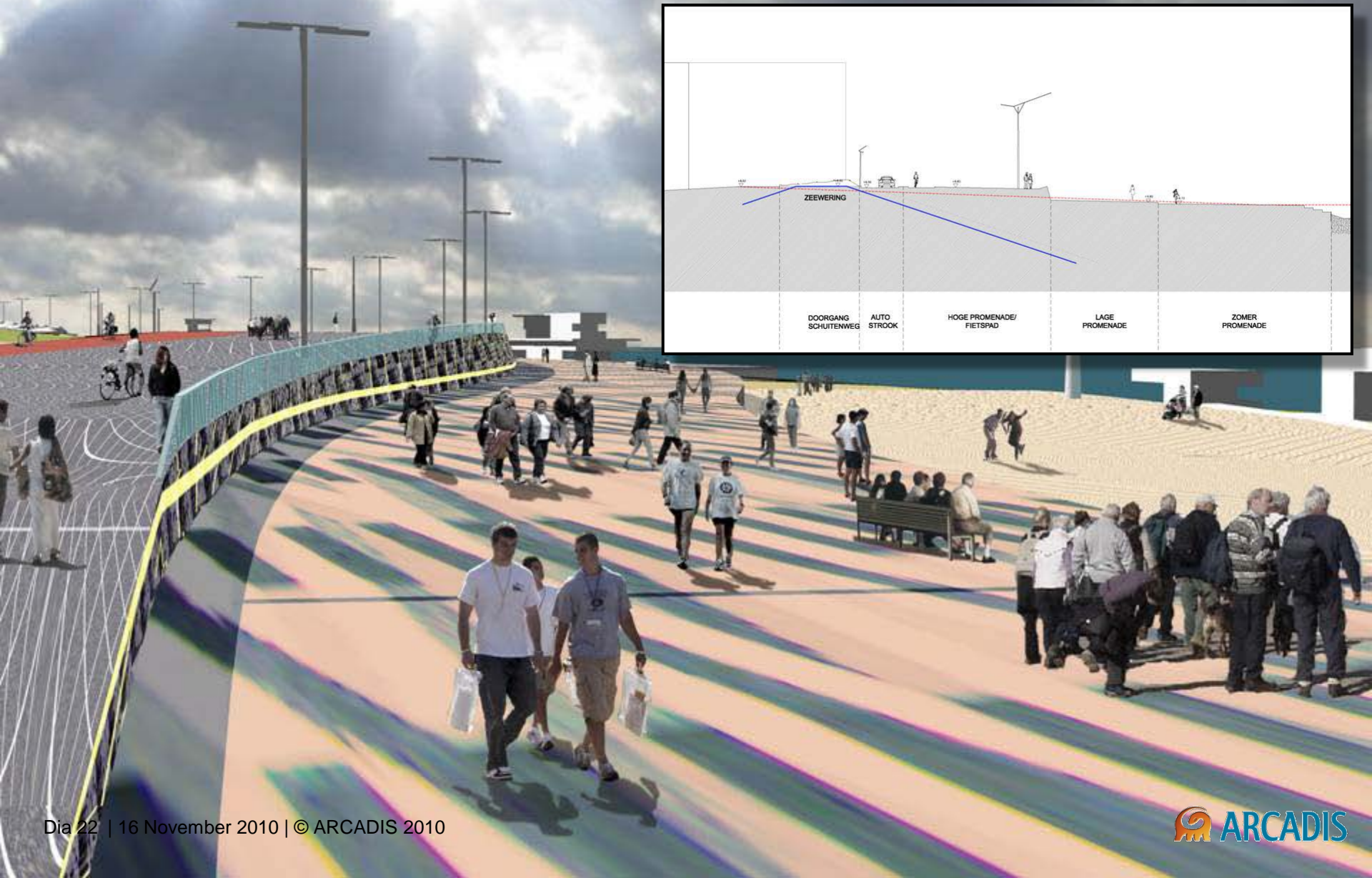


Scheveningen: 'Dike-in-Boulevard' concept

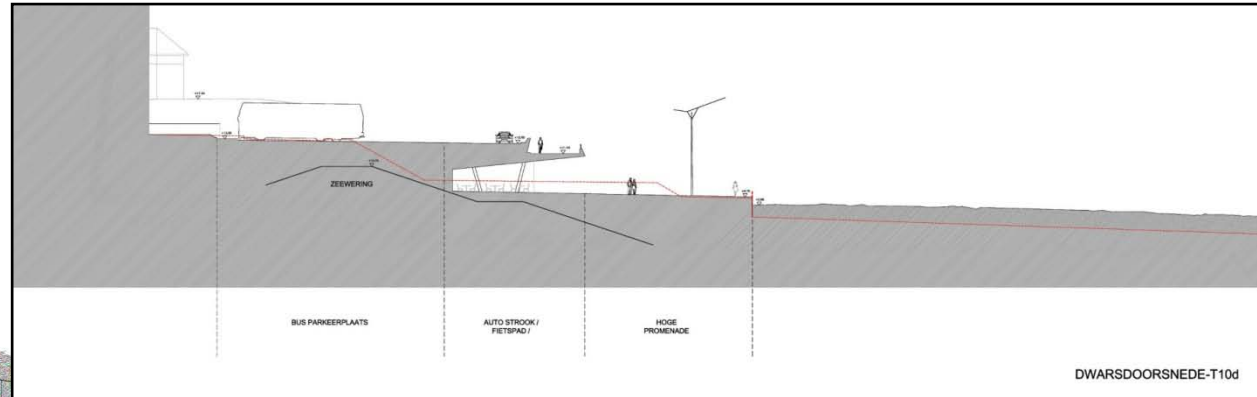
- A hidden dike behind/below an extended beach



Scheveningen: What it will look like



Scheveningen: What it will look like (cont.)



Scheveningen: in progress



Combined/hybrid solutions

In the HPZ-case:

- An existing dike

In the other cases:

- A new build dike
- Covered/fronted by a new dune (Noordwijk)
- Integrated in a new boulevard (Scheveningen)

But always:

- With a protecting beach/dune in front of it
- A combined/mixed defense system

Conclusions

Hybrid constructions yield:

- An eco-engineering approach
- Dynamic, adaptive, pro-active solutions
- A sound way to mitigate (even unforeseen) effects of climate change
(just add some sand)



Imagine the result