Energy for society: The value and need for interdisciplinary research

Invited Presentation to the "Towards a Consumer-Driven Energy System" Workshop, International Energy Agency Committee on Energy Research and Technology, Technical University of Denmark, Lyngby, Denmark, October 12-13, 2017

Benjamin K. Sovacool, Ph.D
Professor of Energy Policy
Director of the Sussex Energy Group
Director of the Center on Innovation and Energy Demand
Professor of Business and Social Sciences
Director of the Center on Energy Technologies

Data sources

- "Social Science Insights on Energy, Climate, and Society," *Nature Climate Change* and *Nature Energy* (joint Special Collection), May 2016, with Paul C. Stern and Tom Dietz. Available at: http://www.nature.com/energyclimatesociety.
- *Energy Research & Social Science*, available at http://www.journals.elsevier.com/energy-research-and-social-science/ and http://www.sciencedirect.com/science/journal/22146296

nature energy

- Why do we need better energy social science?
- How much is it currently used (results from a 15 year content analysis)?
- Key findings and implications

Why do we need social science

(1) Making research more useful

Centre on Innovation and Energy Demand

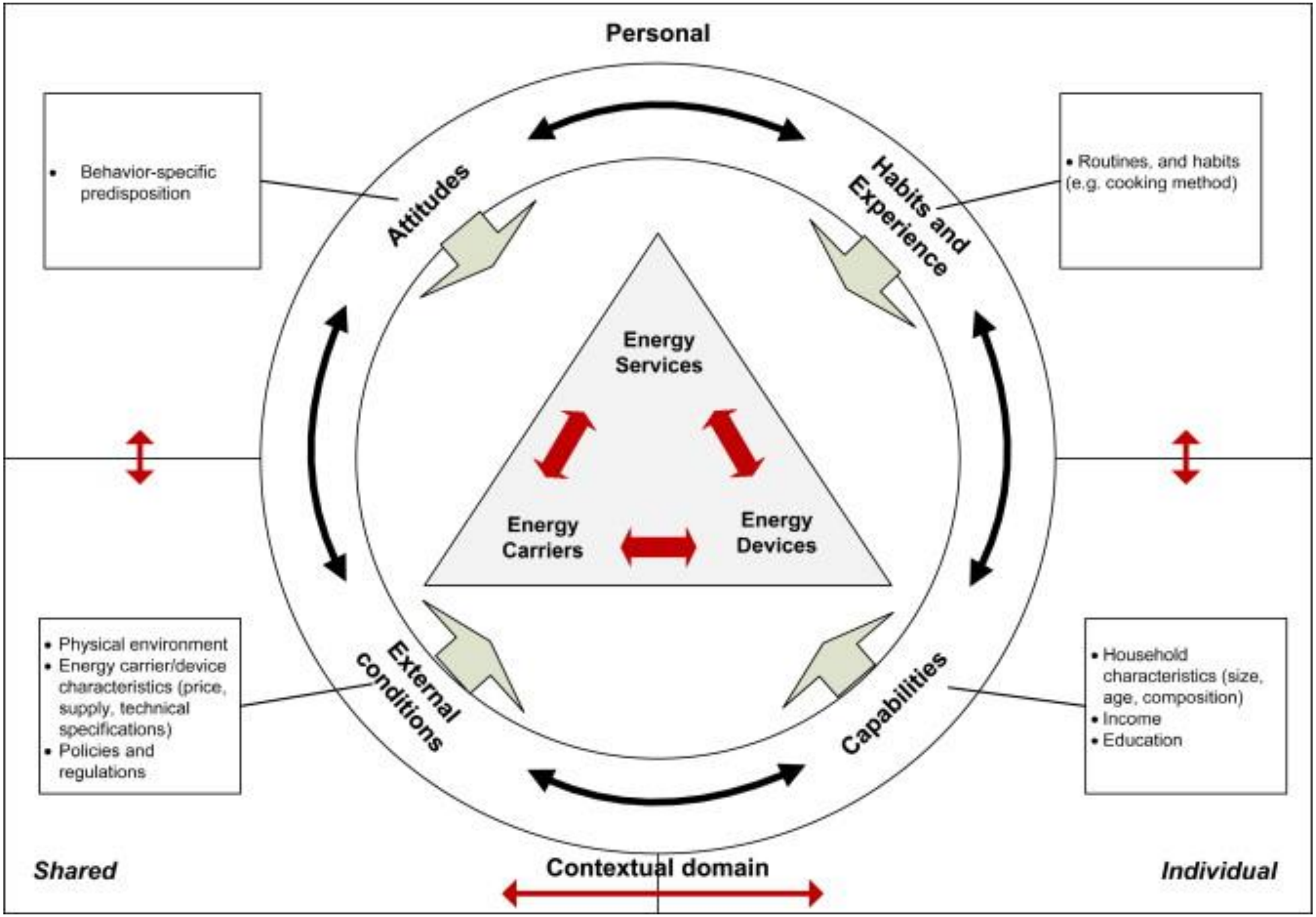
Table 1 | A typology of social science energy and climate research.

