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Engineering imaginaries: Anticipatory foresight for solar radiation management governance

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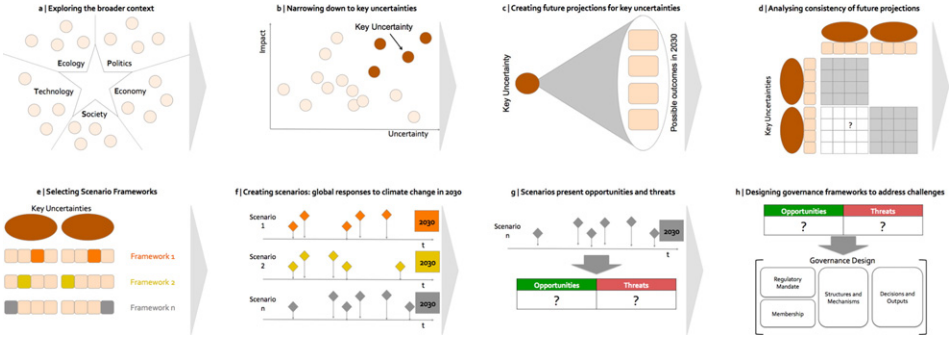
HIGHLIGHTS

- SRM governance options are implicitly designed around visions of the future.
- The project sought to explore the capacity of scenario methods to ground discussion of governance.
- The project evaluated governance options against multiple imaginary but plausible scenarios.
- The capacity of governance options to be adaptable to a wide range of possibilities was explored.
- Scenarios encourage an anticipatory mode of thinking about navigating SRM's risks and benefits.

GRAPHICAL ABSTRACT



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ABSTRACT

Since solar radiation management (SRM) technologies do not yet exist and capacities to model their impacts are limited, proposals for its governance are implicitly designed not around realities, but possibilities – baskets of risk and benefit that are often components of future imaginaries. This paper reports on the project Solar Radiation Management: Foresight for Governance (SRM4G), which aimed to encourage an anticipatory mode of thinking about the future of an engineered climate. Leveraging the participation of 15 scholars and practitioners heavily engaged in early conversations on SRM governance, SRM4G applied scenario construction to generate a set of alternative futures leading to 2030, each exercising different influences on the need for – and challenges associated with – development of SRM technologies. The scenarios then provided the context for the design of systems of governance with the capacity and legitimacy to respond to those challenges, and for the evaluation of the advantages and drawbacks of different options against a wide range of imaginary but plausible futures. SRM4G sought to initiate a conversation within the SRM research community on the capacity of foresight approaches to highlight the centrality of conceptions of the future to discussions of SRM's threats and opportunities, and in doing so, examined and challenged the assumptions embedded in conceptualizing SRM's aims, development and governance, and discussed the capacity of governance options to adapt to a wide range of possibilities.

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1. Governing solar radiation management

The controversial idea of solar radiation management (SRM) – a set of hypothetical approaches that suggest that reflecting a small portion of incoming sunlight back into space can reduce climate warming and mitigate some of its impacts – has in recent years been the subject of growing debate as a form of geoengineering or climate engineering, defined as deliberate and large-scale interventions in the climate system aimed at counteracting the impacts of climate change (Shepherd et al. 2009; IPCC 2014; Schäfer et al. 2015).

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SRM, however, does not exist as full-fledged technologies and deployment strategies, but as an early set of hypothetical proposals, research activities and discourses based largely within academic networks in the global North. Hardware development remains immature and un-scaled; national governments have yet to take clear positions on deployment or even the need for exploratory research. If SRM emerges into a complex landscape of issues, actors, and agendas in global politics, it will pose challenges at every stage from innovation to implementation. Early concerns may seem more tangible with emerging discussions on experimentation outside the lab (see Doughty 2015 for examples of past small-scale field tests; see Keith et al. 2014 for an initial typology of proposed future tests).

Questions of how to govern SRM have thus been central to early discussions. As with many emerging science and technology issues, a diverse research community of climate modellers, engineers, and ethical, legal and political scholars currently plays a constitutive role in conceptualizing the challenges implicated in the totality of "engineering" the climate, as well as in proposing appropriate systems of governance – constellations of actors, practices and mechanisms seen as capable of navigating those challenges. However, these proposals operate under - or at least emphasize - different criteria and assumptions: the regulatory mandate and the technical or societal dimensions of its objectives, the range of climate engineering technologies addressed, the stage of innovation targeted (research, field-tests, deployment, or the full chain of development), the relevant actors to be engaged, the capacity and perceived legitimacy to make or enforce decisions, and reliance on legally-binding regulatory structures or on "soft" policy options. Within this landscape, how can the merits or drawbacks of individual proposals be more symmetrically compared and evaluated?

