

Factors affecting the uptake of climate engineering and maritime decarbonization: insights from consumer research

Prof. Malcolm Wright

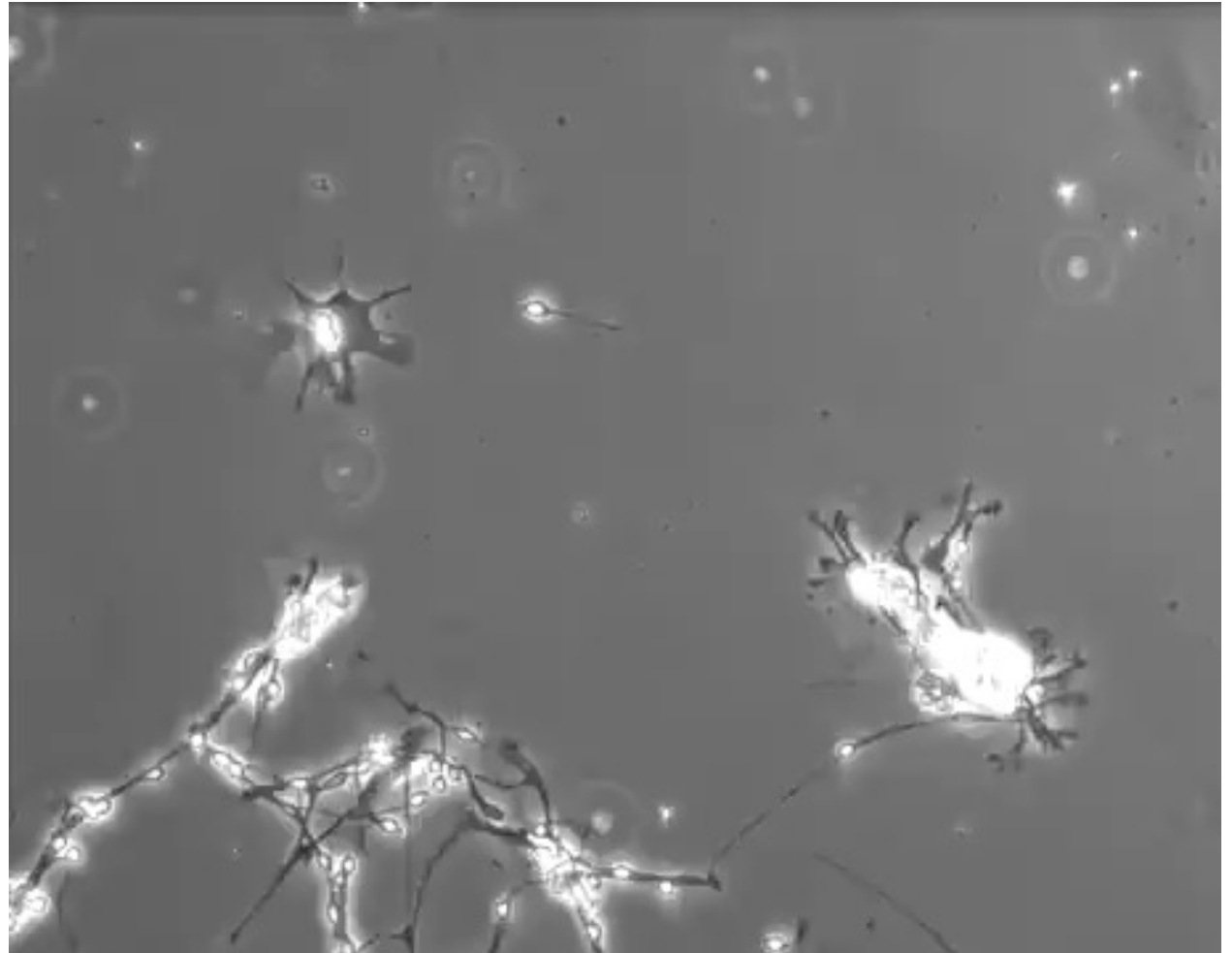
MSA Charitable Trust Chair in Marketing

Massey University



Why draw on consumer research?

<https://gfycat.com/elatedfrightenedasiansmallclawedotter>



A quantitative evaluation of the public response to climate engineering

“Atmospheric greenhouse gas concentrations continue to increase . To avoid severe climate change and the attendant economic and social dislocation, existing energy efficiency and emissions control initiatives may need support from some form of climate engineering.

As climate engineering will be controversial, **there is a pressing need to inform the public and understand their concerns before policy decisions are taken ...”**



	Initial Study (2012)	Follow up (2018)
Qualitative Phase	n = 30	n = 15
Quantitative Phase	n = 2028	n = 2989
Countries Surveyed	Australia, New Zealand	Australia, NZ, USA, UK
Methods Evaluated	Biochar, Enhanced Weathering, Air Capture, Stratospheric Aerosols, Cloud Brightening, Mirrors in Space	Substituted Bioenergy with Carbon Capture and Storage (BECCS) for Biochar
Quantitative method	Participants viewed concept boards with an image and concept description, inclusive of advantages and disadvantages, then picked any attributes they associated with that concept	Same method, updated materials
Reference	Wright, M. J., Teagle, D. A., & Feetham, P. M. (2014). A quantitative evaluation of the public response to climate engineering. <i>Nature Climate Change</i> , 4(2), 106-110.	Carlisle, D. P., Feetham, P. M., Wright, M. J., & Teagle, D. A. (2020). The public remain uninformed and wary of climate engineering. <i>Climatic Change</i> , 160(2), 303-322.



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Enhanced weathering involves increasing the rate that carbon dioxide dissolves minerals to form limestone. This can be achieved through greater exposure to the atmosphere, fine grinding or heating of the minerals, and could be applied to volcanic ash, sand or mine tailings. The resulting limestone traps the carbon dioxide for thousands of years. Enhanced weathering can be implemented locally, increased gradually, and stopped at any time. It could take decades to lower global temperatures. It will produce large amounts of limestone and could use a lot of water. It has similar environmental impacts to mining.

