FACT AND FICTION IN GLOBAL ENERGY POLICY

Fifteen Contentious Questions

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CONCLUSION

Values and Truth, Fact and Fiction in Global Energy Policy

In 1975, after the first oil shock and energy crisis of the decade had subsided, the US National Academies of Science launched an ambitious enterprise: it created the Committee on Nuclear and Alternative Energy Systems (CONAES), with the goal of providing a "detailed analysis of all aspects of the nation's energy situation."[1] To ensure broad stakeholder representation, an interdisciplinary committee was created. It enlisted members from universities, government laboratories, oil companies, instrument manufacturers, electric utilities, banks, and law firms. It solicited participation from engineers, physicists, geophysicists, economists, sociologists, ecologists, a physician, a banker, and a public interest attorney. The idea was that within two to three years, this committee should be able to produce a 150- to 200-page report presenting recommendations, based on a consensus of experts, as to which technologies the government should support and which it should not (meshing nicely with our conclusion in chapter 3).

Unfortunately, the result was a series of meetings that could have been hosted by Jerry Springer. As Philip Handler, president of the National Academy of Sciences, noted in 1978, "That first meeting of CONAES was remarkable; the tension seemed almost physical; profound suspicion was evident; first names were rarely used; the polarization of views concerning nuclear energy was explicit. Four years later, that polarization persists, and many of the same positions are still regularly defended."[2]

By 1981, contention and disagreement had swelled the report to 718 pages. Despite repeated rounds of external review, the experts were not able to reach any type of common ground. Eventually, the powers that be gave up and released a report with chapters split into competing "sides," encumbered by a sea of caveats. To get members to sign off on the publication, an appendix was included in which committee members could offer their "personal comments when they wished to clarify or take exception to statements in the text."[3]

The process of preparing the report demonstrates the difficulties faced by any group trying to arrive at agreement on energy issues. "It simply can't be done," CONAES committee chairman Harvey Brooks concluded, "at least not within any group that honestly represents the spectrum of defensible views in today's academic, intellectual, and industrial community."[4] If some of the brightest and best experts were unable to agree on the role of energy technology for just one country, should we be surprised that, globally, the problem of disharmony and disagreement is only amplified?

In this final chapter, we attempt to explain the contention manifest in our 15 questions. We argue that at least six causes of contention underpin the conflicting frames on energy issues: competing interests, rapid changes in technology or data, uncertainty, marginalization of certain stakeholders, competing values, and flat-out hubris. With the hope that readers might want to become part of the solution, we also offer some maxims for avoiding or minimizing contention, which center on understanding the sources of your own frame and the frames of others.

Causes of Contention

As we mentioned in the introduction to this book, a distinguishing feature of the volume is that it focuses on subjective frames—differing conceptions of reality, or worldviews—rather than on objective facts. Indeed, there are no less than eight competing energy frames permeating opposing positions on our 15 questions, as listed in table 16.1—and this list is probably far from exhaustive. Each of these frames influences how energy is conceptualized, what variables of analysis are important, how energy resources are valued, and indeed, what merits attention as an energy problem. One of the most popular frames, that of the "technological optimist," holds that we can fix practically any problem with technology. This cognitive frame of mind weaves through our chapters on energy efficiency, peak resources, shale gas, renewables, electric vehicles, biofuel, geoengineering, clean coal, and nuclear power. The technological optimist mindset embraces the notion that we can keep living as we do, as long as we keep innovating. This worldview is contested by notions that it is individual behavior or consumer demand that must be changed (the "conscientious consumer" frame) or that we should prioritize protection of the environment above and beyond the delivery of energy services (the "environmental preservationist" frame). Although all frames are not in conflict at all times, many harbor the potential for conflict. When it comes to complex issues like energy, with its numerous systemic influences, there is bound to be something that people with different frames can disagree over.

Viewing energy governance as a political venue populated by stakeholders with competing frames suggests that advocates of a particular energy system should recast their arguments based on whom they are addressing. For example, nuclear power can be opposed not only on national security grounds (weapons proliferation) and economic grounds (cost overruns and liability from accidents) but out of concerns about environmental ethics (damage from uranium

Table 16.1. Eight Competing Energy Frames

Icon	Frame	Explanation	Chapter(s) in which evident	Key proponents	Central value for energy resources	Focus of concerns
LED lightbulb	Technological optimists	Energy is merely a property of heat, motion, and electrical potential. We can design various technologies to provide it and to repair whatever damage is done.	2 (energy efficiency) 4 (peak resources) 5 (shale gas) 6 (renewables) 7 (electric vehicles) 8 (biofuel) 10 (geoengineering) 11 (clean coal) 12 (nuclear power)	Physicists, scientists, engineers, politicians	Efficiency	Inefficiency and entropy; environmental restrictions on expanded supply
Dollar bill	Free-market libertarians	Energy is a commodity, or collection of commodities, such as electricity, coal, oil, and natural gas. It is best managed by the free market.	2 (energy efficiency) 3 (government intervention) 4 (peak resources) 11 (clean coal) 13 (energy independence)	Economists, financiers	Price	Cartels and inefficient economic behavior; energy problems arising not as the result of imminent depletion of domestic or foreign reserves but from government policy errors exacerbated by the cartel-like actions of oil-producing nations

(continued)

Table 16.1. (continued)