Fundamental understanding	Immediate usefulness: No	Immediate usefulness: Yes
Yes	Pure basic research (for example, history of energy use during the Renaissance).	Use-inspired basic research (for example, studies of the determinants of the adoption of energy efficient technologies).
No	Research that makes no contribution to knowledge; sponsored research or advocacy drawing inappropriately or selectively on science (for example, campaigns to discredit climate change science).	Purely applied research (for example, analysis to support more effective advertising campaigns for household renewable electricity systems).

The top-right cell is sometimes referred to as Pasteur's quadrant.

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

(2) Understanding energy behavior and consumption



Source: Kowsari R, Zerriffi H. Three dimensional energy profile: a conceptual framework for assessing household energy use. *Energy Policy* 2011; 39(December (12)):7505–17

(3) Constructing and deconstructing risk

Centre on Innovation and Energy Demand

Table 2 | Eight energy system risk profiles.

Technology		Availability	Affordability	Resilience	Sustainability	Security
Oil	Pros	Historically in plentiful supply. Readily transported.	Historically inexpensive.	Many uses (such as electricity, transport).	Established supply networks.	Source of revenue for exporters.
	Cons	Majority of supply is in unstable nations. Risk of rapid depletion.	Future costs could present economic hardship.	Supply is controlled by unstable regimes. Supply routes are prone to risk.	Source of GHG 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 (such as electricity, heating, cooking).	Established supply networks.	Source of revenue for exporters.
	Cons	Significant supply is in unstable nations. Rapid depletion.	Potentially expensive after low-cost reserves are depleted.	Some supplies controlled by unstable regimes. Supply routes are prone to risk.	Source of GHG 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 (such as 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.

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

(3) Constructing and deconstructing risk

Centre on Innovation and Energy Demand

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 PV 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. Among the 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. Manufacture of solar cells dependent on rare earth minerals imports.
Nuclear power	Pros	Can help diversify energy portfolios.	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 the electric grid when malfunctioning. Prone to terrorist attacks.	Presents major waste and safety challenges, as well as health risks.	Presents major waste management and safety challenges. Has troubling links with weapons proliferation. May require authoritarian or interventionist government regimes.

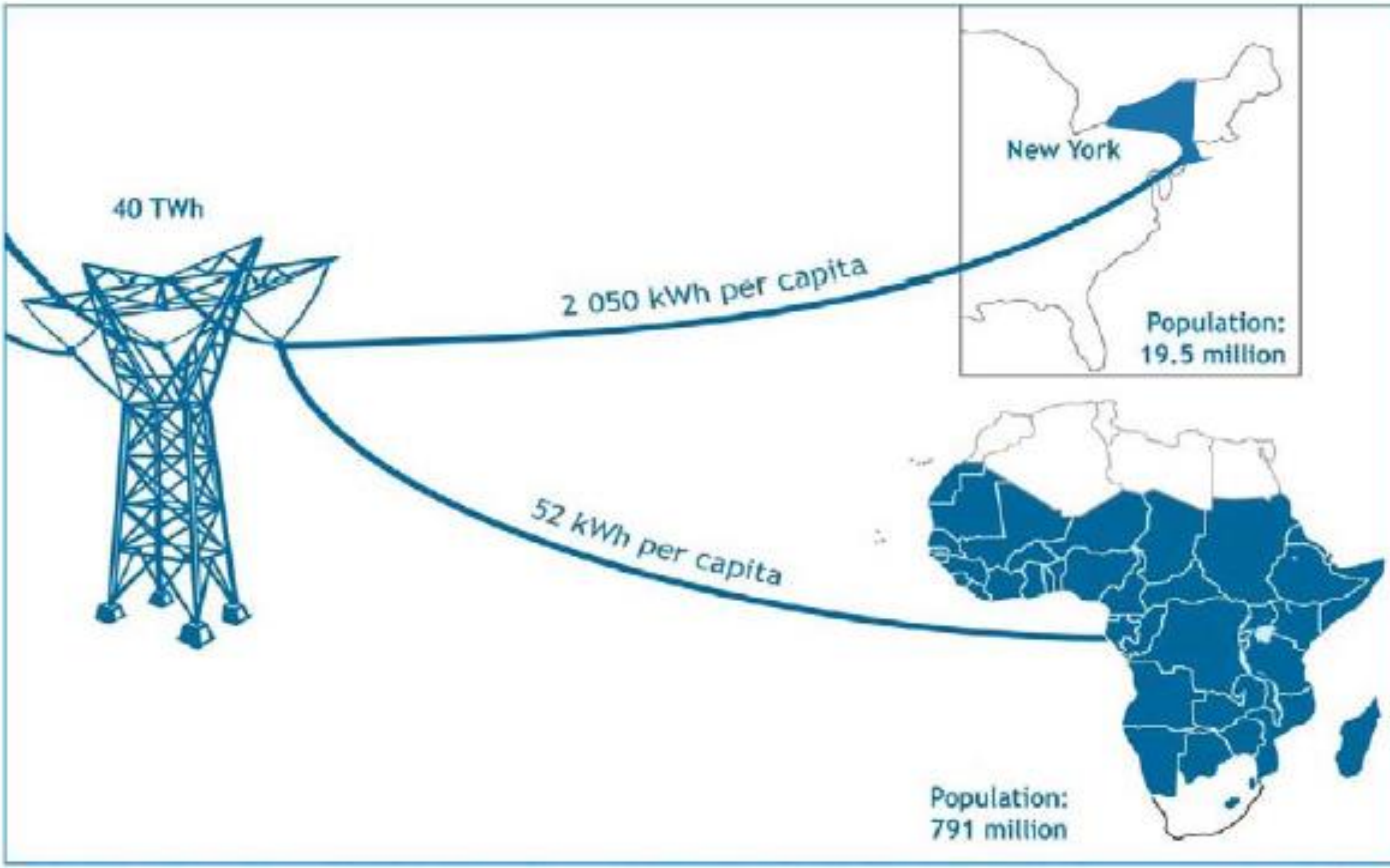
(3) Constructing and deconstructing risk