Which of the descriptions in the list below do you think applies to Enhanced weathering?

Please select as many as apply.

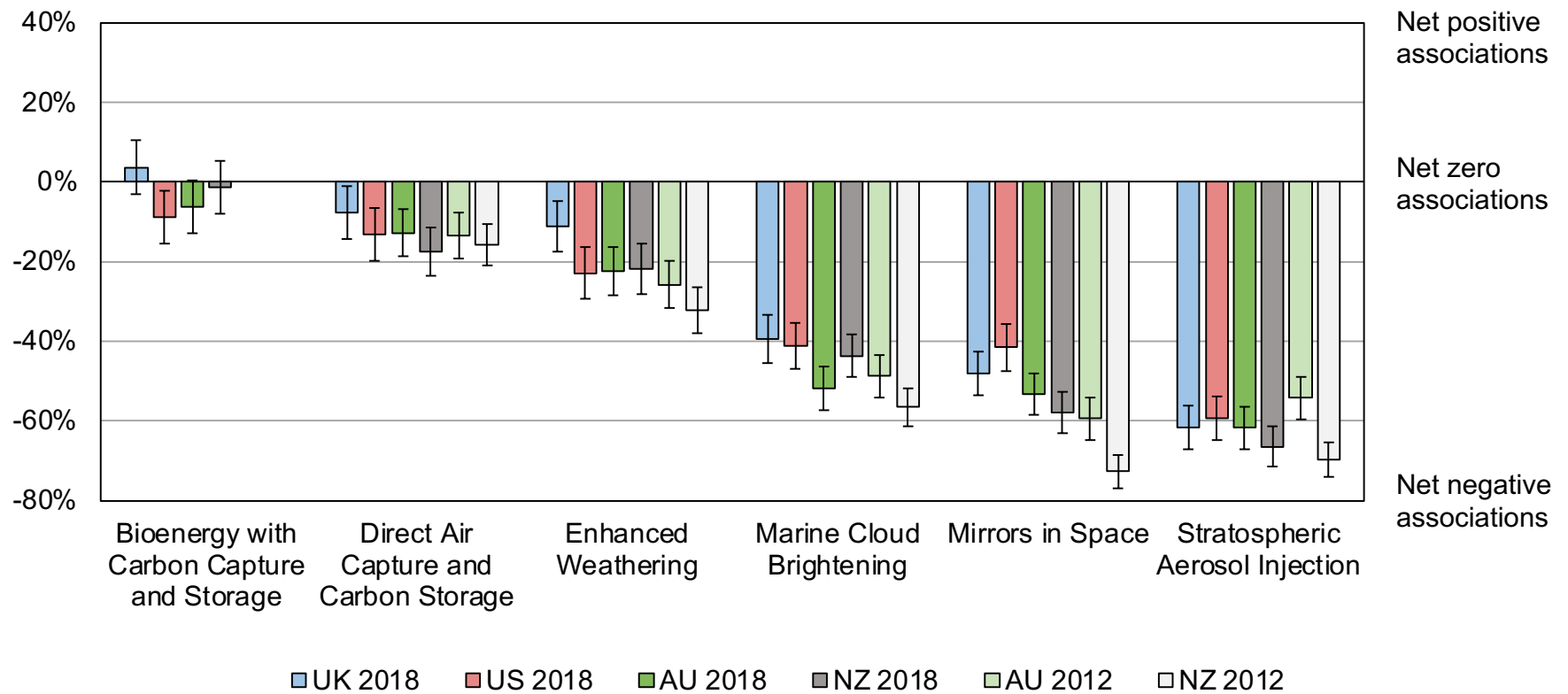
Risky
Understandable
Cost effective
Artificial
Unpredictable
Long-term sustainability

Environmentally friendly
Quick-fix
Eyesore
Beneficial
Controllable
Unknown effects

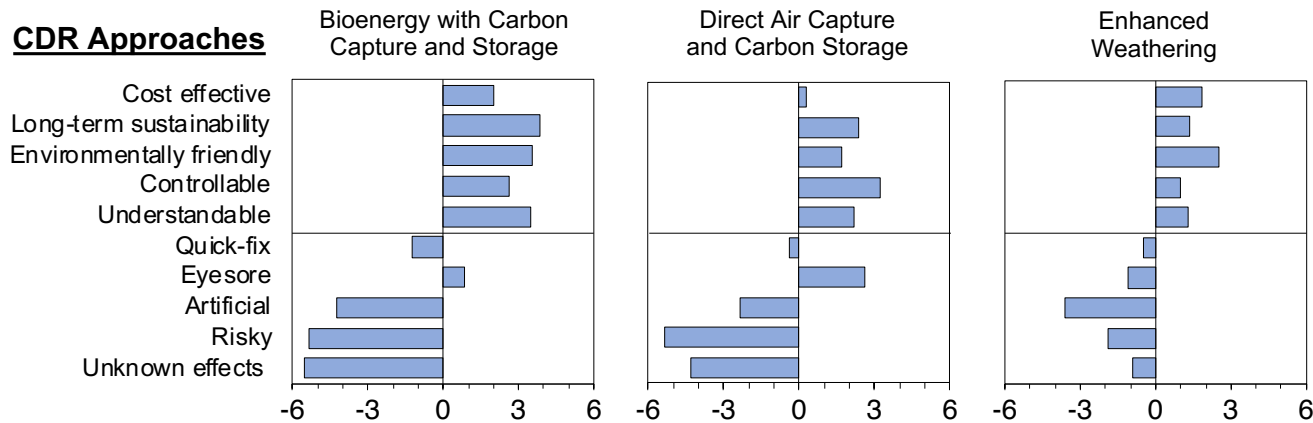
Negative attributes predominated over positive attributes for climate engineering