Icon	Frame	Explanation	Chapter(s) in which evident	Key proponents	Central value for energy resources	Focus of concerns
Flag planted on a hilltop	Defenders of national security	Energy supply is a strategic resource that must be defended militarily.	3 (government intervention) 7 (electric vehicles) 8 (biofuel) 12 (nuclear power) 13 (energy independence) 15 (energy transitions)	Security experts, defense analysts, political scientists	Energy access; geopolitical stability	Uneven geographical concentration of energy resources; political instability of producing and consuming countries; declining availability of fuel substitutes
Giving a leg-up	Energy philanthropists	Energy services are a fundamental human right.	9 (climate change mitigation and adaptation) 12 (nuclear power) 14 (global crisis)	Nongovernmental organizations, aid groups, economic development theorists	Equity; empowerment	Indoor air pollution; inequality; energy poverty
Polar bear	Environmental preservationists	Energy production and distribution can be an environmental bane.	1 (pollution) 2 (energy efficiency) 9 (climate change mitigation and adaptation) 11 (clean coal) 14 (global crisis)	Environmentalists, consumer and public interest organizations, affluent households	Environmental footprint	Overconsumption of energy; externalities; rapid depletion of natural resources and ecosystem services

Scales	Justice advocates	Energy decisions must respect free, prior, informed consent and be equitable in their distribution of costs and benefits.	3 (government intervention) 9 (climate change mitigation and adaptation) 12 (nuclear power)	Lawyers, ethicists, philosophers	Equity, transparency	Unfair or inequitable energy planning; forced relocation of communities living near energy infrastructure
Pyramid	Neo-Marxists	The global energy system exploits class inequality.	9 (climate change mitigation and adaptation) 14 (global crisis) 15 (energy transitions)	Activists, socialists, unions, labor economists, political ecologists	Access, especially by class	Concentration of wealth; unfettered growth and expansion at the expense of communities and the environment; centralization and consolidation
Open book	Conscientious consumers	We consume energy to affirm or even realize our social values and lifestyles.	1 (pollution) 2 (energy efficiency)	Anthropologists, psychologists, sociologists, behavioral economists, corporate sustainability managers	Convenience, cleanliness, price	Energy illiteracy; incompatible or unsustainable values

Table 16.2. Six Causes of Contention in Energy Deliberations

Cause of contention	Explanation	Academic disciplines supporting this claim
Competing interests	Energy is big business and no one wants to lose when the loss amounts to one's livelihood.	Political economy, political science, economics, geography
Complexity and change	Stakeholders base their support on data and technology projections that are contentious and change rapidly.	Engineering, industrial processes, innovation studies, energy policy
Risk and uncertainty	Differing interpretations of hazards and their implications can convince people to make poor decisions.	Risk management, project management, social psychology
Undemocratic exclusion and injustice	Energy systems can exclude or marginalize people from the decision-making or licensing process.	Social justice, contemporary ethics, legal studies, policy analysis
Values and ideology	Distinct systems of values and beliefs can lead to competition over what should be prioritized.	Political science, sociology, anthropology, cultural studies
Energy evangelism	Energy is such a heated topic that the outcome can become a matter of religious or political faith—downgrading or ignoring opposing information.	Sociology of expectation, group psychology, communication studies

mines) or justice (exclusion from the decision-making or licensing process). Similarly, when trying to convince someone about the merits of energy efficiency, it can be sold as a boon for the environment (the least-cost way to save emissions), a leg up for national security (an effective way for lessening energy dependence), or an enabler of local employment (providing more jobs per unit of energy saved/delivered than alternatives). Indeed, this explains why multiple worldviews were represented in the discourse presented in each chapter.

Our list of frames in table 16.1 also implies that energy discussions of any real depth will ultimately sire disagreement rather than consensus. To further unpack this statement, we elaborate here on what we see as six likely sources of contention, drawn from a mosaic of academic research (table 16.2).

Competing Interests

Energy is big business, meaning that there is so much at stake that it can become a battleground for competing interests. In a typical year, almost one in seven dollars in your pocket eventually finds its way to the energy sector. Direct energy expenditures in 2012 amounted to $1.42 trillion in the United States, or about $4,560 per capita (10.4% of gross domestic product).[5] International purchases of oil and gas amount to roughly $1.2 trillion per year (meaning that two-thirds of all oil and gas is traded internationally), in addition to another $1 trillion in annual revenues from the extractive industries sector, to which coal is the largest contributor. No less than 200 billion barrels of crude oil, worth some $20 trillion, are traded as stocks or futures each year. These staggering amounts say nothing about investments "sunk" into energy infrastructure over the past century,[6] which could add another $30 to $50 trillion to the equation.[7]

Entrenched interests are everywhere. One estimate places the global workforce at roughly three billion workers, with 21% of that workforce engaged in industrial activities directly connected to energy extraction, production, and consumption. This figure—630 million workers—excludes those employed in energy-intensive sectors such as agriculture or building construction.[8] Economic interests committed to energy production begin at the extraction phase, in exploring and drilling for oil and natural gas, mining coal and uranium, cultivating biomass, building dams, and harvesting wind and solar energy for power production. At the manufacturing stage—refining oil, processing natural gas, cleaning coal, pelletizing and refining biomass, and transporting energy commodities—a prodigious number of activities take place, and each activity is supported by embedded investment, contractual commitments to workers, and political ties.[9] There are also thousands of energy-related companies at later stages of energy conversion and use. For instance, the United States has more electric utilities—inclusive of large investor-owned utilities, rural electricity cooperatives, government power providers, and smaller distribution and transmission utilities—than it has Burger King restaurants.[10] As in the upstream situation, each of these downstream enterprises has entrenched investments that engender opposition to change. So eliciting change is not just about convincing behemoths such as the ExxonMobils of the world to embrace wind power. The challenge is less akin to turning a supertanker and more akin to trying to align a cluster of marbles atop a table on a sailboat in rough seas.