Centre on Innovation and Energy Demand

Technology		Availability	Affordability	Resilience	Sustainability	Security
Biofuels	Pros	Most nations have some supply.	Potentially a good use of waste.	Can be produced by a variety of sources.	Meshes well with agrarian communities.	Can enhance agricultural development strategies, and 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 the 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. One of the highest ratios of jobs per kWh.	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 encourage battles over standard setting.

(4) Determining equity, fairness, and justice

Centre on Innovation and Energy Demand



In sum:

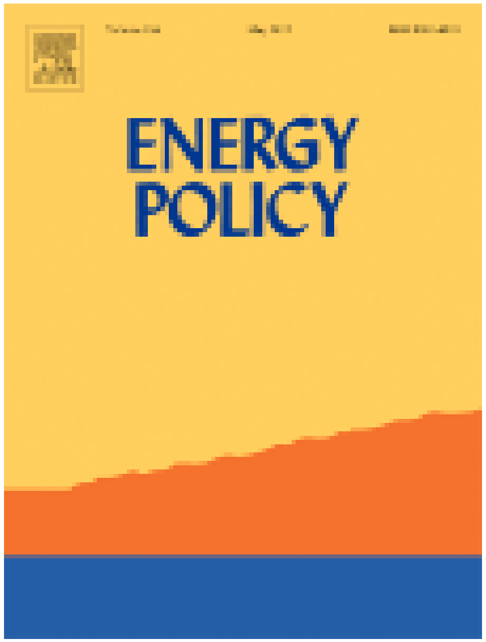
Centre on Innovation and Energy Demand

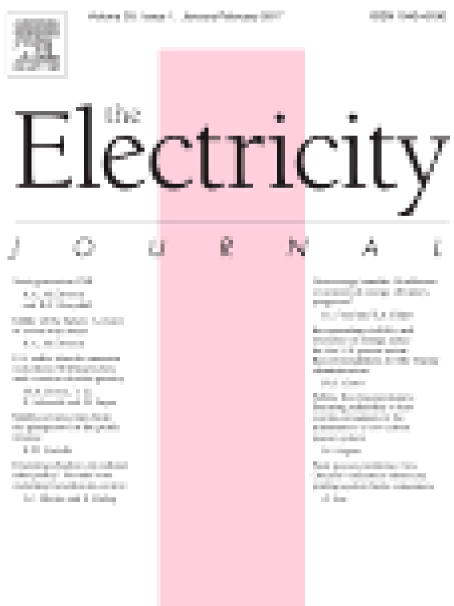
- The arts, humanities, and social sciences are instrumental parts of problem-driven research that can also advance scientific, conceptual, or theoretical understanding
- They are elemental in refining our knowledge about the non-technical dimensions to energy end use, demand, and consumption
- They are key to helping us identify energy and climate risks and also in determining acceptable solutions, as well as the distribution, framing, and communication of risk
- They are needed to address issues of morality, ethics, philosophy, equity, and fairness, and to humanize the discussion of energy topics and technologies

A (slightly older) study: how much is social science used? (Answer: not much)