Rank	Attribute	UK 2018	US 2018	AU 2018	NZ 2018	AU 2012	NZ 2012
1	Unknown effects	22	24	24	24	24	25
2	Risky	17	19	19	18	16	16
3	Artificial	13	12	13	14	12	13
4	Understandable	9	7	7	8	8	7
5	Environmentally friendly	8	8	8	7	8	9
6	Controllable	8	7	7	7	7	8
7	Long-term sustainability	7	7	7	7	7	7
8	Quick-fix	6	6	6	6	7	6
9	Eyesore	5	5	5	6	6	6
10	Cost effective	5	5	5	4	5	3

Net positive memory associations showed respondents preferred CDR to SRM

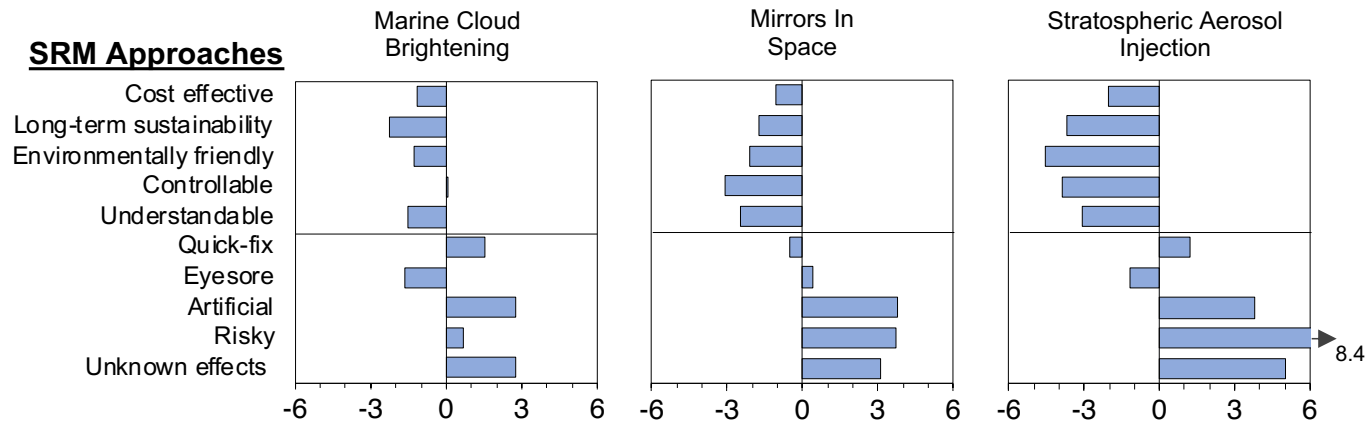


CDR Approaches



**Concept
maps
explained
the results
(UK shown)**

SRM Approaches





Let's apply these approaches to alternative marine fuels for decarbonizing the shipping industry

Survey n = 992 UK respondents. Data gathered
September 2020 using the Dynata panel