Entrenched interests of this type suggest that contention and power struggles are inevitable and unavoidable features of energy decision making; they can perhaps be managed but are never eliminated. Energy (and climate policy) is not just "a tradeoff between the present and the future, but also a tradeoff between winners and losers at any given time."[11] As such, analysts need to be more open to the probability that a given energy pathway will distribute benefits inequitably and more willing to accept that there will always be relative losers. Controversy can be particularly sharp when the effort to reduce environmental or health risks may jeopardize other socially valued objectives such as employment and economic growth.[12]

Complexity and Change

Rapid changes in technological capability, resource availability, and prices wreak havoc on data analysis. Unfortunately, data in the energy sector turn over much faster than peoples' convictions—meaning that many people continue to cling to positions supported by obsolete information.

Consider how economic changes in conventional energy alone can alter analyses. Figure 16.1 depicts the market prices of all four major energy fuels from 2004 to 2011. During this period, oil prices oscillated from a low of $37 to a high of $96 per barrel; natural gas prices from a low of $11 to a high of $15.60 per million cubic feet (Mcf); coal from a low of $42 to a high of $98 per ton; and uranium from a low of $15 to a high of $88 per pound.

Energy prices are increasingly subject to capricious change in response to a variety of influences. The price of oil, for instance, jumped dramatically during the oil shocks of the 1970s, during both Gulf Wars, and during the "Arab Spring" of 2011, among other events. The price of natural gas at the Henry Hub trading point in New York skyrocketed from $6.20 per million BTUs (MMBtu) in 1998 to $14.50 in 2001, then dropped precipitously for almost a year, only to rebound again.[13] Hurricane Katrina caused similar price spikes for both oil and gas when the storm disrupted natural gas refining and reprocessing infrastructure in the Southeastern United States. Transportation bottlenecks and demand surges in major developing countries such as India and China have been partly to blame for coal price increases. Other influences such as constricted rail service, flooding, hurricanes affecting barge routes, mine closures, and restrictions on mountain top removal also increasingly influence energy market dynamics. Even the predominant fuel for nuclear power plants, uranium, has exhibited considerable volatility. The cost of uranium jumped from $7.25 per pound in 2001 to $47.25 in 2006, an increase of more than 600%. With price swings of this magnitude, discussions about comparative economic value take on bipolar characteristics. Someone debating the economic merits of natural gas over coal in 2006 would have been in a far weaker position than in a debate over the same issue in 2008. What a difference two years can make in the energy sector.

Complexity and rapid change are eroding humans' ability to rationally manage energy systems. Work on improving cooperation for solving social problems suggests that some variables are key to success.[14] These variables include the availability of high-quality, accurate information and predictable changes in technology and institutions. Conversely, complexity and change are corrosive for effective governance and cooperative efforts because change gives rise to arguments over whether the emergent trend is sustainable, subject to regression, or just temporary.

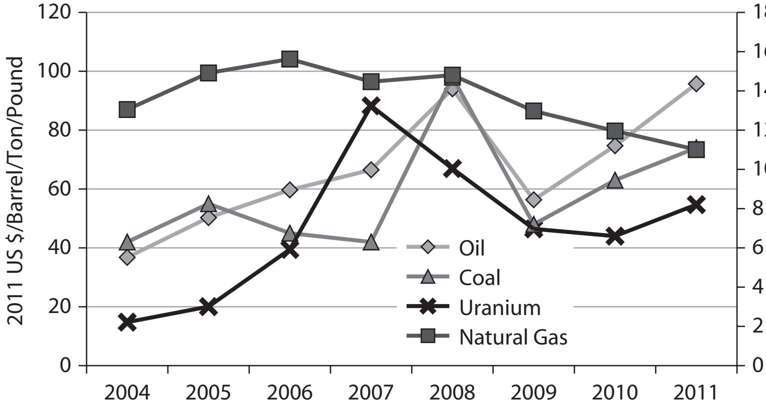

Figure 16.1. Yearly Average Energy Prices, 2004–2011 *Sources:* Coal data from CAPP/NYMEX Coal Futures Settlement Prices of Central Appalachian; oil data from the Cushing, OK, WTI Spot Price FOB; natural gas data from the Henry Hub Gulf Coast Natural Gas Spot Price; uranium data from the Nuexco exchange spot price. *Note: Left axis:* uranium—weighted average price, uranium spot contracts, dollars per pound U_3O_8 equivalent; oil—US Crude Oil First Purchase Price, dollars per barrel; coal—dollars per ton, Central Appalachian bituminous. *Right axis:* natural gas—Annual Residential US Natural Gas Price, dollars per million cubic feet (Mcf).

The complex nature of many technological markets also hampers predictions about the future. Here are a few humorous but revealing examples of just how off-base experts can be:

- Octave Chanute, American aviation pioneer, 1904: “Airplanes will eventually be fast, they will be used in sport, but they are not to be thought of as commercial carriers. To say nothing of the danger, the sizes must remain small and the passengers few, because the weight will, for the same design, increase as the cube of the dimensions, while the supporting surfaces will only increase as the square.”[15]
- Clark Woodward, admiral in the US Navy, 1939: “As far as sinking a ship with a bomb is concerned, you just can’t do it.”[16]
- Thomas Watson, future CEO of IBM, 1943: “I think there is a world market for maybe five computers.”[17]
- Dekka Recording, 1962, after rejecting the Beatles: “We don’t like their sound, and guitar music is on the way out.”[18]
- Lawrence Rocks and Richard Runyon, energy analysts, 1972: “[China] will never be an economic super-state because of her low energy resources.”[19]
- Margaret Thatcher, future prime minister of the United Kingdom, 1974: “It will be years—not in my time—before a woman will become Prime Minister.”[20]

All of these erroneous forecasts were based on historical extrapolation of trend data that still proved to be wrong. In other words, these forecasters had no empirical evidence to support an alternative perspective, and so they clung to their beliefs in the face of disconcerting evidence—a ripe cause of contention that we see in many of our chapters.

