Understanding the environmental and social impacts of large-scale offshore solar deployment

We will start at 12:30 CEST

European MARINE BOARD
Advancing Seas & Ocean Science

BAMBOO Brown Bag Lunch, 21 October 2025

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Understanding the environmental and social impacts of large-scale offshore solar deployment

Sheila Heymans

BAMBOO Brown Bag Lunch, 21 October 2025

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Who is EMB?

The European Marine Board (EMB) bridge the gap between science and policy by providing high-quality advice

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Event agenda

Time	Item	Speaker
11:30 - 12:30	Lunch (in-person only)	
12:30 - 12:35	Opening welcome	Sheila Heymans (EMB)
12:35 - 12:50	Presentation on potential natural impacts and benefits	Pedro Vinagre (WavEC, Portugal)
12:50 - 13:05	Presentation on potential social impacts and benefits	Gerdien de Vries (TU Delft, Netherlands)
13:05 - 14:25	Interactive discussion (in-person only)	All Moderator: Sheila Heymans (EMB)
14:25 – 14:30	Closing words	Sheila Heymans (EMB)

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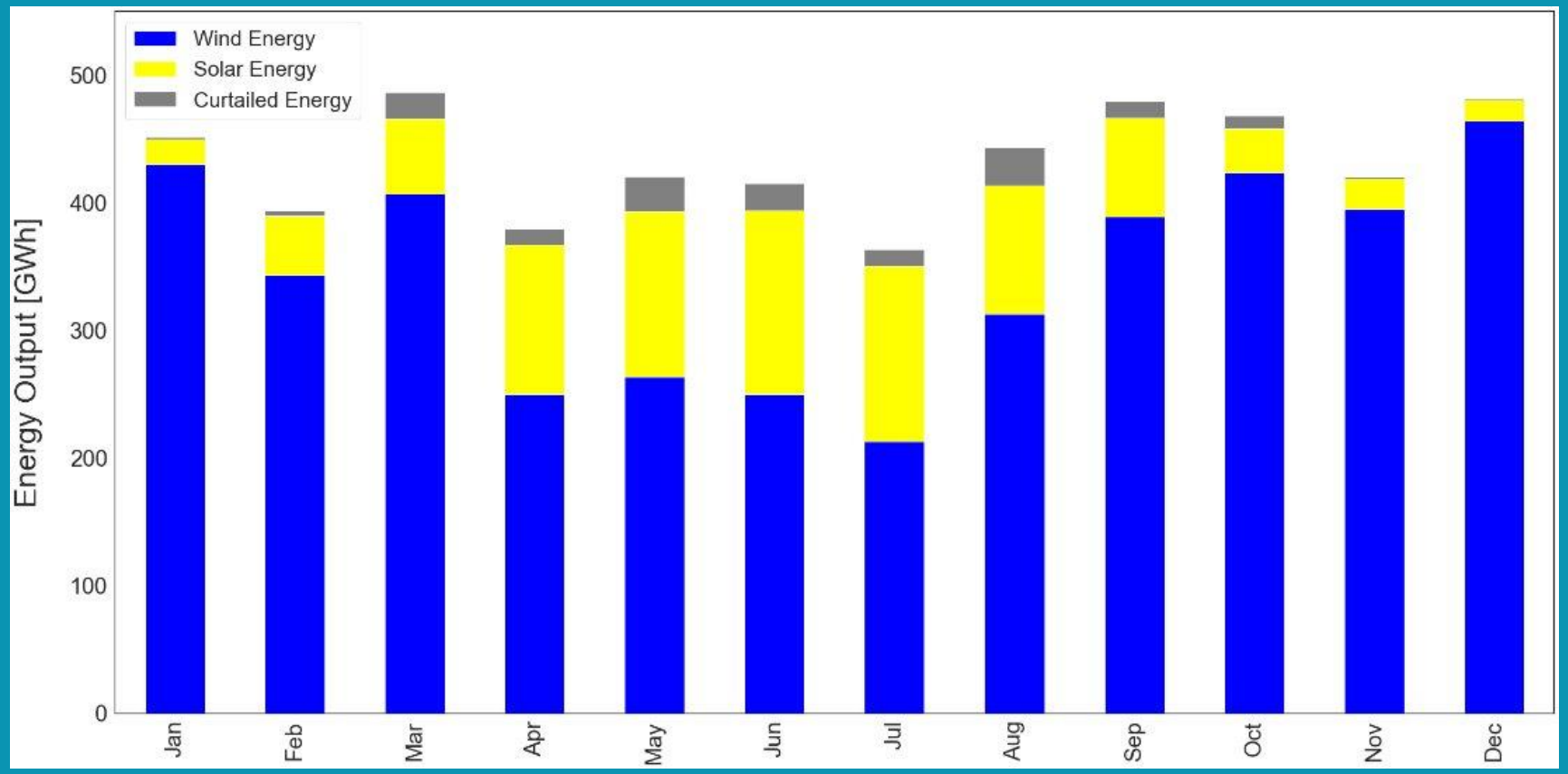
BAMBOO Project Details

Project Contractual Details	
Project Acronym	BAMBOO
Project Name	Build scAled Modular Bamboo-inspired Offshore sOlar systems
Project No.	101136142
Call	HORIZON-CL5-2023-D3-01
Topic	HORIZON-CL5-2023-D3-01-03
Type of Action	HORIZON Innovation Action
Project Coordinator	RINA Consulting S.p.A.
Project Start Date	January 1, 2024
Project End Date	December 31, 2026
Granting authority	European Climate, Infrastructure and Environment Executive Agency (CINEA)

BAMBOO's vision is to **enable Europe's approach to offshore renewable energy** by developing a **groundbreaking offshore solar system spanning 1km²** with an installed capacity of 50-200 MW **that fits in-between 4 offshore wind turbines and has a complementary generation profile**