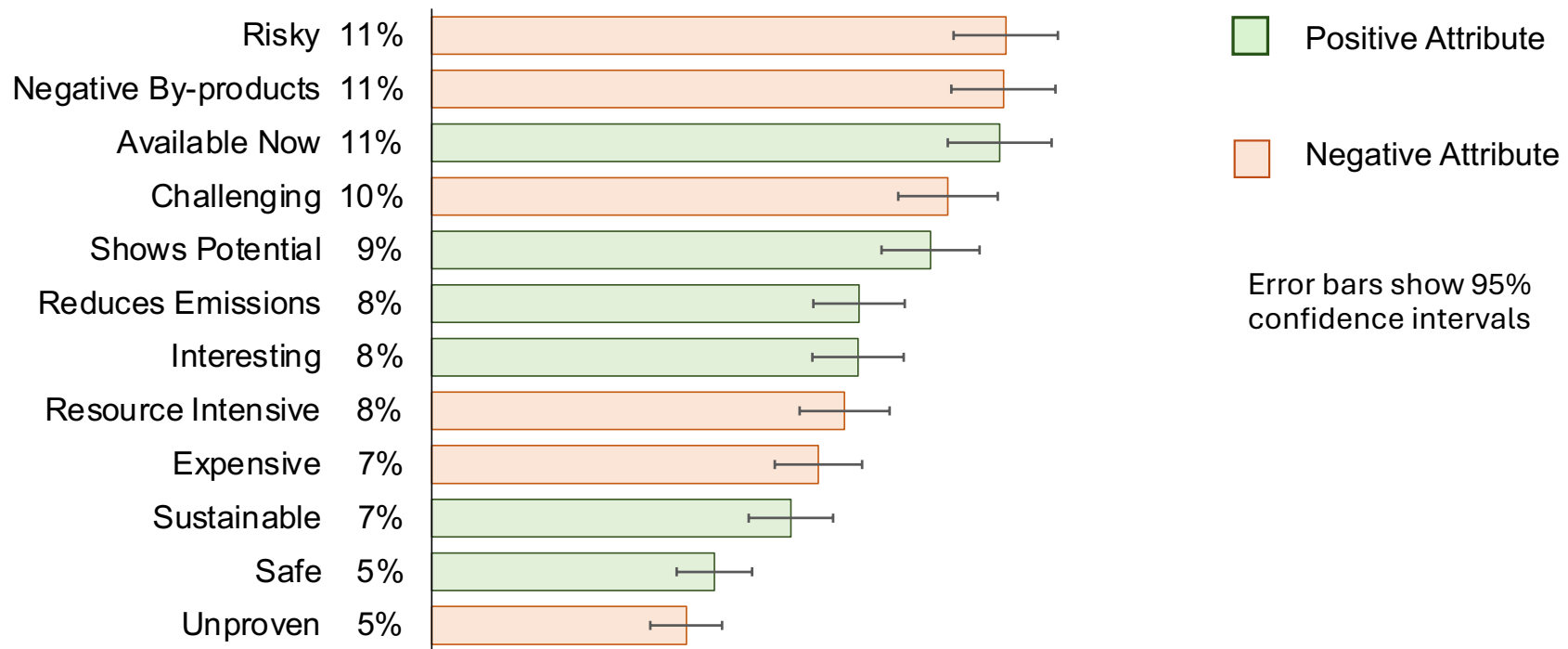
<https://www.dynata.com/>



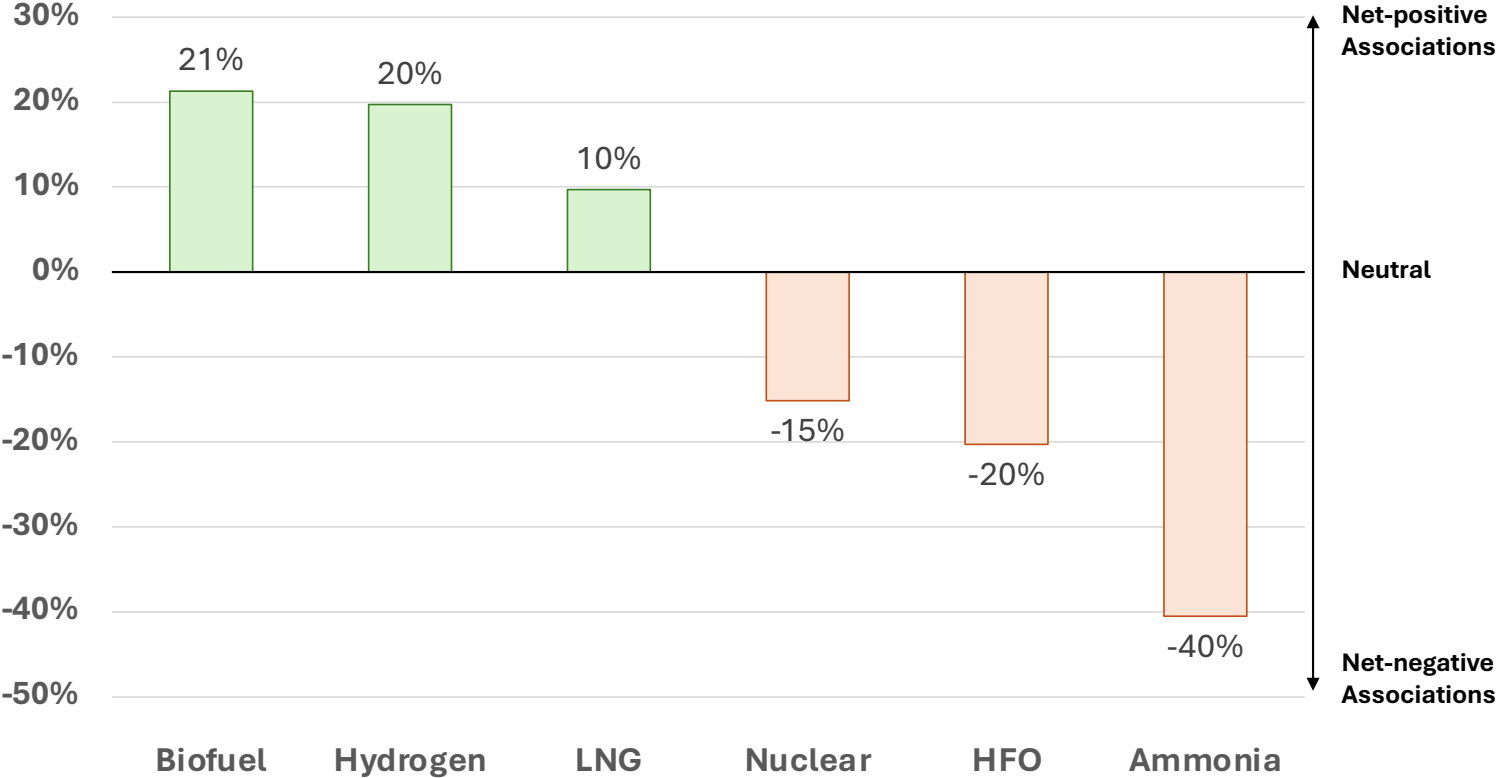
Carlisle, D. P., Feetham, P. M., Wright, M. J., & Teagle, D. A. (2023). Public response to decarbonisation through alternative shipping fuels. *Environment, Development and Sustainability*, 1-20.