Risk and Uncertainty

It is normally assumed that knowledge reduces uncertainty and so improves decision making. But as many of our chapters show, aleatory uncertainty (that which we cannot know) in complex systems (wicked problems) leads to a situation in which stakeholders with more knowledge (albeit still incomplete) become further entrenched in their positions and make worse decisions. The best example of this concerns support for nuclear power. Compared with the average insurance company underwriter, nuclear engineers have far more technological knowledge about nuclear plant operations. Yet, despite this advanced knowledge, these engineers are far more likely to discount aleatory risk to support nuclear power. Indeed, we know this to be true because no Japanese power plants have been underwritten by insurance policies. After Fukushima, it turns out that the individuals who were less "well-informed" made the better decisions.[21] Similarly, contention can arise over whether consequences are viewed as reversible or irreversible. When effects are irreversible (such as the alteration of a river for a hydroelectric dam or the extinction of a species), they may be even more difficult to resolve.

Conflicts over the feasibility, viability, or desirability of a given technology often boil down to different interpretations of "systemic risk"—hazards that are complex, uncertain, and ambiguous and have the potential to reverberate throughout political, social, and economic dimensions.[22] Consider two competing frames—free-market libertarian and environmental preservationist—and their disagreement over a technological option such as carbon capture and storage (CCS). Those embracing free-market libertarianism perceive extreme risk in abandoning the status quo (dependence on fossil fuel). To them, the riskiest course of action is to transition away from conventional energy because this will erode corporate profits and alter control over the global energy system. At risk, for them, are millions of jobs and trillions of dollars of infrastructure. Their conclusion is to support CCS. Conversely, the environmental preservationists perceive the greatest risk to lie in continuing to support a technology that continues to devastate the environment. To them, doing nothing births future crises, and technical fixes represent unknown risks that can never be fully predicted or controlled. They argue that applying technology on a global environmental scale is suicidal—it should be avoided as a matter of self-preservation and precaution. Their stance is to oppose CCS.

Nuclear power offers a good example of how even shared frames can be in conflict. Justice advocates might point to the risks of having no energy at all—societies in the developing world left, literally, in the dark, with the extreme injustices and health effects of energy poverty. To these individuals, nuclear power is a necessary evil, a tool that can expand access to modern electricity networks and minimize the amount of life-endangering soot and smoke choked down by mothers and young children. Other justice advocates might oppose nuclear energy due to the risks involved in its fuel cycle (such as contamination of indigenous community lands by uranium tailings), its connection to weapons of mass destruction, or the massive consequences of a serious accident (typically affecting underprivileged and/or minority populations the most). Both groups agree that the risks are huge, but they view them in opposite ways with opposing courses of recommended action.

Undemocratic Exclusion and Injustice

Another source of contention is exclusion and injustice in matters of energy: marginalizing people or excluding them entirely from the decision-making process. This can involve involuntary resettlement, lack of consent for an energy project, marginalization of communities living near energy infrastructure, or exclusion from input into the policymaking process. Chapter 5 (shale gas), chapter 6 (renewable electricity), and chapter 12 (nuclear power) all present evidence of how such exclusion can germinate into actual opposition to a particular energy system. More egregious are the cases presented in chapter 14 (global energy security) of people being forcibly resettled due to mining, energy infrastructure, and climate change projects around the world—people who ended up losing their homes, their livelihoods, and in some situations their dignity. A global study warns that the impact of such displacement often extends beyond loss of land to include joblessness, homelessness, marginalization, food insecurity, increased health risks, social disarticulation, and the loss of civil and human rights.[23]

These actions provoke conflict because they are seen as unjust—as violating time-honored notions of due process and justice. Procedural justice refers to equity in the process of allocating costs and benefits (i.e., transparency and access), whereas distributive justice refers to equity in the final allocation of costs and benefits (who gets what and who is charged what). As geographers John Farrington and Conor Farrington put it, "A just society is one that inter alia grants the opportunity of participation in society to all of its members, and a society will certainly be unjust if it does not grant this opportunity to all of its members. Thus, a just society is inter alia a socially inclusive one, and a society is unjust if it is a socially exclusive one."[24] Such procedures are an instrumental part of preserving basic fundamental liberties, and sociologist Claire Haggett suggests that without due process, public support for any given technological system will decline precipitously. As she writes, "While fiscal regulations and subsidies, technical efficiency and political deliberations all affect the deployment of renewables, the stark fact remains that all of this matters little if there is no public support for a development."[25] Conflict will probably be lessened if principles of procedural and distributive justice are followed.[26] If injustice of either type is evident, the possibility of stakeholder opposition will be far greater.

Values and Ideology

Sometimes, a conflict over a given energy option is not only about risk assessment—that is, the hazards—but also about values. Unlike a preference, a value is a nonnegotiable principle that causes a stakeholder to prioritize one thing over another: values provide "a standard for assessing our behavior and that of others."[27] As coalition expert Paul Sabatier explains, core values rarely change over short time spans, and when they become a factor in an energy decision, the importance of all other variables tends to be deemphasized.[28] Therefore, competing values, if present in an energy decision, can result in heated conflict.

An astute reader might ask at this time, how can nuclear power (or any other technology) be value-laden? What, after all, is the core value that could underpin support for nuclear power? Some nuclear power supporters base their support on a concern for the environment. James Hansen, for example, argues that climate change is by far the most serious threat humankind faces and that alternative sources of noncarbon energy are insufficient to expedite the energy transition needed to avert the worst perils attributed to climate change.[29] Therefore, one could argue that for Hansen and colleagues, the underlying value is an environmental ethic: environment first. Yet, for this "value" to underpin support for nuclear power, a non-value-laden assumption is necessary: alternative sources of noncarbon energy are insufficient. In this example, as in many of the other value-laden debates discussed in this book, a value has become attached to a given solution, not because it is inherently attached, but because the proponent of the solution linked that solution ineluctably with that particular value. This is an important distinction: energy debates are not about values; they are about ideologies masquerading as values. Ideologies are different; they are not always healthy, nor are they always premised on real values.