Complementarity



NL Simulation based on OOE-OSI1 Model for North Sea

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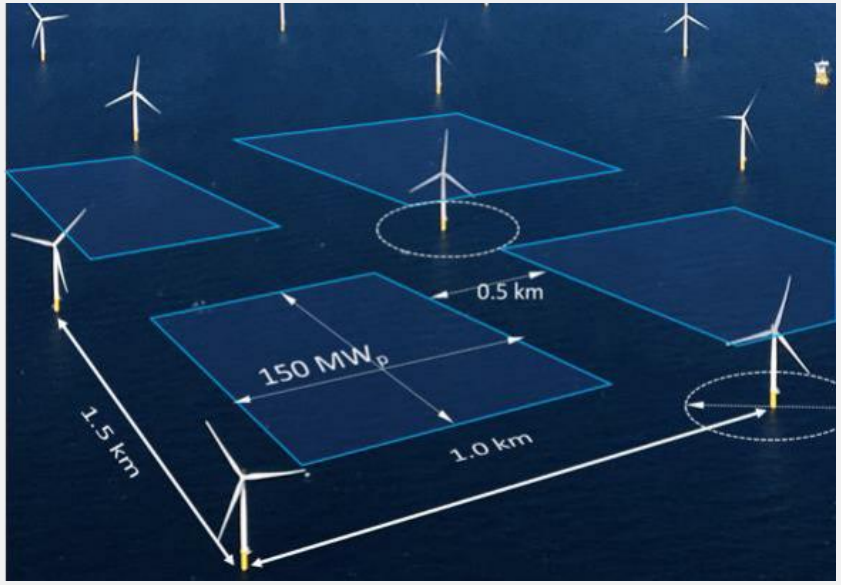
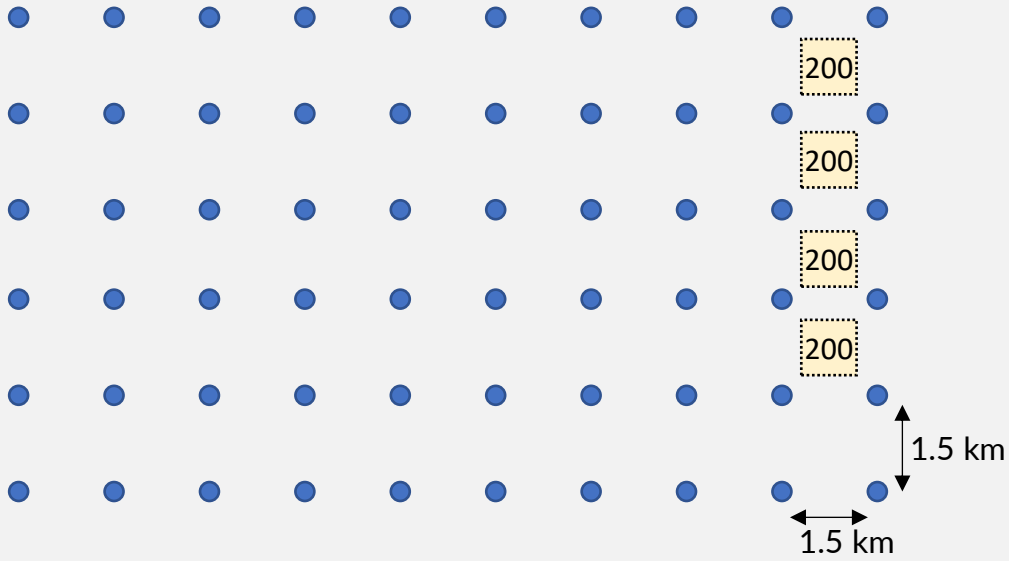
Project ambition

To **tackle the challenges and barriers** for the **implementation of a sustainable, large-scale offshore solar system of 1km² (50-200 MW)** that will act as an **Industry Standard for the rollout of offshore solar projects worldwide**



1:1 power integration of solar requires 3% of wind farm space



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Context for this discussion

Subject Matter Expert Workshop held in April 2025

- ❑ participants from a range of **natural and social science** backgrounds and countries
- ❑ wide-ranging discussions on potential **positive and negative** impacts and benefits
- ❑ consideration of impacts from **large- and small-scale** deployments, including with wind
- ❑ consideration of European **sea basin** differences

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Meet the speakers

Dr Pedro Vinagre

- Marine ecologist at WavEC, Portugal
- Extensive expertise in EIA and environmental monitoring, especially for offshore projects
- Active in expert groups such as with ICES and GESAMP

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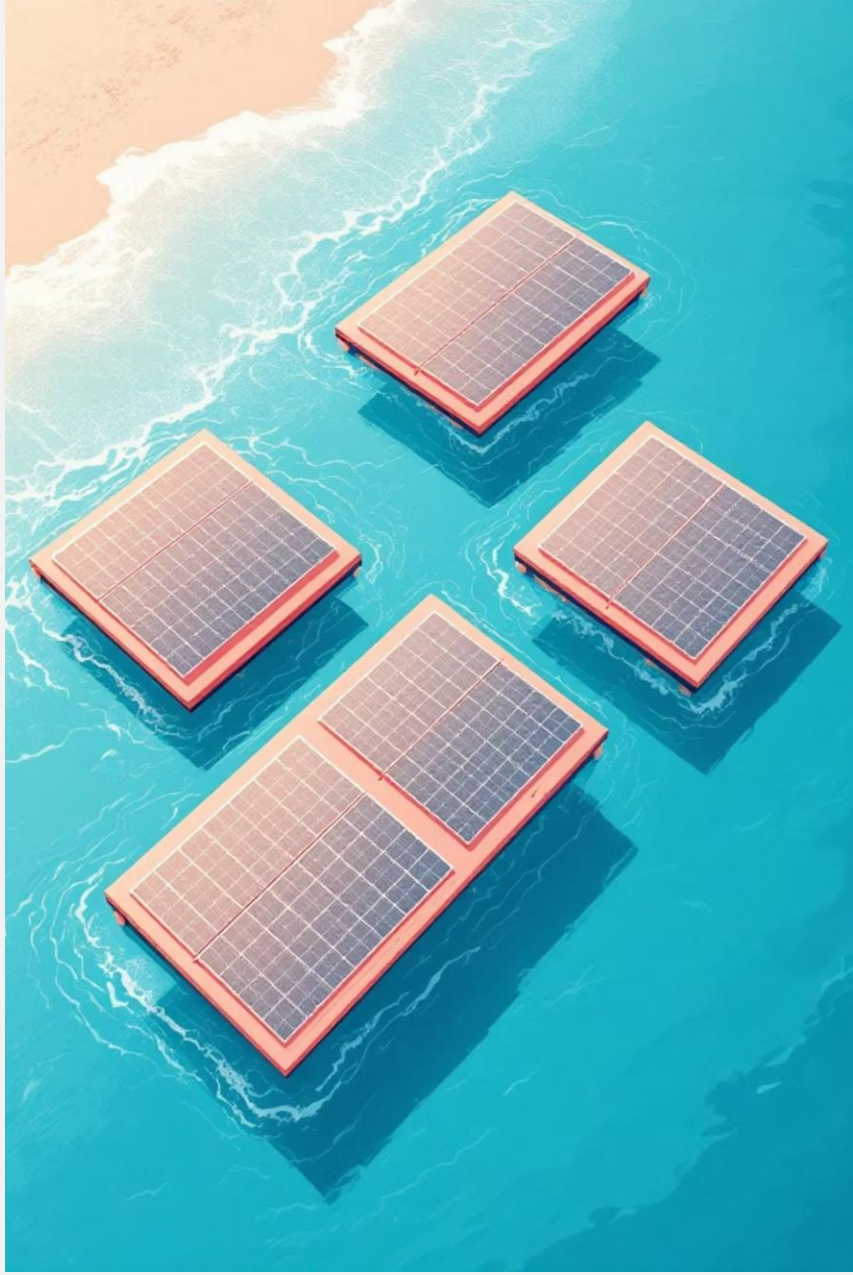
Environmental Impacts of Offshore Solar