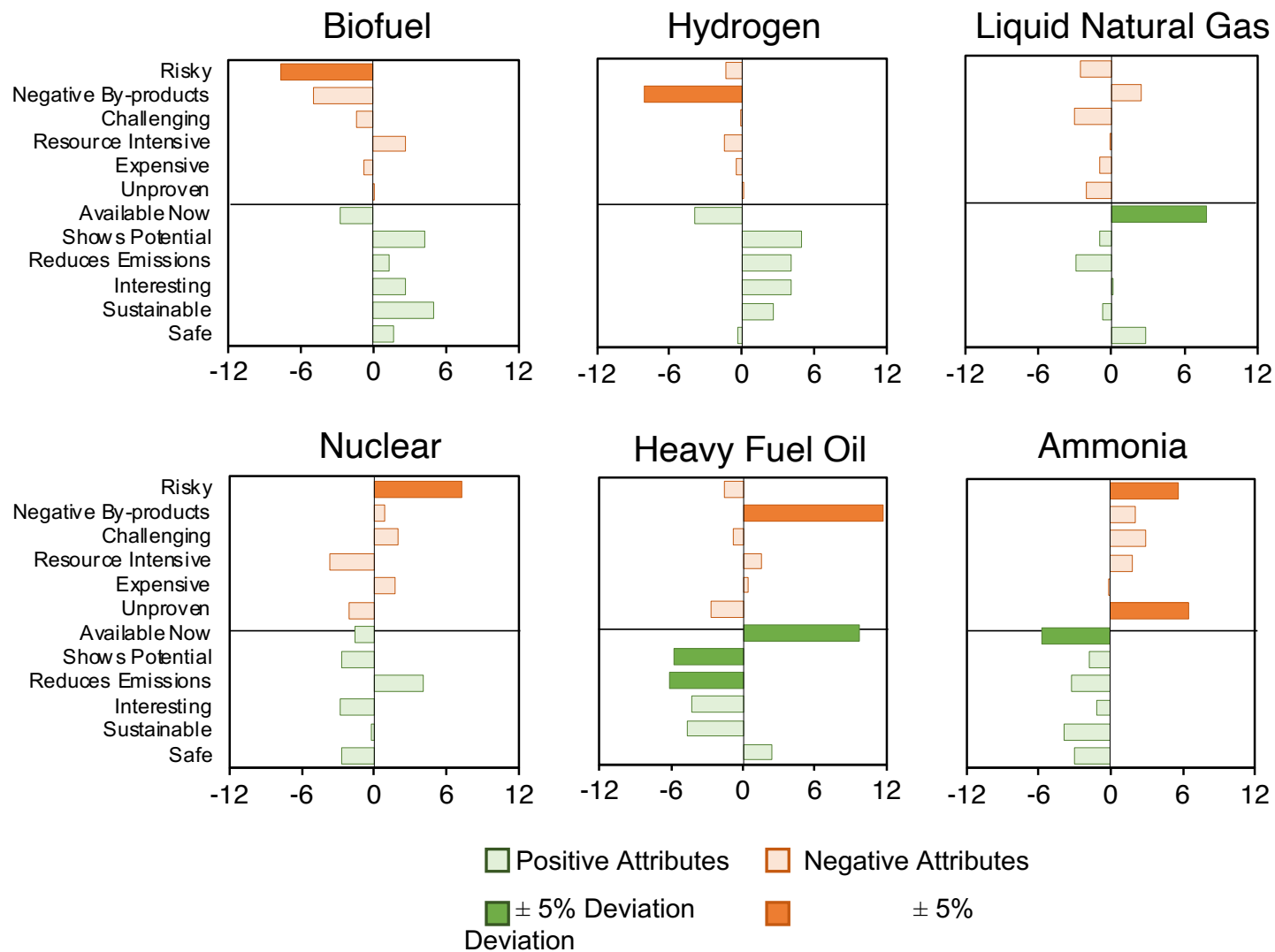
“The international shipping industry is exploring use of carbon-neutral fuels to help eliminate greenhouse gas emissions by 2050. However, the public acceptability of alternative shipping fuels remains unknown. Here we examine UK public perceptions for six shipping fuels using a mixed-method approach ... “

Attribute Association Rankings



Net Positive Memory Associations





Conclusion

Respondents strongly dislike ammonia, perceived as unproven, risky, and lacking availability. Despite lingering stigma, nuclear is preferred over the incumbent heavy fuel oil, though both are perceived negatively. Perceptions of liquid natural gas are somewhat positive, suggesting that it provides an acceptable near-term option while other fuels are developed. Biofuels and hydrogen are clearly favoured, owing to biofuel's perceived low risk and hydrogen's lack of negative by-products.

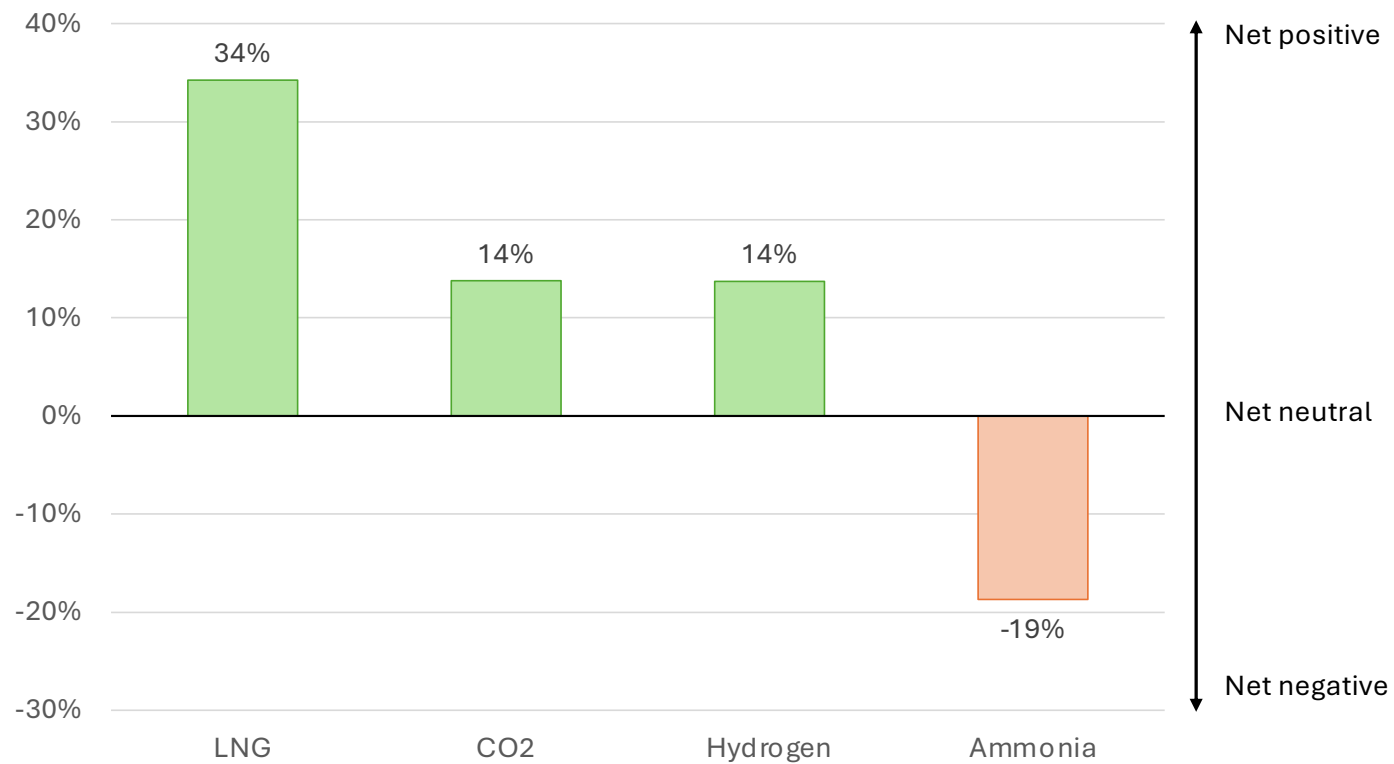


What about carbon capture, transport and storage through ports?