Sample of articles in our content analysis

Centre on Innovation and Energy Demand





Sample of articles in our content analysis

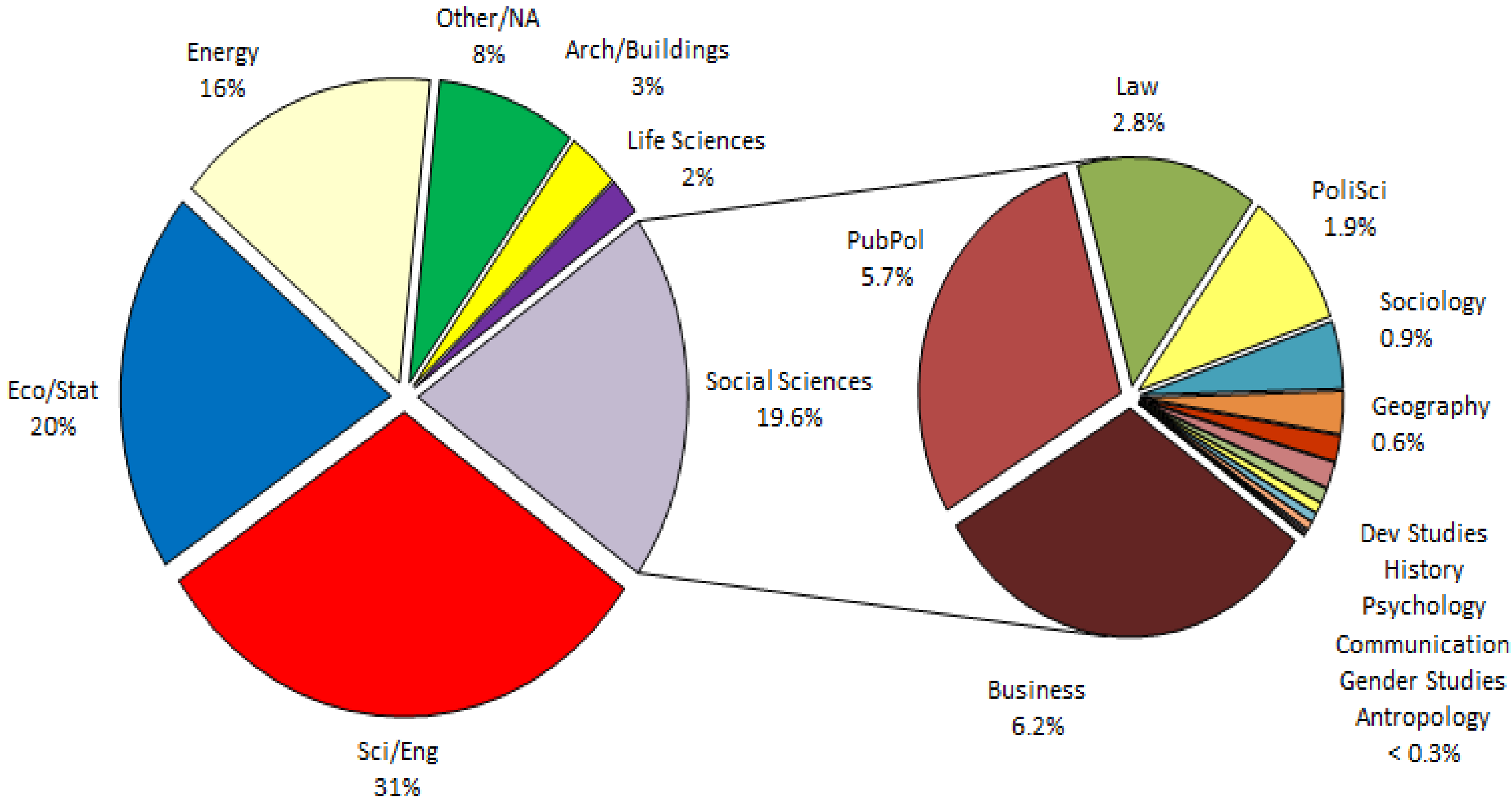
General statistics for energy studies journal articles, 1999–2013.

Year	Number of total articles	Number of authors	Number of disciplinary affiliations	Number of institutional affiliations	Number of disclosed funding sources	Number of methodological approaches	Number of country case studies	Number of discussed technologies	Number of discussed topics	Number of references[a]
1999	187	368	346	355	196	206	206	296	425	1780
2000	183	332	281	277	190	213	170	253	325	2451
2001	199	420	500	413	224	225	239	415	635	2940
2002	202	361	374	311	220	211	207	266	519	2879
2003	219	425	448	389	235	231	252	350	594	3288
2004	238	508	597	483	295	262	293	473	822	4778
2005	276	609	653	548	296	299	290	439	610	5539
2006	474	1102	932	1016	532	499	540	1080	1266	12,833
2007	287	670	626	504	332	320	329	809	773	5221
2008	237	523	470	470	147	275	241	772	698	5108
2009	314	684	707	680	334	383	322	938	903	6820
2010	384	822	799	810	414	469	401	1121	1250	8486
2011	392	850	852	842	398	445	410	1219	1298	8534
2012	383	844	883	809	420	414	390	1335	1258	8576
2013	469	1031	1129	974	505	560	525	1490	1432	10,846
Total	4444	9549	9597	8881	4738	5012	4815	11,256	12,808	90,079

[a] Includes only *Energy Policy* for all years and the *Energy Journal* from 2003 to 2013.