Understanding the dual nature of environmental effects at demonstration and large-scale deployment



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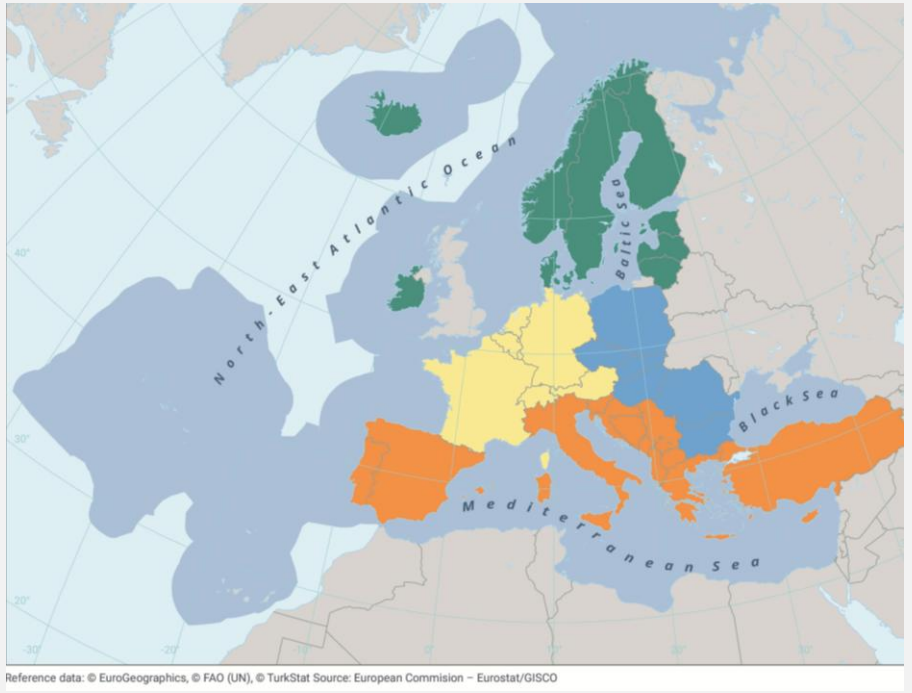
Understanding impacts

Potential impacts are very context specific:

- location / sea-basin
- size and nature of the installation
- local natural and social contexts
- presence of migration route or biologically sensitive areas



Generalisation is not possible
Impacts can be both **positive and/or negative**, depending on this **context**
Impacts can also **combine** in various ways (e.g. cumulative, synergistic, antagonistic)

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Some examples

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Air–Sea Interaction & Water Quality

Negative Impacts

- Reduced mixing due to shading/wind blocking
- Reduced light penetration decreases phytoplankton productivity under arrays
- Altered oxygen, chlorophyll, nutrient availability
- Potential impacts on food web base

Positive Impacts

- Reduced seawater warming and evaporation
- Reduced algal bloom formation, including toxic species

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Hydrodynamics & Sediments

Negative Impacts

- Altered hydrodynamic properties affect local currents
- Reduced mixing can affect circulation & stratification
- Altered thermohaline gradients, salinity & density patterns
- Altered sediment transport patterns

Positive Impacts

- Wave damping: Protection for sensitive coastal areas and infrastructure
- Wave damping: Potential reduction of coastal erosion
- Wave damping: benefits for co-located offshore wind, aquaculture, etc.

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Marine Ecosystem & Biodiversity Changes

Negative Impacts

- Unknown food web alterations at large scale
- Potential spread of non-native species via structures
- Risk of invasive species using platforms as stepping-stones
- Changes to predation patterns in shaded areas

Positive Impacts

- Artificial reef effect attracting mobile fauna
- Increased hard substrate for colonization
- *De facto* marine protected area (no trawling)
- Enhanced fish stocks through reserve effect

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Birds & Mammals Interactions: Risks & Opportunities

Collision & Barrier Effects

Mirror/glare effect of panels may confuse birds. Structures may create barriers to migration routes and reduce feeding grounds.