Survey n = 1070 UK respondents, data gathered September 2022
using the Dynata panel <https://www.dynata.com/>

IDRIC Project
WORK UNDER REVIEW

Net positive memory associations





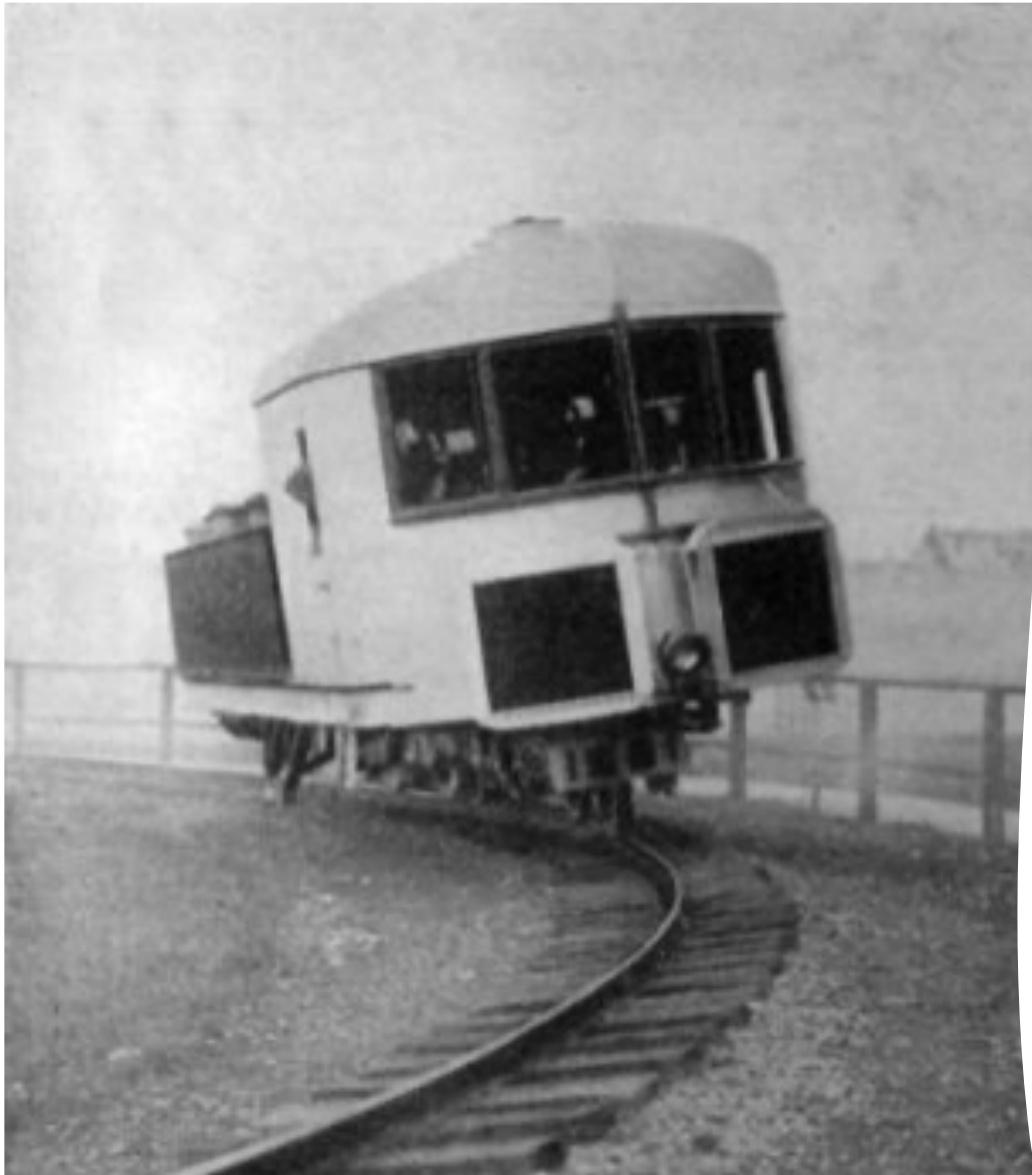
Next problem: How quickly will decarbonized shipping be adopted?



Innovation is NOT just about capability

Consider a gyroscopically controlled monorail service

- Extremely stable
- Comfortable cornering
- Single standard rail on sleepers
- Easily laid in new areas
- Electric transmission



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Acceptability involves other characteristics