Source: Sovacool, BK. "What Are We Doing Here? Analyzing Fifteen Years of Energy Scholarship and Proposing a Social Science Research Agenda," *Energy Research & Social Science* 1 (March, 2014), pp. 1-29

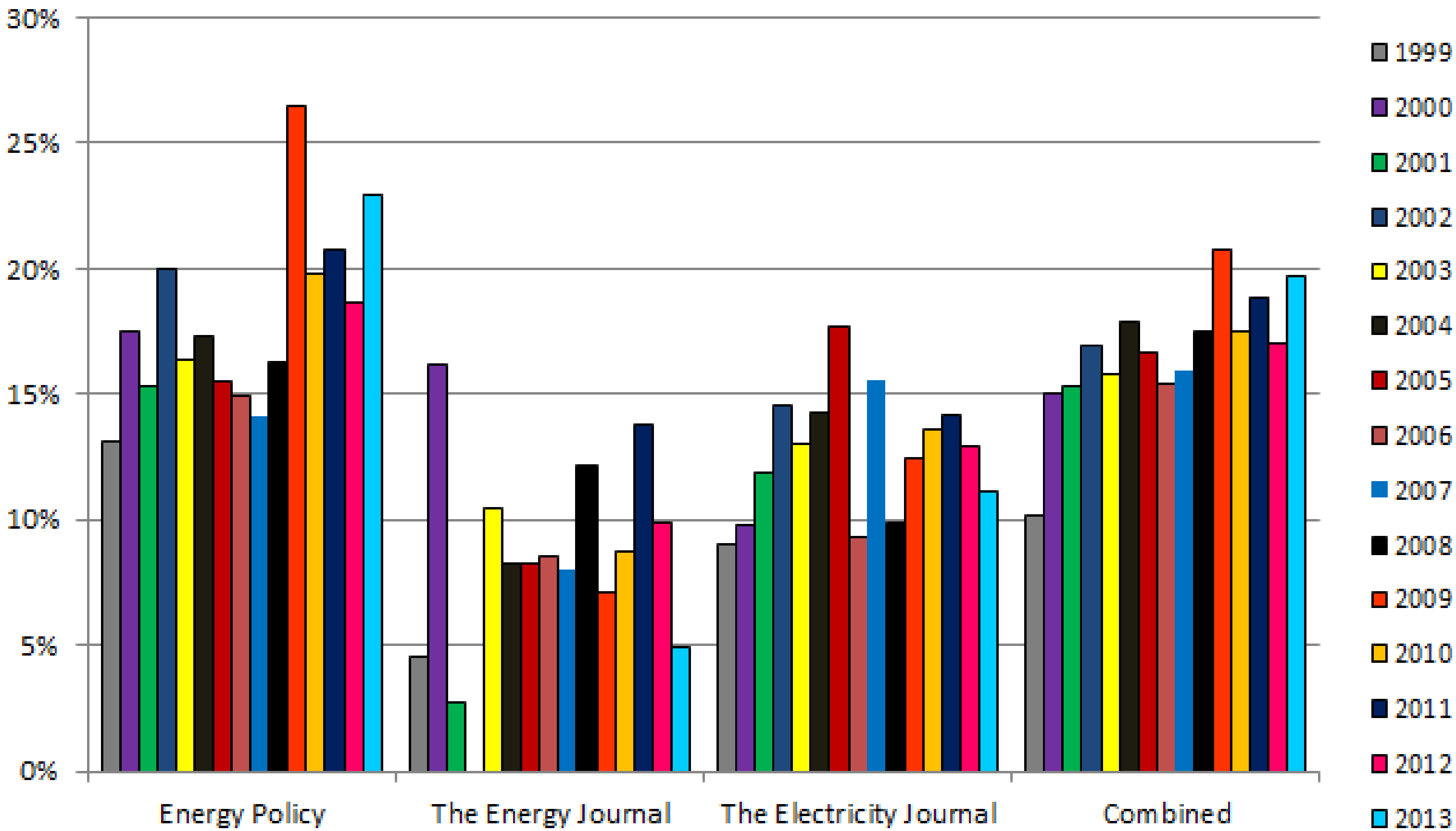
Disciplinary Affiliation for Energy Studies Journal Articles, 1999 to 2013 (n=9,597)



Source: Sovacool, BK. "What Are We Doing Here? Analyzing Fifteen Years of Energy Scholarship and Proposing a Social Science Research Agenda," *Energy Research & Social Science* 1 (March, 2014), pp. 1-29

Share of Female Authors for Energy Studies Journal Articles, 1999 to 2013 (n=9,549)