2. Engineering imaginaries

This paper reports on Solar Radiation Management: Foresight for Governance (SRM4G), an anticipatory foresight (see Section 4) project that sought to design and test a framework for adjudicating between the capacities of different SRM governance proposals by focusing on one particular set of assumptions embedded in them: the challenges that are emphasized as the most important for governance to navigate in the political landscape of the future (Section 3). Since SRM technologies do not yet exist and capacities to model their impacts are limited, governance of activities from development to deployment is implicitly designed not around realities, but possibilities. Proposals refer to baskets of risk and benefit that are often components of visions of the future in which SRM research and deployment has (or has failed to) become a reality, positing a range of imaginary but compelling outcomes that influence how SRM is engaged with in the present.

A common concern in the near term is that even considering SRM research might cause states and other actors to reduce their mitigation and adaptation activities; a response might be to tie decision-making on SRM into the UNFCCC from its earliest stages (Honegger et al. 2013; Zürn and Schäfer 2013). The optics of outdoors experimentation may cause public outcry, or there may be perverse incentives from interest groups to promote, control, or disguise technology development. For these, some propose additional codes of conduct, responsible innovation frameworks, and disclosure mechanisms (Rayner et al. 2013; Stilgoe et al. 2013; Craik and Moore 2014), (networks of) national research programs with oversight capacities (Long et al. 2010), and intellectual property governance (Reynolds et al. 2016).

At the same time, many argue that the challenges of an engineered climate cannot be discussed in isolation from the risks of the planet warming under current emissions pathways – that is, not researching or deploying SRM poses its own salient set of risks. These tend to place a emphasis on reducing ignorance and forestalling premature rejection through immediate research and field-experiments, and argue against overly burdensome multilateral governance at early stages in favour of more informal coordination between research networks and bottom-up norm creation to allow outdoors experiments to go ahead (Victor 2008; Parson and Keith 2013; Morgan et al. 2013; Parker 2014). Still others perceive a clique of scientists heralding a technofix that might perpetuate the carbon economy and an exploitative relationship between more developed economies and the global South, or between human civilization and the natural world. One responding governance proposal is a moratorium on all outdoors experimentation (ETC 2010).

In the longer term, there may be state-based competition over pursuit of technological capacity for deployment or over the proposed temperature of the "global thermostat". In the event of deployment, some fear that the uneven alteration of regional weather patterns would adversely affect lives and livelihoods, that establishing liability and compensation would be difficult, and that siloed national agendas, political brinksmanship, or outright conflict would result. Recognizing that these risks require governmental participation, responses range from minilateral clubs of technologically capable states or indispensible major emitters (Victor 2008; Virgoe 2009; Parson 2014), or governance by one or several UN bodies (Honegger et al. 2013; Zürn and Schäfer 2013; Bodle and Oberthür 2014; Lloyd and Oppenheimer 2014; Lin 2015), depending on how one emphasizes the potential for different groupings of states or international bodies to mitigate or exacerbate those risks.

A comprehensive and evaluative review of all governance proposals is lacking in the literature, and is beyond the scope of this paper. The point that might suffice for our purposes is that many of the conceived challenges which motivate governance designs are future-oriented, have entwined technical, societal and environmental dimensions, and consist of cascading sequences of events that cannot be concretely predicted (for an examination of the deep uncertainties in forecasting climate engineering futures, see Chris 2016). In many articulations, SRM contains emergent linkages with climate change and energy, state and human security, health, biodiversity, resource scarcity, intellectual property, science and technology as an escalating enterprise, and historic dynamics between major global powers. Such implications have to be generated in a way that relies as much upon the imaginations of researchers as their knowledge. Yet, these conceptions are subject to implicit, ambiguous assumptions about the shape of future developments, and to the biases that accompany the expertise of their proponents.

3. The SRM4G project: using scenarios to explore the governance of SRM

Highlighting the influence that conceptions of the future exercise upon SRM regulatory designs can act as a lens through which the research community can assess the merits of different goals and building blocks of governance. This was the premise of Solar Radiation Management: Foresight for Governance (SRM4G): a collaborative project between the Institute for Advanced Sustainability Studies (a hybrid research institute and think tank on pathways towards global sustainability) and Foresight Intelligence (a strategic planning consultancy), upon which this paper elaborates (see also the workshop report at Boettcher et al. 2016).

The aims of SRM4G were to:

1. Initiate a conversation among researchers involved in early discussions on SRM governance regarding the capacity of foresight and scenarios approaches to methodologically ground discussions of governance design regarding such future-oriented technologies.
2. Highlight the centrality of conceptions of the future to discussions of the risks and benefits of SRM, and to consider an expansive range of challenges that cannot be derived from technical assessments or climate models
3. Examine and challenge the assumptions embedded in conceptualizing SRM's aims, development, and governance.
4. Evaluate how well SRM governance options perform under alternative societal, political and environmental conditions, and to discuss

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