In many of our chapters, we saw contentious perspectives sustained by a broad array of ideologies. Consider the chapters on climate change (looking at mitigation and adaptation, geoengineering, and clean coal). The pathways dif-

Table 16.3. Comparative Analysis of Mitigation, Clean Coal, Geoengineering, and Adaptation

Category	Mitigation	Clean coal	Geoengineering	Adaptation
Timing	Costs now, benefits delayed	Costs now, benefits later	Costs now, benefits very soon	Costs whenever, benefits may be relatively soon after
Temporal incidence	Costs now, benefits to later generations	Costs now, benefits now and to later generations	Benefits mostly to the generation bearing the costs	Benefits mostly to the generation bearing the costs
Geographical incidence	Local costs, global benefits	Local costs, local and global benefits	Local or broader costs, global benefits	Local costs, often relatively local benefits
Sectoral incidence	Focus on emissions from energy consumption	Focus on energy-intensive industries (cement, iron, and steel) and power plants	Only a few options are likely to garner political support	Highly heterogeneous
Relation to uncertainty	Must act early despite greater uncertainty	Must act early despite greater uncertainty	May act later after reducing uncertainty	May act later after reducing uncertainty
Governance issues	Dominated by national goals and international negotiations	Dominated by traditional energy companies and those with significant storage capacity	International oversight needed because of possible actions of rogue nations and individuals acting on their own	Dominated by state and local agencies, but need for coordination is great

fer in terms of timing, temporal and geographical incidence, relation to uncertainty, and governance (table 16.3). These differences can become polarized—people who support putting off dealing with the problem are irresponsible; those who suggest prompt action are hasty—and when this happens, groups become ideologically divided. One cannot support the alternative view because it would mean spurning a value of great importance, regardless of whether the ideology in question is really supported or justified by the value.

The debate over the advisability of geoengineering or CCS is predicated on ideologies pertaining to human progress and technological confidence. One view attaches a high degree of confidence to technological ingenuity, based on historical achievements. Through technology, we are living longer, healthier, and more literate, entertained, luxurious, and fulfilling lives. As E. O Wilson caricatured, "Genius and effort have transformed the environment to the benefit of human life. We have turned a wild and inhospitable world into a garden.

Human dominance is Earth's destiny. The harmful perturbations we have caused can be moderated and reversed as we go along."[30] Geoengineering and clean coal exemplify this ideology of technological ingenuity overcoming a (sometimes) hostile environment. We are, in this perspective, a planet of engineers who are progressively tasked with fine-tuning an engine that we understand well enough to accommodate any contingency.

A competing ideology argues that the earth's environmental endowments and ecological systems have evolved over billions of years to form a complicated adaptive system that is locked together by numerous pliable yet ultimately fragile connections. As Wilson, again, put it, "The biosphere creates our special world anew every day, every minute, and holds it in a unique, shimmering physical disequilibrium. On that disequilibrium the human species is in total thrall. When we alter the biosphere in any direction, we move the environment away from the delicate dance of biology."[31] Interfering with this system, which we neither control nor comprehend, threatens our own existence. Geoengineering and clean coal, in this view, ignorantly and recklessly interfere with supple biological and terrestrial systems that have cradled and nursed humanity through the eons.[32] We are, in this perspective, a planet of untrained tinkerers who are progressively tasked with fine-tuning an engine that runs on a technology with which we are unfamiliar, using a set of tools that might or might not be sufficient for the job.

Such competing ideologies breed conflict precisely because the thing becomes a symbol for the ideology. To argue that we should embrace simpler technological options is tantamount to saying that we have lost control of our destinies—even though opponents are not necessarily making such an argument. That is the inherent problem with ideological conflict: the thing under contention becomes a proxy for the ideology itself. It does not matter whether there are better alternatives to support the ideology or whether the ideology is even based on verifiable facts. When a thing becomes an ideology, it becomes *the* ideology.

Energy Evangelism

As alluded to earlier, sometimes contention arises not from rational thought or a clash of ideologies but from misplaced expectations. Put another way, hope can affect how one favors a certain energy system over another, meaning that actors become converts to a particular symbolic vision. Visions for the future are key elements in the process of technological development and acceptance.[33] Two science and technology specialists, writing about "sociotechnical imaginaries" percolating into nuclear research in South Korea and the United States, point out that national "imaginations can penetrate the very designs and practices of scientific research and technological development."[34] To this day, proponents of nuclear power are still chasing the vision put forth in the 1950s of nuclear energy becoming "too cheap to meter."[35] The continuing controversy over nuclear energy is as much about a series of serious mismatches between expectations and experience as it is about, say, the cost of reactors or the risk of accidents.[36]

Such technological visions and/or rhetorical fantasies can sow contention in at least three ways. First, they become exclusionary and self-replicating, convincing those who do not share these visions to leave a project or disciplinary field entirely.[37] Second, they convince sponsors to underestimate costs and overestimate benefits. In their comparative survey of nuclear power programs in several countries, John Byrne and Steve Hoffman noted that nuclear power has been and continues to be evaluated in the "future tense," that is, in terms of what it will bring rather than what it has already wrought. In short, advocates are guilty of "sweeping away current concerns for future gains."[38] Third, technological fantasy can breed contention by convincing powerful stakeholders to endorse a technology with almost religious fervor, pinning it to utopian narratives about how grandly society will be changed once a particular technology is adopted. For another example of this phenomenon, one need only harken back to the US Republican presidential campaign of 2008, with Sarah Palin leading a room full of adults in an exalted chant of "Drill, baby, drill." More recently, the Tea Party has created a historical alliance with the Sierra Club, known as the Green Tea Coalition, that has been fighting with evangelical zeal for increasing the use of solar power.[39]