Resting Habitat Provision

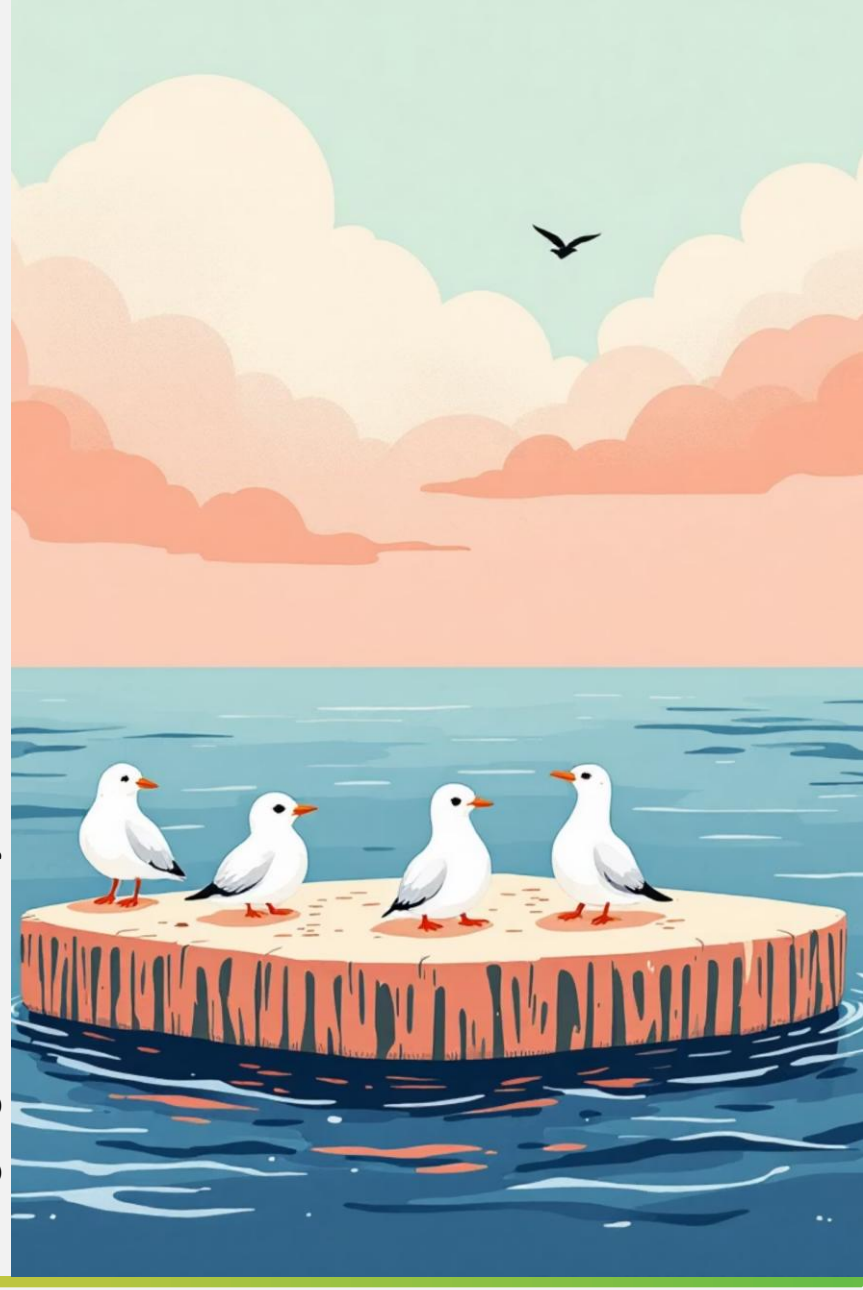
Platforms provide additional resting places, potentially counteracting coastal habitat loss from sea level rise and human activities.

Attraction to Hazardous Areas

Aggregation of prey may attract birds/mammals to areas with collision risks (especially when combined with wind turbines).

Enhanced Feeding Opportunities

Prey aggregation (as consequence of shaded/protect habitat and artificial reef effects) could enhance feeding opportunities.



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Priority Research & Monitoring Needs

01

Food Web Dynamics

Understand large-scale food web changes across different sea-basins, including ecosystem service impacts and effects on human food chains

02

Wave Attenuation Benefits

Quantify damping effects for different designs and potential protection benefits for wind turbines, aquaculture, and coastlines

03

Ecosystem Carrying Capacity

Determine tipping points at sea-basin scale and contextualize cumulative impacts within climate change scenarios

04

Baseline & Long-term Monitoring

Maximize monitoring at pilot sites to understand incremental effects, even if small-scale impacts differ from large-scale expectations

05

Adaptive Management Frameworks

Develop flexible approaches that adapt to evolving knowledge, changing sea-user interactions, and climate-driven environmental changes

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General considerations

- **More research is needed to understand impacts**
  - Particularly **cumulative impacts** and of **large-scale deployments**
  - Important to **consider synergies** with other sectors to **explore co-benefits, reduce trade-offs** and **ensure policy coherence**

- **Context matters**
  - Environmental impacts must be considered within wider sea-basin context and **weighed against climate change consequences of inaction**.

- **Implications to future large-scale projects**
  - Maximise and optimise opportunities for **data gathering, monitoring, and sharing** to increase understanding about impacts
  - Explore and address implications for **existing requirements** such as **EIA**

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Thank you!

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Meet the speakers

Dr Gerdien de Vries

Associate Professor in Climate Psychology
Delft University of Technology, Netherlands
Faculty of Technology, Policy and Management
Multi-Actor Systems Department

Extensive research on human responses to climate change and participation in the energy transition

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Climate Psychology

Approaches climate and energy-related issues with psychological perspectives, theories, and methods.

It goes beyond the study of behaviour: it acknowledges the human subject and its rich intrapersonal life as nested within their social and ecological context.

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Relevance

Equity and Inclusion

C.5 Prioritising equity, climate justice, social justice, inclusion and just transition processes can enable adaptation and ambitious mitigation actions and climate resilient development. Adaptation outcomes are enhanced by increased support to regions and people with the highest vulnerability to climatic hazards. Integrating climate adaptation into social protection programs improves resilience. Many options are available for reducing emission-intensive consumption, including through behavioural and lifestyle changes, with co-benefits for societal well-being. (*high confidence*) {4.4, 4.5}