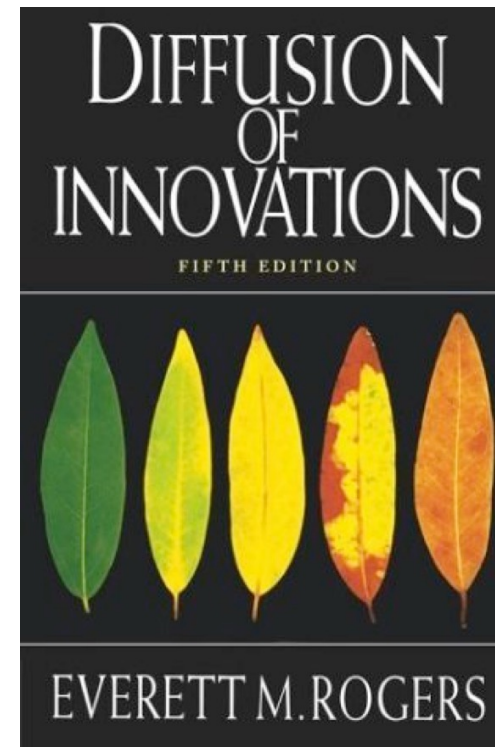
Relative advantage

Compatibility

Complexity

Trialability

Observability

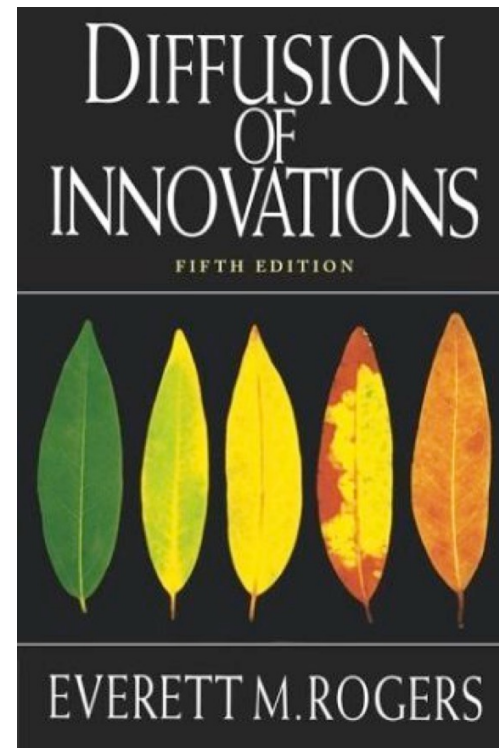


White social factors create a dynamic process for diffusion (adoption) of innovations

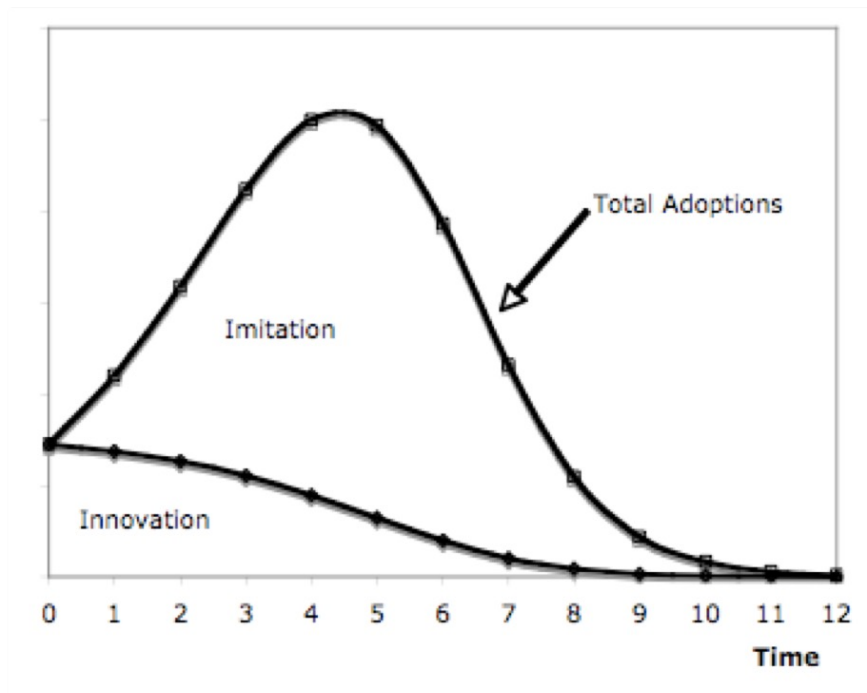
“Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system.”

Rogers (2003)

Emphasis mine



Consumer adoption theory describes the dynamic aspects of diffusion



The Bass Model has 3 parameters

M Market potential

p Coefficient of innovation

q Coefficient of imitation

Innovative adoption is always occurring

But imitative pressure **builds** as the number of prior adopters increases

As the market approaches saturation both innovation and imitation have progressively **fewer** potential adopters to act upon

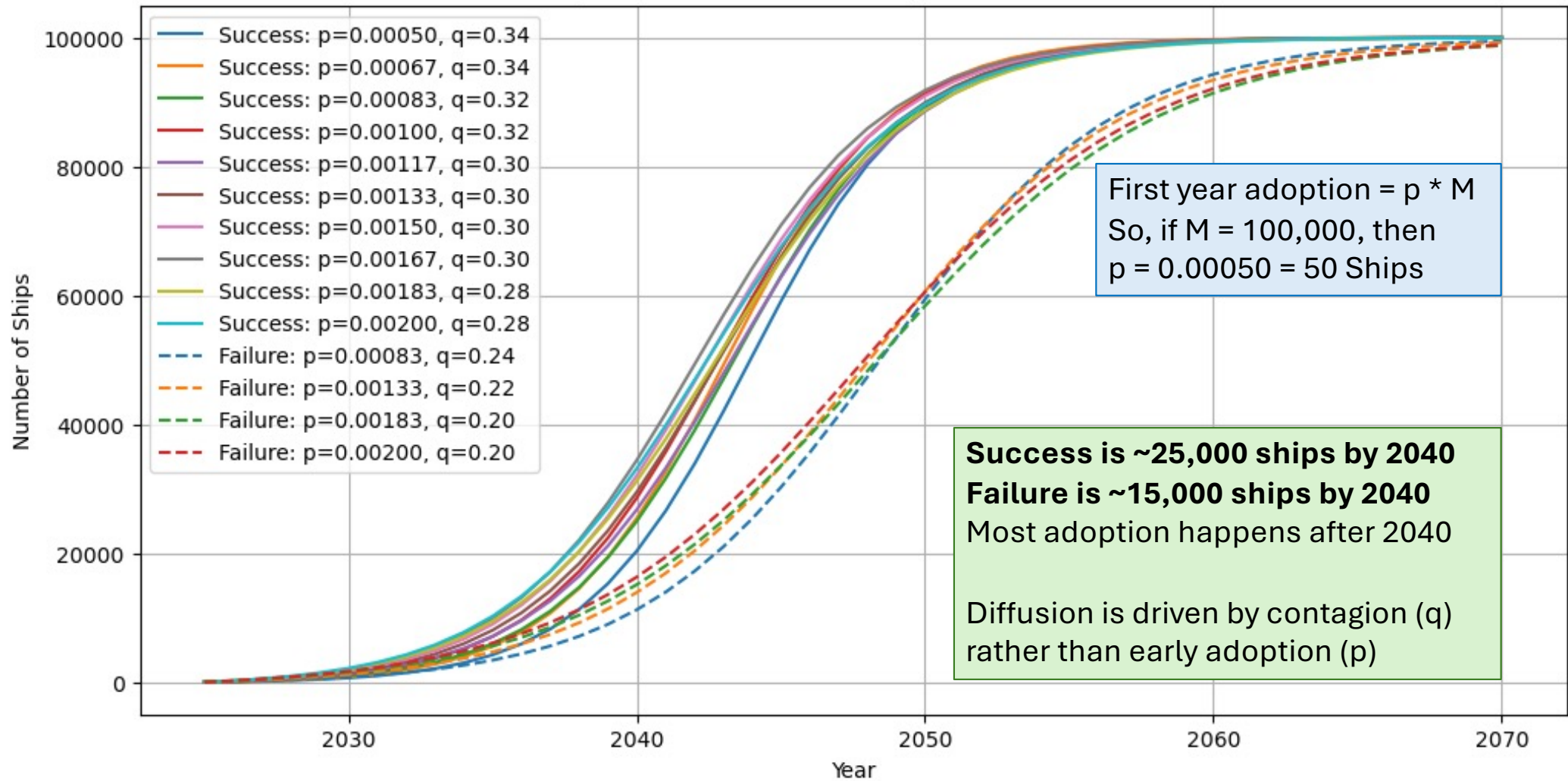
Application of the Bass model to project pathways for shipping fleet decarbonization