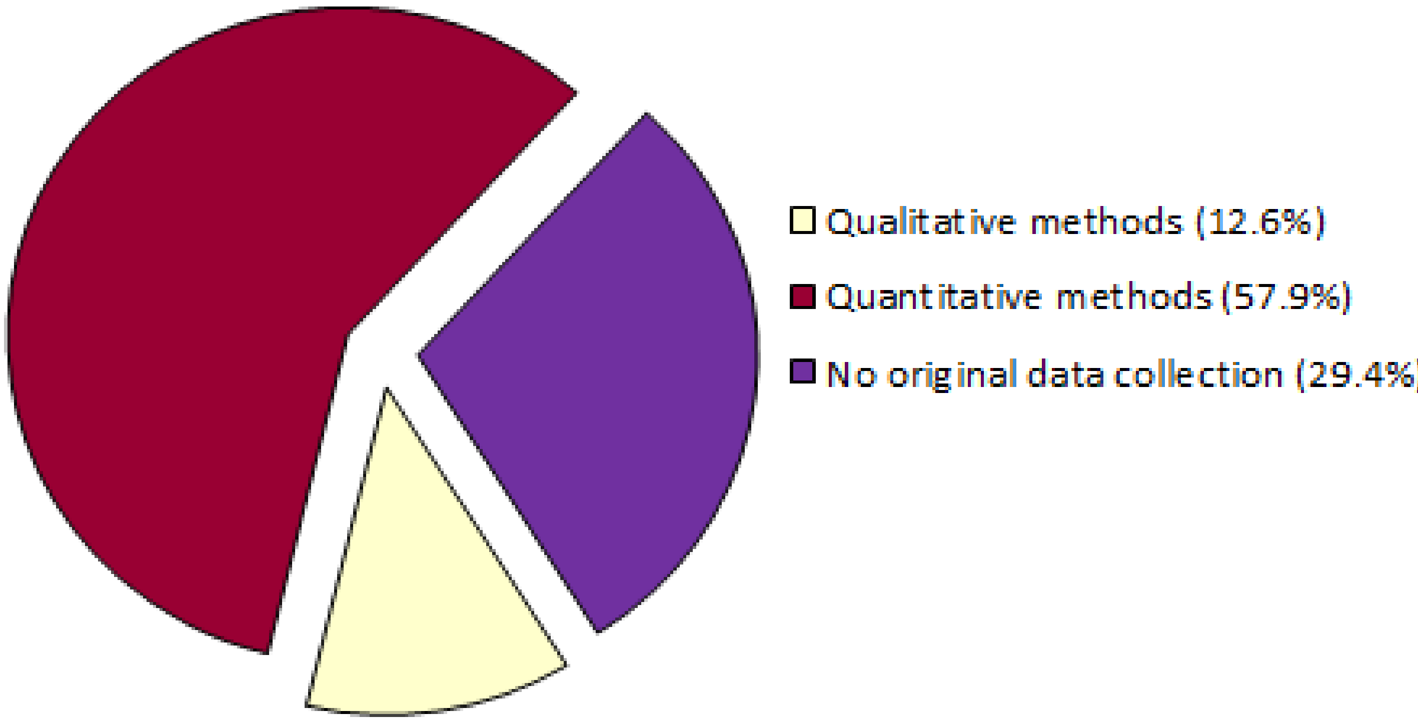
Centre on Innovation and Energy Demand



Source: Sovacool, BK. "What Are We Doing Here? Analyzing Fifteen Years of Energy Scholarship and Proposing a Social Science Research Agenda," *Energy Research & Social Science* 1 (March, 2014), pp. 1-29

Methodological Approaches of Energy Studies Journal Articles, 1999 to 2013 (n=5,012)

Centre on Innovation and Energy Demand



Qualitative methods" refer to original data collected through research interviews, surveys, questionnaires, or field research. "Quantitative methods" refer to original data collected through economic modeling, forecasting, econometric analysis, programming, statistical analysis, input/output analysis, cost benefit analysis, lifecycle assessments, remote sensing, and other similar tools.

Citations from Energy Studies Journal Articles, 1999 to 2013 (n=90,079)

Centre on Innovation and Energy Demand

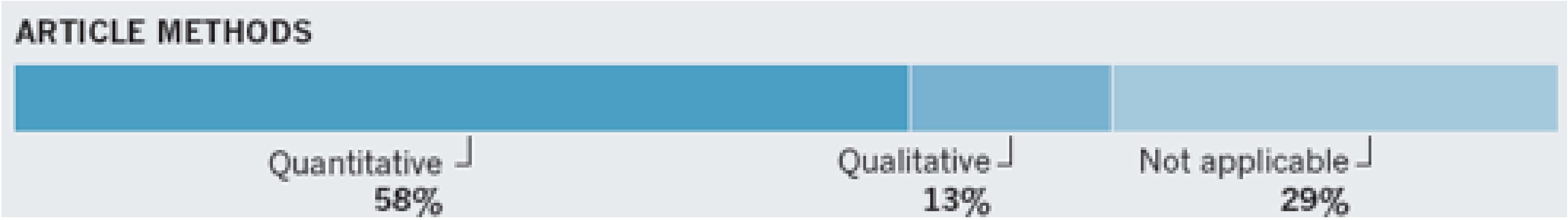
	Non-Classified/Grey Literature	Self-Citations	Economics	Science	Books	Social Science	Arts & Humanities
1999	1018	75	217	141	274	55	0
2000	1540	170	187	178	320	54	2
2001	2054	203	241	127	255	60	0
2002	1959	158	196	208	295	63	0
2003	2287	229	250	213	223	85	1
2004	2950	304	474	472	434	144	0
2005	3552	400	515	483	377	212	0
2006	7439	964	1209	1608	884	714	15
2007	2847	430	659	677	328	279	1
2008	2823	352	616	663	273	379	2
2009	4137	466	747	656	519	292	3
2010	5363	594	812	748	611	354	4
2011	5179	686	798	951	554	355	11
2012	5046	682	869	945	649	372	13
2013	6588	826	1108	1054	849	402	19
Total	54782	6539	8898	9124	6845	3820	71
%	60.8	7.3	9.9	10.1	7.6	4.2	0.08

Five key findings and implications

Finding 1: Under-utilized human-centered and comparative methods

Centre on Innovation and Energy Demand

- Of the roughly 13 percent of articles that reported using "human-centered" research methods, these were dominated by surveys (7.8 percent), with far fewer studies utilizing field research, research interviews, or focus groups