IPCC AR6 Report, WG III, Chapter 5

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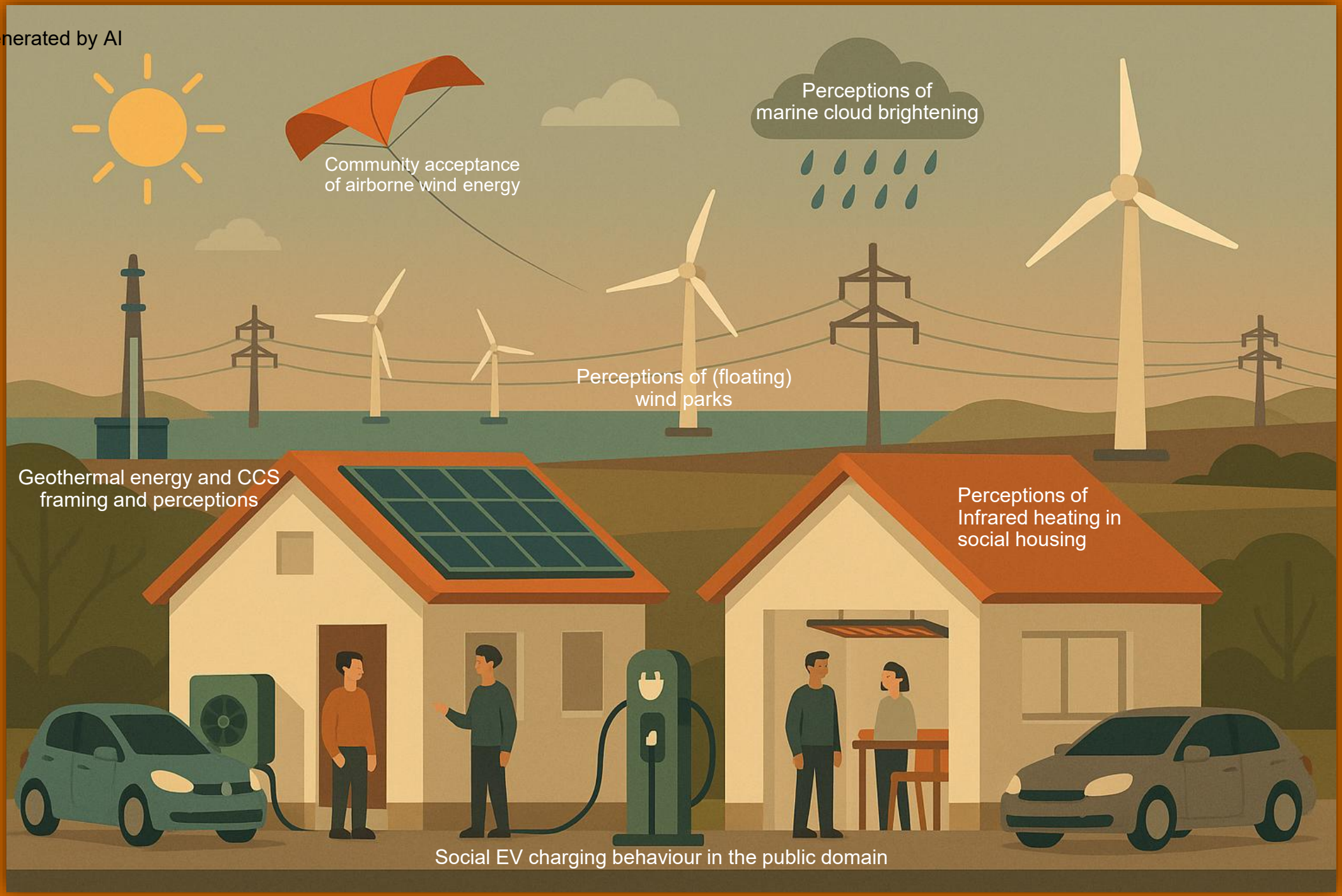

Social Scientific Research

- Starts with Behavioural Analysis
- What type of behaviour is of interest?
- Often: social acceptance of general public, but there is more!
- Decision-making, investing, using, voting etcetera
- Psychologists are very specific in defining behaviour

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Social Acceptance

- It is often not about the **technology**
- But about the **process**….
- And opponents and proponents can be loud
- Do not forget the **silent middle**

de Vries, G. (2017). How positive framing may fuel opposition to low-carbon technologies: The boomerang model. *Journal of Language and Social Psychology*, *36*(1), 28-44.

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Determinants of Behaviour

We differentiate between psychological and contextual factors

Psychological (intra-personal processes)

- Examples: experience, expectations, self-efficacy, trust, perceived hassle

Contextual (processes between person and environment)

- Examples: Economic, institutional, geographical and technological factors
- Not to forget: interpersonal processes such as culture, cohesion and communication (e.g. participation, engagement)

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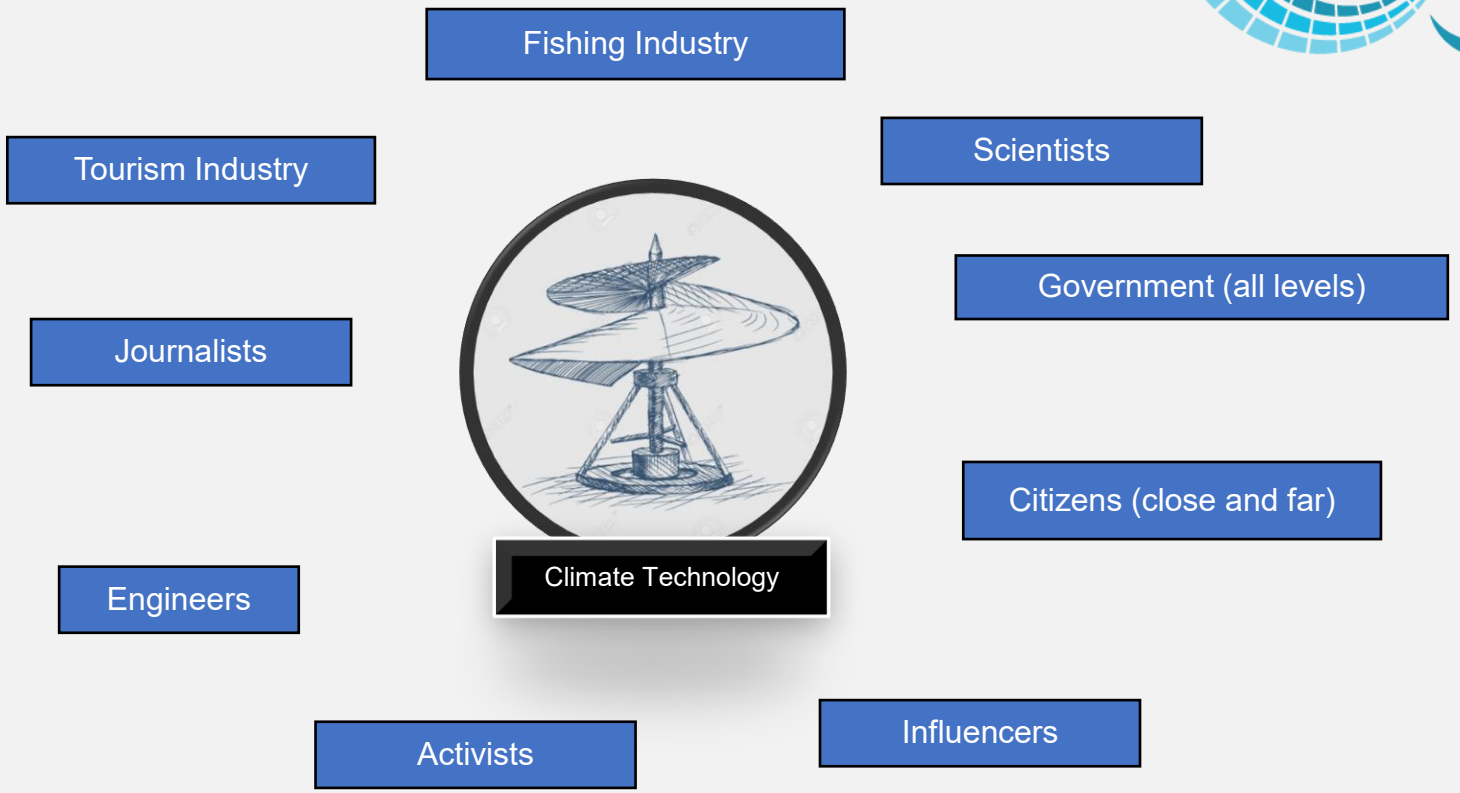
Communication