Developing deep attachment to technologies in which one has a financial, reputational, political, or vocational stake is not new. One study found this "utopian" and "religious" theme was present in historical deliberations about steam engines, automobiles, hydroelectricity, and nuclear energy.[40] Even experts have been shown to suffer from varying degrees of "trained incapacity,"[41] "selective remembrance,"[42] and "occupational psychosis,"[43] related terms that describe how people prepare to see the world in certain ways, while simultaneously developing a bias that blinds them to other perspectives. This is extremely corrosive to deliberative discourse, particularly in rapidly evolving technology markets. As one study noted, "Public discourse suffers because our society has mechanisms only for resolving conflicting interests, not conflicting views of reality."[44]

Six Maxims for Readers

In reflecting on the 15 questions in this book and the causes for contention discussed above, we wanted to offer some parting guidance to help improve analytical skills in energy governance and decision making. The following six maxims or solutions can help bring far better perspective and understanding to the analysis of energy problems. For readers who are members of the general public, this will make you better citizens; for policymakers, this will make you better practitioners:

1. Know the players: To reveal competing interests, understand where the power lies and how it manifests itself in energy decisions.
2. Inform yourself: To counter the rapidity of change, keep up-to-date and educate yourself about energy technologies and issues.
3. Be prudent about risk: To manage risk and uncertainty, attempt to make energy decisions that are based on clear ethical principles and are well-informed by science.
4. Seek diversity and inclusivity: To avoid undemocratic exclusion and opposition by special interest groups, remember that energy decisions must meet the needs of a broad spectrum of citizens and stakeholders.
5. Practice self-reflection: To understand underlying ideologies, strive to become aware of your own ideological frames that might prohibit a balanced analysis.
6. Embrace technological agnosticism: To avoid energy evangelism, look beyond a given energy technology to the services it provides, and recognize that many systems can deliver the same solution.

Know the Players

To address competing interests, our first maxim is to seek to know the players: make the interests behind an energy system transparent, acknowledge trade-offs, and expect push-back. Readers can start by making an attempt to understand the undercurrents in support of a given energy system. In short, continually ask, "Energy *for whom*?" or "*Who* benefits from this frame?"

Understanding the relationship between power and technological dominance is important on three levels. First, it reminds us that the existing energy regime—with its gas stations, oil refineries, electricity substations, transmission lines, extensive natural gas pipelines, coal mines, and varying types of generating and consuming technology—was and is by no means inevitable. The success of incumbent technologies is the product of coercion, competition, and politicking. Since the current system was created and entrenched by people, it can also be changed by people, but to do so requires competitive engagement with powerful foes.

Second, clarifying why certain stakeholder groups support certain energy technologies allows us to study and analyze the enabling factors that create winners and losers. The implication of this is that a technology can acquire market appeal in two ways: by possessing superior technology or by possessing stakeholder appeal. The Danish wind power industry is a case in point. Initially, the Danish government's strategy was to encourage large manufacturing concerns to lead a wave of wind power development that was predicated on economies of scale. When it became apparent that larger firms were not interested in this market niche and that support for wind power came largely from farmers and farming cooperatives, the government altered its policy to encourage cooperative investment.[45] The success of this is now evident when viewing the vistas in virtually every rural area throughout Denmark.

Third, revealing competing interests highlights the fact that competition will always exist among certain energy options, meaning that we should expect push-back because there will inevitably be losers with any change. Satisfying everybody or every energy objective is an elusive aim. As evidence of this, one study investigated five distinct strategic approaches designed to lessen a country's dependence on imported fuels, to provide energy services at the cheapest price possible, to enable universal access to electricity grids, to mitigate greenhouse gas emissions, and to foster energy systems that can operate under conditions of water stress and scarcity.[46] The authors concluded that each of the five strategies was, more often than not, in conflict with the others. A group that supports climate change mitigation might advocate a ramped-up presence for nuclear power, whereas a group supporting water security might seek to phase out nuclear power. No single strategy optimized all energy security criteria.

In sum, for most stakeholders in the energy sector, energy policy is a zero sum game, where change means that someone gains at someone else's expense.[47] Although some of the conflicts that arise when trying to bolster energy security could be attenuated through better strategic planning, there is no silver bullet when it comes to optimizing energy security—or pleasing all interests. Conflict and power relations are inescapable in the global energy system.

Inform Yourself

To counter rapid changes in energy technologies, prices, resources, and so on, we urge readers to stay informed. Critical to this challenge is to ensure that the sources of your knowledge are diverse so as to avoid becoming biased by the media or others. We also urge policymakers and planners to support public education outreach programs. Thomas Jefferson is attributed with the saying that "a democratic society depends upon an informed and educated citizenry," but for education to occur, people have to be informed "even against their will."[48]

With that said, information and education programs must be carefully tailored to suit the audience. Information is less likely to be used if accessing or interpreting it requires the assistance of an expert. When stakeholder response is an objective of an education campaign, change directed at behavior perceived to be directly under the individual's control, involves few barriers or adjustments, and includes built-in incentives (or lacks disincentives) tends to be the easiest to initiate.[49] Psychologists Renee J. Bator and Robert B. Cialdini, for example, found that public information campaigns can accomplish their goals if they (1) recognize saturation and realize that their message must compete with thousands of others, (2) set achievable goals that emphasize moderate and easy changes in behavior, and (3) target specific audiences and thoroughly understand the demographics, lifestyles, values, and habits of each audience.[50] When structured this way, public information campaigns have changed norms and shifted social attitudes. This is exemplified by specific programs for mitigating household hazardous waste disposal and littering, which reduced these undesirable behaviors by 10% to 20%.[51]

