CLOSING SESSION ON THE ROLE OF THE NATIONAL SCIENCE FOUNDATION

Climate Intervention in an Earth Systems Science Framework: A Workshop Professor Benjamin K. Sovacool, Director June 21, 2023 Email: sovacool@bu.edu

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Technology	Availability	Affordability	Resilience	Sustainability	Security
Oil (pros)	Historically in plentiful supply; readily transported	Historically inexpensive	Many uses (i.e. electricity, transport)	Established supply networks	Source of revenue for exporters
(cons)	Majority of supply in unstable nations; risk of rapid depletion	Future costs could present economic hardship	Supply controlled by unstable regimes; supply routes risk prone	Source of greenhouse gas emissions; depletable; risk of damaging spills.	Source of dependence and insecurity for importers
Natural Gas (pros)	Historically in plentiful supply; readily transported	Historically cheap source of peak load fuel	Many uses (i.e. electricity, heating, cooking)	Established supply networks	Source of revenue for exporters
(cons)	Significant supply in unstable nations; rapid depletion	Potentially expensive after low-cost reserves are depleted	Some supplies controlled by unstable regimes; supply routes risk prone	Source of greenhouse gas emissions; depletable	Source of dependence and insecurity for importers
Coal (pros)	Historically plentiful; linked to transport infrastructure; supplier diversity	Historically cheapest source of base-load fuel	Many uses (i.e. electricity, steel making); easily stored	Historically stable source of employment	Source of revenue for exporters
(cons)	Rapid depletion	Mercury, CO ₂ and other emissions produce severe hidden costs.	Supply route congestion	Key threat to climate change; source of major health problems	Source of insecurity for importers
Hydroelectric Dams (pros)	Key domestic resource; Relatively predictable supply	Cheapest historical source of renewable energy	Largely subject to domestic control; flexible renewable source	Clean source of energy	Easy to manage once established
(cons)	Supply expansion has limits	Environmental damages and decommissioning can represent hidden costs	Undermined by drought, technical failures, and terrorist attacks	Engenders environmental degradation and can entail the forced relocation of communities	Can become targets during periods of social or military conflict
Solar and Wind Electricity (pros)	Key domestic resource that any nation can exploit	Many technologies are now commercially viable	Different technologies suit different needs; easy to scale up; decentralized	Clean source of energy; highest ratio of jobs per kWh	Decentralized generation improves system safety; Can minimize impact of fossil fuel price increases
(cons)	Supply can be intermittent and unpredictable	Intermittency poses hidden costs	Can be undermined by environmental or climatic changes	Requires integration with other systems	Can be expensive and a source of voter dissent, dependent on rare earth minerals imports
Nuclear Power (pros)	Can help diversify energy portfolio	Low historic operating costs after facilities have been paid off and/or subsidized	Large, centralized plants are easy to secure	Viewed as a low-carbon pathway to cheap energy in the future	Nuclear technology spin offs can provide scientific benefits; nuclear power is a status symbol
(cons)	Requires high level of technical expertise	Prone to cost overruns and long lead times	Can undermine electric grid when malfunctioning, can also be prone to terrorist attacks	Presents major waste and safety challenges, health risks	Presents major waste management and safety challenges; Has troubling links with weapons proliferation; may require authoritarian or interventionist government regimes
Biofuels (pros)	Most nations have some supply	Potentially good use of waste	Can be produced by a variety of sources	Meshes well with agrarian communities	Can enhance agricultural development strategies, minimize oil imports
(cons)	Not enough to fully replace other fuels	Food versus fuel controversy	Requires continued expansion of land-use to expand supply; hard to ramp up.	Can require inputs such as pesticides and fertilizers	Not an advanced use of land; gives rise to deforestation and resulting human and environmental insecurity
Energy Efficiency (pros)	Opportunities available everywhere	Cheapest way to reduce carbon footprint	Significantly reduces impact of conventional fuel price increases	Gives rise to innovation and competitive advantage	Inexpensive to implement
(cons)	Knowledge needed to exploit	Can in some cases cause a rebound or takeback effect	Solutions exhibit a progressively increasing cost profile	Displaces jobs in traditional energy industries	May encourages battles over standard setting)

Stern, PC, BK Sovacool, and T Dietz. "Towards a Science of Climate and Energy Choices," Nature Climate Change 6 (June, 2016), pp. 547-555

Such risks can be constructed and deconstructed

- How knowledge of risk is depicted, defined, communicated:
- How technologies perform (pollution):
- How classes of people are affected (vulnerability):
- How risks are modelled, distributed:
- How risks are interpreted, planned for, captured in policy, socialized:

Arts & Humanities

Suggested Disciplines: American Studies; Archaeology; Architecture/Built Environment; Area Studies; Art & Design; Classics, Drama, Dance & Performing Arts; English Language & Literature; History; Languages & Linguistics; Music; Philosophy; Theology, Divinity & Religious Studies

Engineering & Technology

Suggested Disciplines: Chemical Engineering; Civil Engineering; Computer Science; Electrical & Electronic Engineering; General Engineering; Mechanical, Aeronautical & Manufacturing Engineering; Mineral & Mining Engineering; Nanotechnology

Life Sciences & Medicine

Suggested Disciplines: Agriculture; Biological Sciences; Clinical Psychology; Dentistry; Food Science & Technology; Health Sciences; Medicine and Medical-related Studies; Neuroscience; Nursing; Pharmacy & Pharmacology; Psychiatry; Public Health; Veterinary Science

Natural Sciences

Suggested Disciplines: Applied Mathematics; Astronomy; Chemistry; Earth Sciences; Environmental Sciences; Geography; Metallurgy & Materials; Physics; Pure Mathematics

Social Sciences & Management

Suggested Disciplines: Accounting & Finance; Anthropology; Business & Management Studies; Communication, Cultural & Media Studies; Development Studies; Economics & Econometrics; Education; Law; Library & Information Management; Politics & International Studies; Sociology; Social Policy & Administration; Social Psychology; Social Work; Sports-related Subjects; Statistics & Operational Research; Town & Country Planning





Energy and climate "social science" is more than a collection of disciplines

- A social or epistemic *community* of scholars
- A *method* or way of doing (often qualitative) research
- A collection of *concepts* or theories
- The domain or interest of particular *topics*
- A family of *journals*



Sovacool, BK, M Iskandarova, and JK Hall. "Industrializing theories: Conceptual frameworks and typologies for industrial sociotechnical change in a low-carbon future," *Energy Research & Social Science* 97 (March, 2023), 102954, pp. 1-36.