- Concise
- Clear
- Balanced (pro's and cons)
- Timely
- Multiple sources
- Engage and interact
- Involve everybody

De Vries, G. (2020). Public communication as a tool to implement environmental policies. *Social Issues and Policy Review*, *14*(1), 244-272..

Whose behaviour?

- Multiple stakeholders
- Multiple interests
- Variety of power
- Micro decisions
- Macro effects



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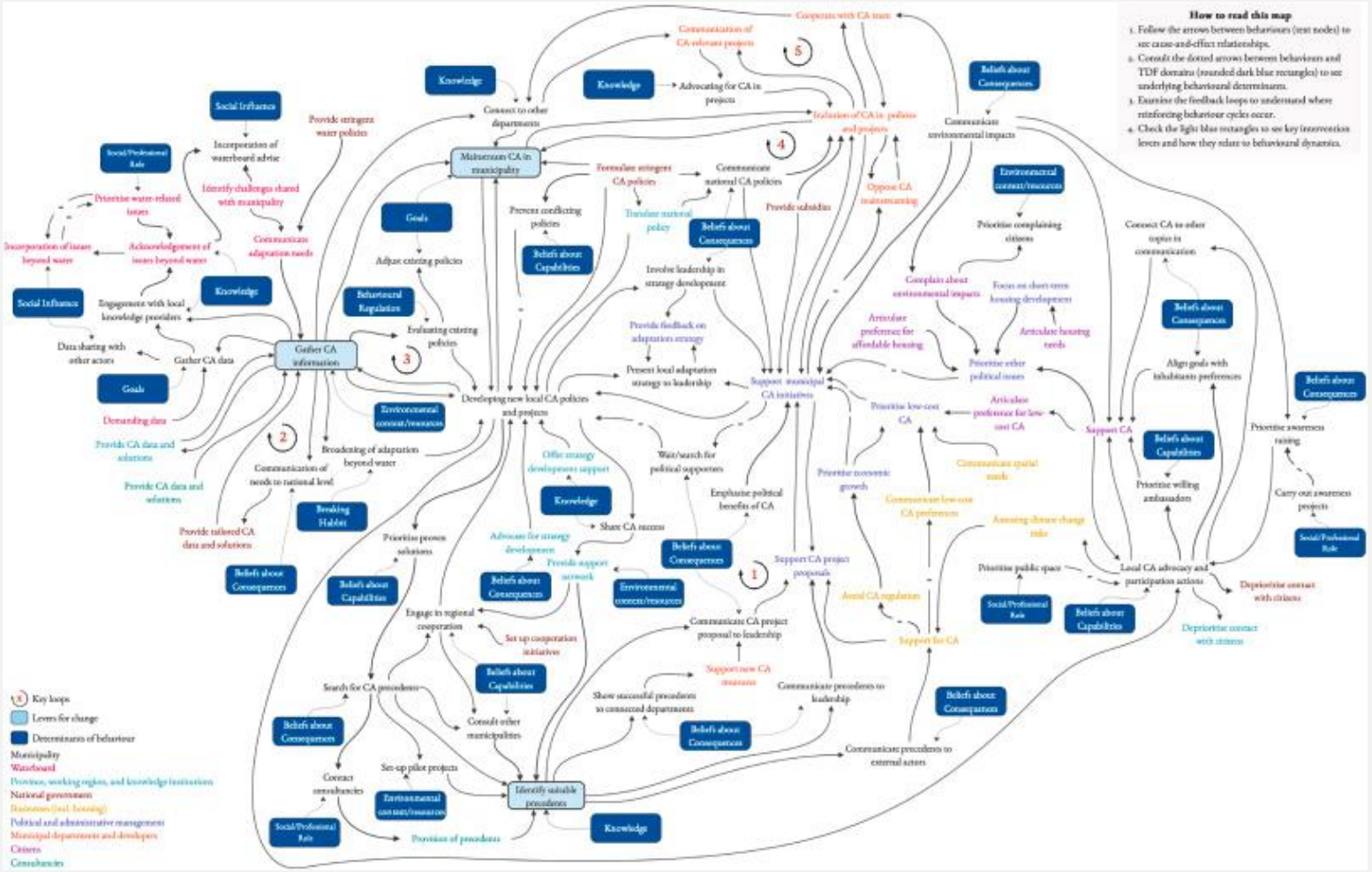
Combine behaviours in a map



Bellmann, K. P., de Vries, G., & Scholten, L. (2025). Understanding slow progress on urban climate adaptation: An empirical analysis of behavioural dynamics in Dutch policymaking. *Journal of Environmental Psychology*, *105*(10266), 6.

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Behaviour Change

- What are the levers?
- Whose behaviour? Others? Your own?
- How?
- What is under your control?
- What type interventions suit?
- Do you have the skills and time to intervene yourself?