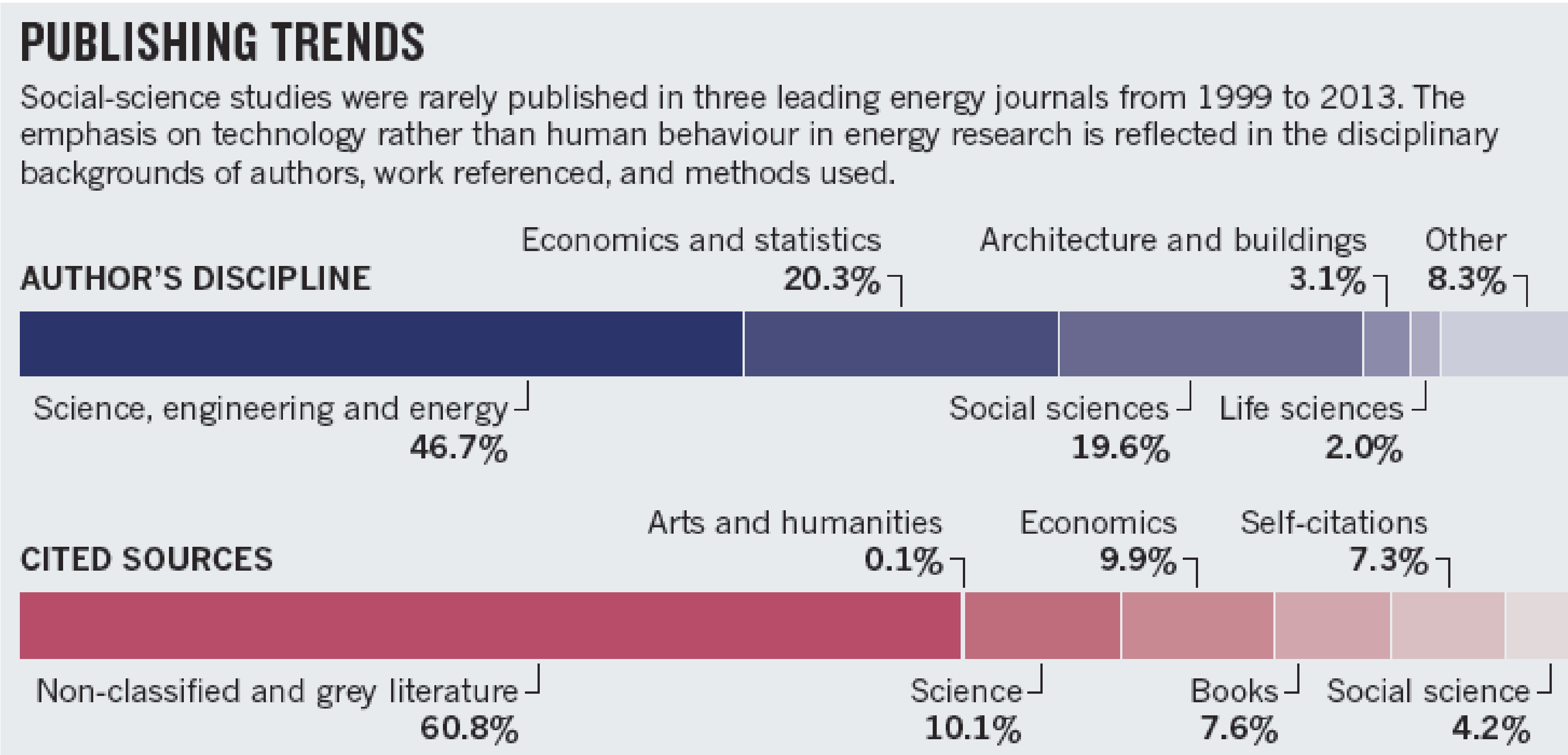


- Interdisciplinary and comparative collaborations were rare: By our calculations less than one out of every four articles reported interdisciplinary affiliations, taken as a proxy for interdisciplinary collaboration

Source: Sovacool, BK. "What Are We Doing Here? Analyzing Fifteen Years of Energy Scholarship and Proposing a Social Science Research Agenda," *Energy Research & Social Science* 1 (March, 2014), pp. 1-29

Finding 2: Under-representation of particular disciplines and sources as well (and countries)

Centre on Innovation and Energy Demand



Source: Sovacool, BK. "Energy Studies Need Social Science," *Nature* 511 (7511) (July 31, 2014), pp. 529-530.

Finding 3: Twelve under-represented topics

Centre on Innovation and Energy Demand

NEGLECTED TOPICS

Twelve subjects seldom considered in energy studies.