Conceptual demonstration with first adoption in 2026

1. Assume fleet size of 100,000 ships
2. Define *success* as ~ 90% adoption by 2050
3. Define *failure* as ~ 60% adoption by 2050
4. Grid search through plausible values of p and q to track feasible pathways to success and failure

A full modelling project would disaggregate by technology, consider changes to market size over time, allow for ship construction lead times and replacement rates, and improve benchmark estimates of p (innovation) and q (imitation)

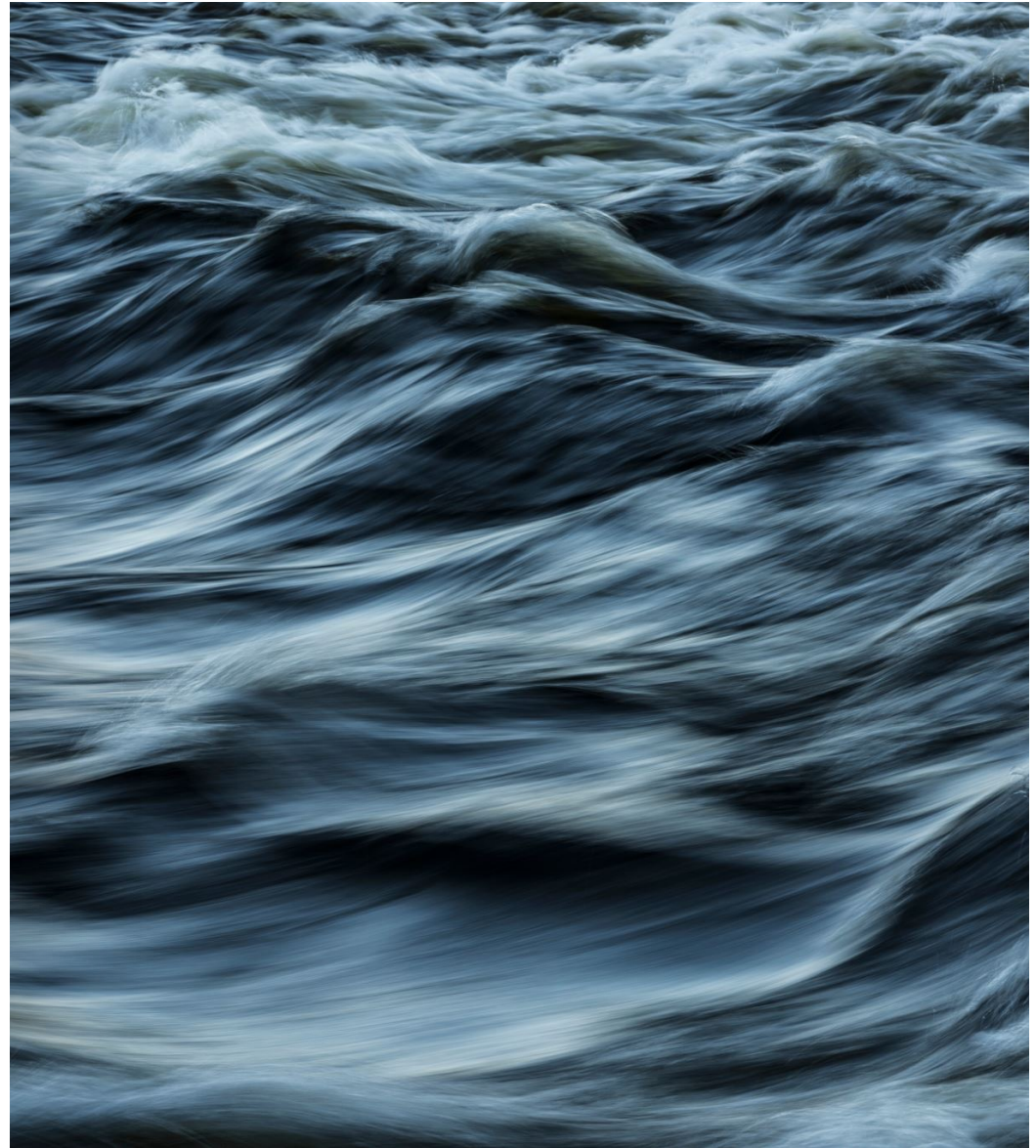
Cumulative Adoption of Decarbonized Ships for Success and Failure Modes



Diffusion processes start with
years of minimal progress

Followed by take off and then
very rapid growth

And then finally, a slow
approach to the asymptote



Thank you

Any questions?