Unfortunately, delivering information to stakeholders in the proper manner is just part of the battle. As the old adage suggests, you can lead a horse to water but you can't make it drink. Recent studies in psychology show that many consumers don't *want* to be better informed about problematic issues such as climate change; instead, they seek to deny that the problem exists so as to assuage feelings of guilt and shame.[52] The implication is that individuals will work to avoid feelings of responsibility for energy insecurity and climate change; some will even cultivate optimistic biases, downgrading any negative information they receive and counterbalancing it with almost irrational exuberance.[53]

Lamentably, formal education is often counterproductive in terms of instilling environmental awareness. Some research suggests that the educational system, far from producing independent thinkers who want to change the world, more often than not serves to entrench the types of material consumption that are responsible for many of our environmental woes.[54] The educational system, according to one education historian, is about creating "masses of industrious workers, loyal subjects, and faithful church members," socializing them into the modern economy.[55] It is therefore unrealistic and perhaps even counterproductive to hope that "education" will solve energy problems, if it indoctrinates us into the global capitalist system underlying many of the energy problems identified in this book. Education is a good start, to be sure, but it remains an imperfect solution. This is why our other maxims are also needed.

Be Prudent about Risk

To learn to discern risk and uncertainty, another maxim must be pursued: strive to be comprehensive in your search for information and look for the hidden linkages. At its core, emergent technology can be considered a response to some earlier flawed technology. Therefore, all new technologies will inevitably possess weaknesses that an analyst must try to identify. A truly prudent energy strategy is one that is comprehensively informed, interdisciplinarily aware, and ethical.

Just as the technological options in the energy sector are diverse, so, too, are the criteria for judging the acceptability of a given technology. The following types of questions can be raised whenever one considers the desirability of a particular energy technology or pathway:

1. Does it harm the environment?
2. Does it degrade the social structure of local communities?
3. Does it damage traditional culture?
4. Does it benefit local economies and utilize local resources?
5. Does it provide education or local participation?
6. Does it promote efforts aimed at conservation and efficiency?
7. Does it foster the well-being of future generations?

While the importance of such questions may appear obvious, most assessments of energy technology continue to ignore the entire range of possible impacts that a given energy system can have on society.

Further complicating evaluation is that some technological decisions serve certain social and environmental goals while directly undermining others. For instance, the deployment of a large nuclear power plant in a small rural community could greatly benefit a select few in the local economy and might even be of value in stimulating industrial growth, but it would also put the community at risk for the sake of electricity that will largely be exported to remote power markets. Similarly, building a large dam may help displace a polluting coal plant (thus improving the environment) but, in the process, destroy aquatic habitats and force widespread relocation of homes and businesses.

Risk profiles not only vary with technology but also change over time. Some technologies, notably energy efficiency and small-scale renewables, produce more easily managed risks. As energy sustainability specialist Mark Diesendorf pointed out, when a nuclear power plant explodes, it is a global disaster; when a solar plant explodes, it is otherwise just another sunny day.[56] For many technologies, risk profiles depend critically on how the technologies are designed and operated. Our chapters have touched on a host of best-practice principles for risky energy systems such as shale gas, coal, and nuclear power. Many of the adverse effects of shale gas are attenuated when waste and fracking fluid discharges are properly monitored, when methane leaks are accounted for, and when siting in environmentally or geologically sensitive areas is avoided. Improvements in occupational safety at coal mines, integrated closure programs and remediation activities after mine closures, and pollution controls at power plants can make coal cleaner. Fully accounting for decommissioning and accident liability costs, enriching uranium with renewable electricity, and following state-of-the-art safety procedures can improve the risk profile of nuclear reactors. Risks for these energy systems can never be eliminated, but there are techniques to better manage them.

Seek Diversity and Inclusion

To minimize exclusion, our fourth maxim suggests that diverse viewpoints and public needs must be comprehensively woven into energy policy decisions. This helps appease competing factions and reduces the costs associated with stakeholder dissent and opposition. Inclusion of input from diverse actors spread across many disciplines, social classes, cultures, and geographical locations also enhances feedback, reduces groupthink, and improves decision making. Public policy analyst Harvey Brooks noted that scientific disputes have always been value-laden, and no practical way of disentangling social interests from technical issues exists.[57] Brooks concluded that policy issues could be resolved only by bringing experts and generalists from the public together so that the values and preferences of the masses were heard. He suggested that this strategy leverages two types of expertise: specialists provide expertise from their fields, while generalists provide expertise on the preferences of society. “Only continual confrontation between generalists and experts,” Brooks concluded, “can synthesize the values of society and the facts of nature into a policy decision that is both politically legitimate and consistent with the current state of technical knowledge.”[58]

In a just society, citizens have a right to knowledge and information, a right to participation, a right to guarantees of informed consent, and a right to life or protection from danger.[59] These rights need to be exercised, however, because to adequately address many of the hazards in modern society—dangerous chemicals and wastes, nuclear power, genetically engineered organisms—the public must be engaged in the policymaking process.

One useful tool for fostering diversity, inclusion, and justice is critical stakeholder analysis, a technique for identifying actors connected to a particular project or energy system. Critical stakeholder analysis can jumpstart dialogue and facilitate discussions among previously disconnected actors, making this process an important component of democratic decision making. It can also reveal power asymmetries among stakeholders. The process of identifying stakeholder interests can promote a common understanding of key agendas and help incentivize collaboration. By making the power relations of stakeholders more visible, critical stakeholder analysis can improve social responsibility and result in acceptable change.[60]

As such, we encourage active participation by all parties in energy discussions so that the energy technology preferences selected for integration into society better match interests and values. Moreover, we must all remain aware that decisions made today affect not only the lives of all who currently tread this planet but the lives of all who come after us. We have an obligation to balance our interests with theirs.