"What if we don't change at all ...
and something magical just happens?"

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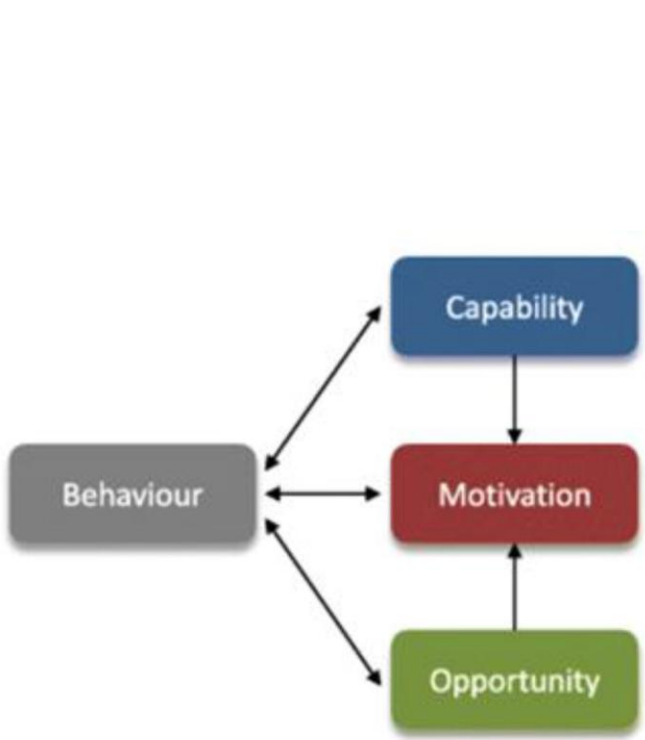
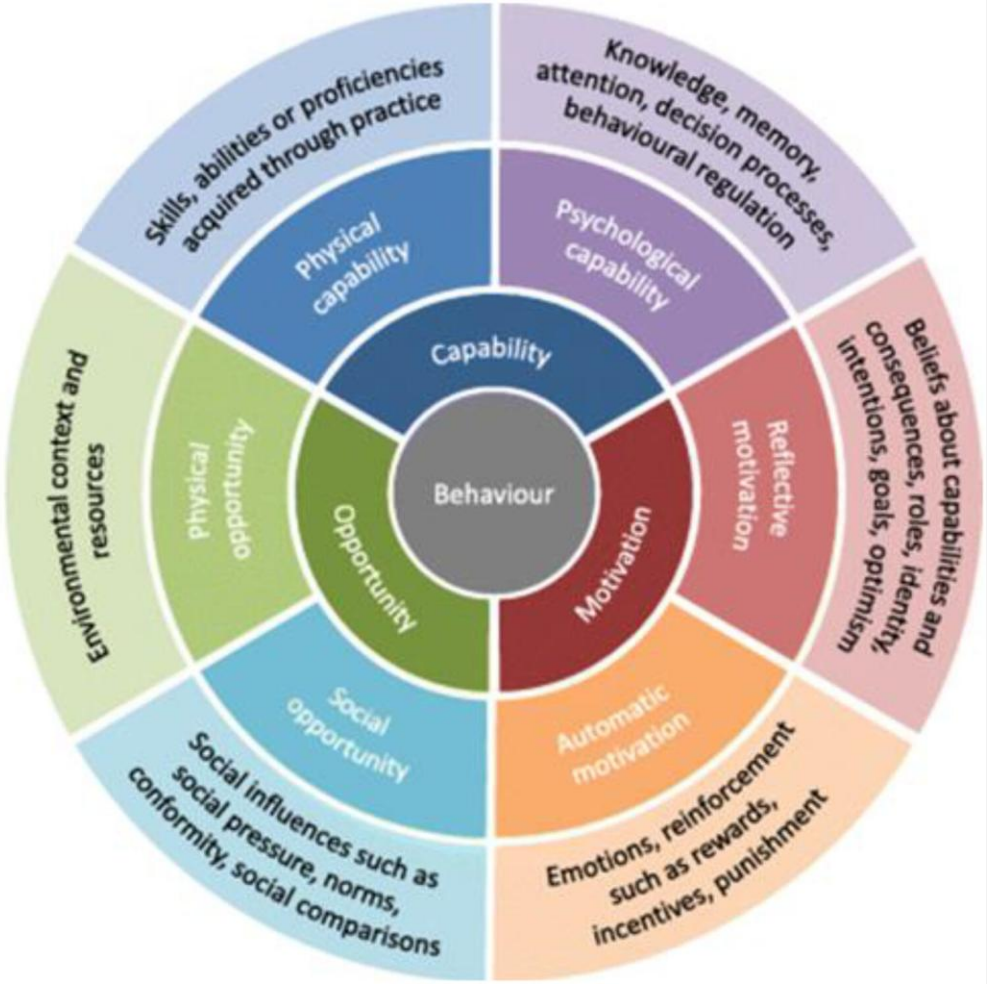
Method to use: Behaviour Change Wheel





Michie, S., Atkins, L., & West, R. (2014). The behaviour change wheel. *A guide to designing interventions*, *1*, 1003-1010.

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science*, *6*(1), 42.