Topic	Example
Gender and identity	Pollution from cooking stoves posing greater risk to women than men
Philosophy and ethics	Future generations bearing the burden of pollution
Communication and persuasion	Energy information changing individual or firm behaviour
Geography and scale	Mismatching the size of energy systems to patterns of demand
Social psychology and behaviour	Shaping energy choices by trust, control and denial
Anthropology and culture	Temporal and regional differences in conceptions of energy services
Research and innovation	How people, markets and institutions drive innovation
Politics and political economy	Resources contributing to conflict or stymying growth
Institutions and energy governance	Evolving rules and norms to address collective energy problems
Energy and development	Energy use contributing to economic growth and falling poverty
Externalities and pollution	Costs to society of erosions of environmental and ecological capital
Sociology of technology	Economic, political and social drivers of energy consumption

Source: Sovacool, BK. "Energy Studies Need Social Science," *Nature* 511 (7511) (July 31, 2014), pp. 529-530.

Finding 4: Novel research needs incentivized

Centre on Innovation and Energy Demand

1. *If you like social science, fund it:* **public and private organizations** should give a bigger slice of funding to social scientists ($1-35 bias)
2. *Collect social data*: to reduce disciplinary bias, **energy ministries, statistical agencies and public utility commissions** should focus more on energy behaviour and demand, rather than just supply, and employ focus groups, interviews, surveys, etc. to create rich, complex narratives
3. *Focus on problems, not disciplines:* **University administrators** should make energy research more problem-oriented, including social perspectives, and tweak promotion guidelines to account for trans-disciplinary approaches
4. *Include others:* **researchers** should do more to accommodate expertise and data from laypersons, indigenous groups, community leaders and other non-conventional participants, and reach across disciplines, and beyond Europe and North America
5. *Incentivize social science methods and concepts*: **journal editors** can prioritize interdisciplinary, inclusive, comparative mixed-methods research in their aims and scope

Source: Sovacool, BK, SE Ryan, PC Stern, K Janda, G Rochlin, D Spreng, MJ Pasqualetti, H Wilhite, L Lutzenhiser, "Integrating Social Science in Energy Research," *Energy Research & Social Science* 6 (March, 2015), pp. 95-99

Finding 5: Challenges certainly remain

Centre on Innovation and Energy Demand

- As editor-in-chief, my anecdotal take from *Energy Research & Social Science* (and *Nature Energy*) is that:
  - North American and European authors still dominate, the English language barrier is real
  - Weak research designs, or none at all
  - Single country case studies (90% plus?)
  - Reliance on a single method (often primary data, which is good, but still …)
  - An emphasis on either theory, or policy relevance or application, but not both
  - Missing all of the above: authorship inclusive of the Global South, with strong research design, comparative cases, triangulated with mixed methods, that contribute both to theory and practice, <1%

Concluding thoughts

Centre on Innovation and Energy Demand

- Energy "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*

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

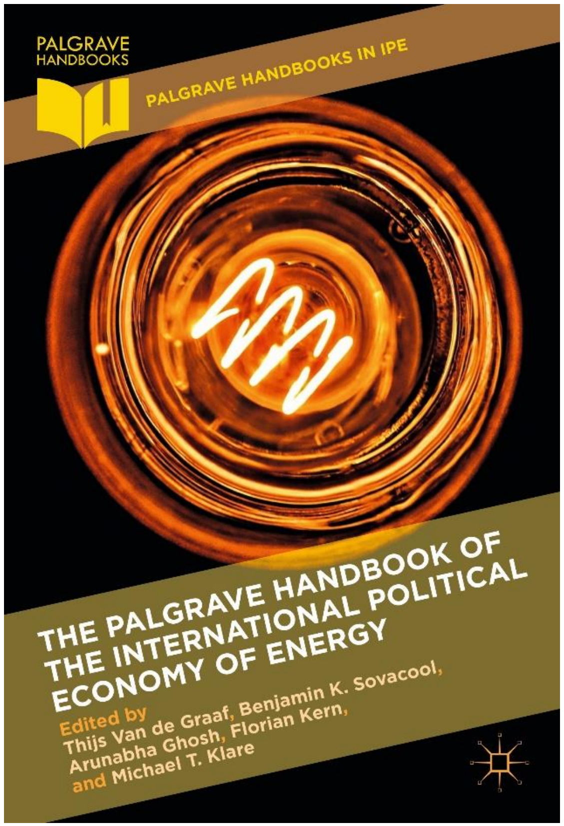
Social Sciences & Management
Suggested Disciplines: Accounting & Finance; Anthropology; Business & Management Studies; Communication, Cultural & Media Studies; Development Studies; Economics & Econometrics; Education; Law; Library & Information Management; Politics & International Studies; Sociology;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

Concluding thoughts

Centre on Innovation and Energy Demand

- The arts, humanities, and social science have immense value to offer the energy and climate communities
- There is a growing recognition within funding bodies, journals, universities, etc. that energy social science research needs to be more than an “afterthought”
- Truly robust, strong interdisciplinary studies remain the exception, rather than the norm
- At least we’re beginning to ask the right questions, even if we aren’t able to generate reliable, causal, robust, and replicable answers

Contact Information



Benjamin K. Sovacool, Ph.D
Professor of Energy Policy
University of Sussex
Jubilee Building, Room 367
Falmer, East Sussex, BN1 9SL
UK: 01273 877128
International: +44 1273 877128
B.Sovacool@sussex.ac.uk