Practice Self-reflection

Our fifth maxim encourages enhanced self-reflection: we all must become more aware of our hidden values and ideological frames and the weaknesses of the assumptions sustaining them. By understanding why we embrace the energy perspectives we do, we can begin to understand how we prioritize issues and, accordingly, how this differs from the way that others prioritize things.

Part of this process involves realizing that even monkeys fall from trees. As proof, psychologist Philip Tetlock studied 284 "experts" who made their living commenting or offering advice on political, social, and economic trends.[61] At the end of the study, after these experts had made 82,361 forecasts, Tetlock found that the specialists were not significantly more reliable than nonspecialists in predicting events. Louis Menand adds that the experts surveyed by Tetlock performed worse than they would have if they had simply assigned an equal probability to the occurrence of different outcomes. "Human beings who spend their lives studying the state of the world," Menand concludes, "are poorer forecasters than dart-throwing monkeys, who would have distributed their picks evenly."[62]

Why are even smart people so prone to making these mistakes? Experts fall in love with their hunches, and they really hate to be wrong. Most people, including experts, tend to dismiss new information that does not fit with what they already believe. Experts use a double standard: they are tough in assessing the validity of information that undercuts their worldview, but lax in scrutinizing information that supports their worldview.

The problems that stem from blinkered or biased perspectives on an issue can be reduced considerably by nurturing a habit of skepticism about one's own knowledge. Sociologist Steve Woolgar refers to this as benign introspection.[63] Sociologist Michael Lynch adds that enhancing self-awareness can include training oneself to recognize the philosophical roots and historical context of one's views—or what we have called frames. By becoming more self-aware, we become more conscious of personal biases and learn to reflect critically on the wellsprings of our own personal values.[64]

Embrace Technological Agnosticism

To stop energy evangelists from establishing a cult of ill-informed followers, our final suggestion is to encourage technological agnosticism by focusing on energy services rather than energy systems. We tend to forget that energy provision is a means to an end, not an end in itself. Energy is useful only insofar as it performs tasks that serve human needs. We do not consume electricity or oil for the fun of it; rather, we consume it to provide thermal comfort, cooked food, hot water, television shows, recorded music, and a host of other services. We don't absolutely need to drill, mine, leech, extract, and deplete natural resources at breakneck speed to achieve this, but we do need a way to provide humanity with the service of energizing our lifestyles.

Such a statement, while obvious to many energy analysts, has somewhat profound implications.[65] Practicing technological agnosticism reorients the direction of energy policy interventions. Proper policy no longer centers on securing barrels of oil or tons of coal as an end in itself, but focuses on optimizing human mobility and comfort. This might include the promotion of walking, cycling, and running paths to enhance mobility rather than focusing only on refineries or roads for cars. Technological agnosticism is centered in the notion that many technologies can provide the same energy service. Indeed, at the current scale of energy demand, there is no single technology that can satisfy all energy needs without creating other problems; instead, a portfolio of options is the only viable approach. As Oxford climate change policy researchers Prins and Rayner suggest, agnosticism implies that rather than a silver bullet, the solution lies in silver buckshot.[66]

Engines and Mirrors, Values and Truth, Fact and Fiction

Overall, this book has attempted to educate and inform readers by pulling back the curtain to reveal some of the precepts underlying contention in energy policy. Asymmetric knowledge, vested interests, and competing ideologies produce fertile ground for deep-rooted disagreement. In the energy world, the only truth is that there is no such thing as a single, overarching perspective when it comes to our 15 questions. Nonetheless, we offer readers some parting thoughts.

Energy systems can be thought of as both engines and mirrors of society. They support goods and services that propel economic development. As economist E. F. Schumacher put it, energy "is not just another commodity, but the precondition of all commodities, a basic factor equal with air, water, and earth."[67] Yet energy systems also reflect human values and provide insight into the leanings of power. This means that purely technical solutions to our energy problems will continue to be contested as long as technologies create winners and losers and the values and ideologies underpinning these technologies remain hidden. Controversy and dissent are basic elements of energy policy.

Given that key questions about energy have less to do with facts and more to do with assumptions and frames, more information or better data will seldom fully resolve conflict. Most people will dismiss data that challenge their worldviews, even if the information is reliable. Provision of information is not always an efficacious mechanism for altering frames; one merely needs to look to politics across the world, where attempts to challenge ideologies can very well do the opposite and further strengthen incumbents. This is particularly true when there are entrenched investments—a prevalent characteristic of the energy sector. Consequently, we can expect energy to remain a contentious topic even after our 15 questions have faded from relevance. So, rather than attempting to marshal "facts" whenever one encounters seemingly illogical support for a particular technology, a better strategy is to endeavor to define vested interests and ideologies and to ask what is at stake and who benefits. This will not yield a solution, but it will explain the seemingly irrational.

As we have seen, energy decisions are not determined by objective fact but by contextual truth, supplemented by a dose of invented, soothing fiction. In many ways, understanding why some ineffective energy technologies move forward while other promising technologies fail to make it to the premier leagues requires advanced detective skills. We need to follow the money, look for clues that reveal entrenched ideologies, and try to strip away the fiction so we can better understand how context shapes truth.

Rather than rejecting opposing viewpoints as ravings from the insane, we should view contention as a pool of clues that can help us better understand competing motives. Rather than treating knowledge as static, we should view it as perpetually evolving as resources are exhausted, prices change, values alter, and technologies mature. Most of all, we should sharpen our ability to hold two competing sides or theses in our head and not only continue to function but manage to synthesize these sides into a higher, more progressive common ground. If we do this, we might be able to shed light on the seemingly paradoxical positions that others take on important energy issues like those examined in this book. Then, as detectives, when we are presented with a specific energy reality, we might be able to understand how we got here, and the means and motives that will drive change in the future.

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