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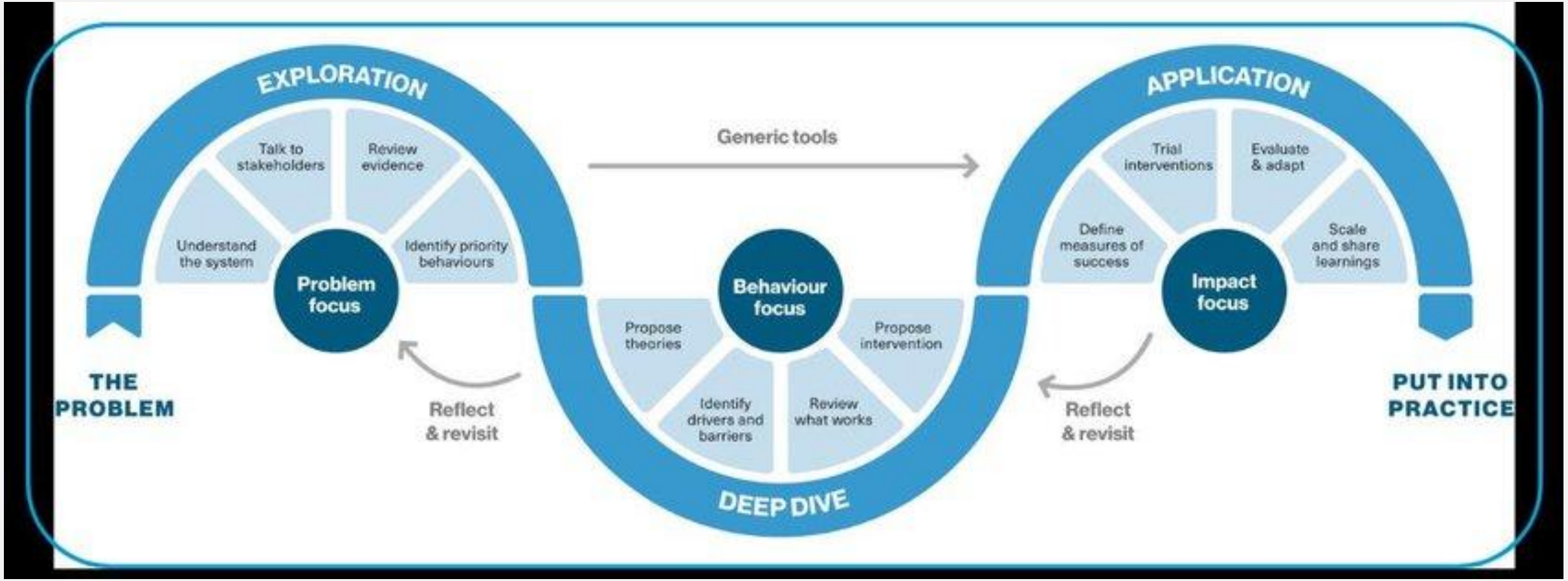
Method to use: Behaviour Works Method



https://www.behaviourworksaustralia.org/about/the-method

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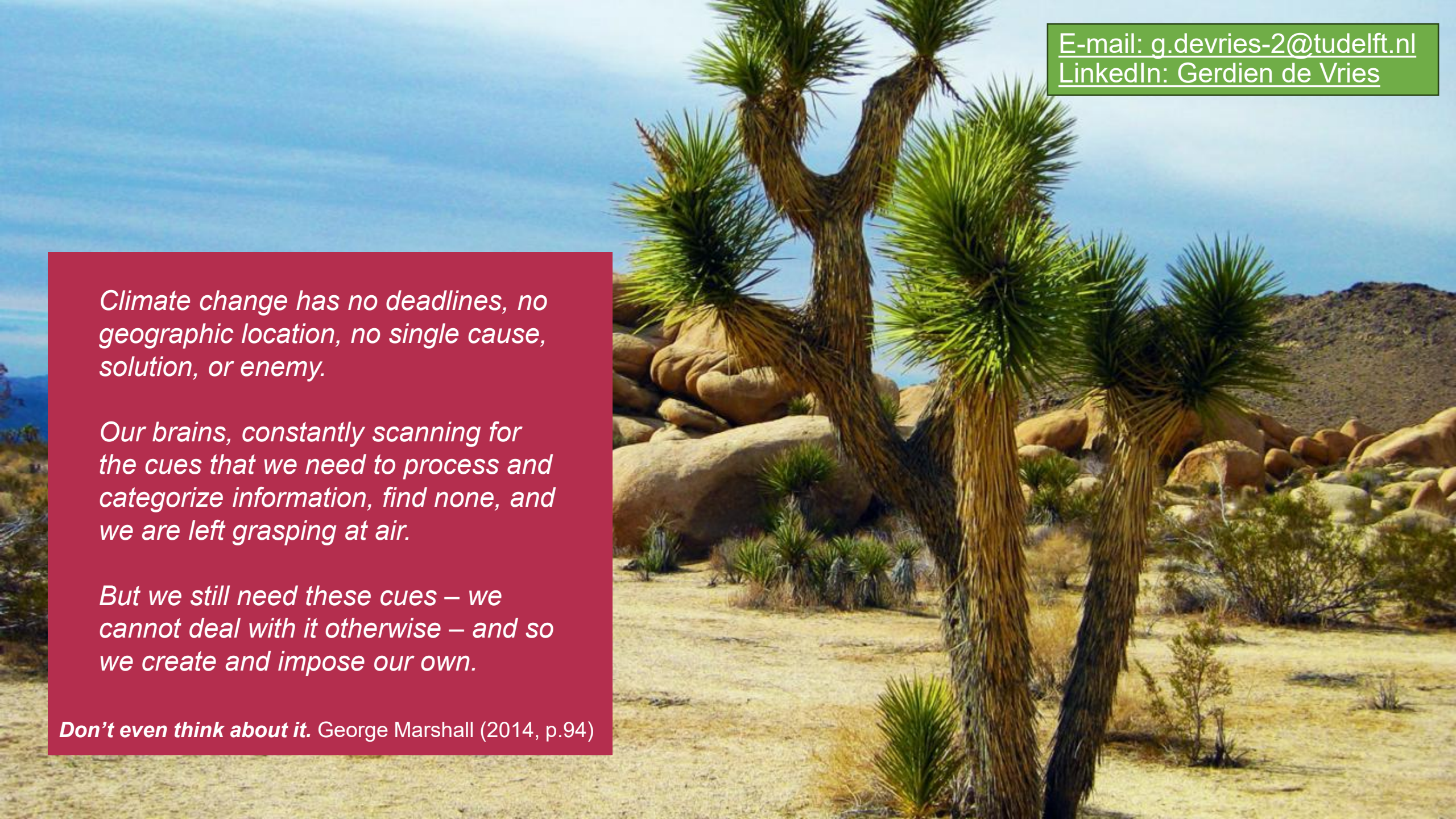
E-mail: g.devries-2@tudelft.nl
LinkedIn: Gerdien de Vries



Climate change has no deadlines, no geographic location, no single cause, solution, or enemy.

Our brains, constantly scanning for the cues that we need to process and categorize information, find none, and we are left grasping at air.

But we still need these cues – we cannot deal with it otherwise – and so we create and impose our own.

Don't even think about it. George Marshall (2014, p.94)