CAPITAL AND CARBON: THE SHIFTING COMMON GOOD JUSTIFICATION OF ENERGY REGIMES

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ABSTRACT

This article traces the regimes of worth that defined energy for centuries as a productive force of human and animal labor, an understanding that transformed in the 18th century to an "industrial-energy" regime of worth supporting an economy of mass production, consumption, and profit and more recently one centered on market forces and price. Industrial and market energy and the conventions and institutions that support them are currently in a period of discursive and material ferment; they are being challenged by different higher order principles of worth. We discuss eight emergent energy justifications that argue what kind of energy is – and is not – in the best interests of society.

Keywords: Orders of worth; regime; capital; energy; modernity; justification

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INTRODUCTION

Carbon-based fossil fuel energy is foundational to the industrialized modernity of the 21st century. With the development in the 19th century of coalfields in Europe and oil wells and coal in the United States, an industrial energy regime – by which we mean *an ordered system for governing ideas, relations, materials, and their application in the economy* – enabled dramatic increases in economic output and societal consumption. Energy-dense fossil fuels transformed production systems and enabled machine-centric and routinized labor processes. The result was a mass production and consumption system novel to human experience.

Although earlier forms of energy including animal, wind, and waterpower continued to exist where locally feasible and economic oil and coal came to dominate production, powering industrialization for the last 200 years in the West and increasingly in the developing world. Despite challenges from other energy sources, the stability of a fossil fuel-based energy regime is evidence of the industrial power of fossil fuels and the market power of petroleum cartels to force other types of energy to the margins. The fossil fuel regime and the prosperity, lifestyles, and values it enables have come to represent deeply embedded sunk costs that sustain it in the face of intensifying calls for transition and societal change.

With the development of a robust global infrastructure supporting fossil fuel energy investment and discovery, extraction, and transmission (via ships, pipelines and an electrical grid), for many energy is an unremarkable backdrop to their economic lives, only noticed when its supply is interrupted or prices spike. In the context of dominant industrial and market discourses about the civilizing effects of fossil fuels, "energy" is often treated by consumers and social institutions as a taken-for-granted and reasonably predictable means of lighting, transporting, and producing goods and services. Embodied energy in food, clothing, water, and other goods is socially invisible to most people. Outside of specialized applications like petroleum gas for automobiles and residential heating and cooling, energy is mostly unseen and often goes unacknowledged.

Energy's "taken-for-grantedness" has also played a role in founding civic discourses about what constitutes "progress" and the "good life." For instance, cultural anthropologist and materialist Marvin Harris described energy as the single most important factor in cultural evolution (Harris, 2001). Claude Levi-Strauss, hardly a materialist, likewise "found the limited energy consumption of 'primitive' societies their distinguishing feature, the reason why they appear 'as societies without history and progress'."[1] It is regular access to energy that enables what are colloquially called "modern lives" and the developed economies they reflect.

We believe, however, that we are entering a new energy epoch, one in which assumptions regarding energy and their connection to development are no longer taken for granted, treated as apolitical, nor left to industry, markets, or states to decide (Mitchell, 2013). That oil and coal became closely associated with "progress," which largely reflects an energy-intensive material life and reduced hardship for those with the means to afford it, emerged over time and survived, indeed one might say subjugated competing narratives and development strategies (Mitchell, 2013; Yeargin, 1991). An important question, then, is how and why has the dominant fossil fuel regime, as a stable justificatory framework for understanding energy, begun to unravel? And furthermore, what are the competing regimes that are contesting its dominance and how do they articulate and understand energy and societal development for the future?

Today, energy – its sources, geopolitics, and effects – is more visible, politicized, and subject to competing frames of meaning than it was throughout a majority of the 20th century. Advocates for different sources of energy lay claim to different rationales, material practices, and values they associate with them, their potential, and the life styles they lay claim to. These range from standard energy efficiency and energy conservation to justificatory frameworks demanding energy downscaling (see Table 1). In the last three decades, then, the globally dominant fossil fuel energy regime and its supporting narrative has weakened as varieties of evidence mount against it. In the language of conventions theory, this suggests that alternative frameworks have emerged that are "testing" and "proving" that the fossil fuel regime is violating important principles held as central in competing narratives. For example, fossil fuels are associated with environmental ruin as well as the social injustices linked to fossil fuel extraction, refining, and distribution. New energy paradigms are dislodging and even displacing the fossil fuel regime by promoting different justifications with revised energy futures.

The economies of worth perspective is an important corrective to understandings that do not acknowledge cultural and institutional factors when explaining social and economic decisions or transformations, and rather rely on references to superior efficiencies, utilities, or other "competitive advantages." In particular, the economies of worth perspective encourages a view of economic contexts that acknowledges the importance of socially founded, conventionalized practices and justifications that give rise to stable meaning regimes that we generically call "the economy" and "free markets."

Yet the economies of worth perspective, while very useful, does not tell us much about where stable orders of worth come from (outside of their derivation from philosophical premises). As sociologists, we assume that derivation is a socially and materially complex process and the result of contestation, negotiation, and hybridization overtime. Therefore, we ask how do social, cultural, and economic processes coalesce to produce materially and ideologically ordered relations or what we are calling "energy regimes?" While we do not propose to have the definitive answer to this questions we believe that we have an opportunity to study and understand a great transformation that is currently in motion: there is growing uncertainty surrounding the meaning of energy, generally, as well as the specific structures that support the fossil fuel energy regime as the centerpiece of modern, industrialized societies. There is an

Table 1. Energetic Justifications.

	Energy Efficiency	Priced Energy	Alternative Energy	Energy Conservation	Energy Justice	Energy Stewardship	Downscaling Energy	Eco-Energy
Relevant worlds of worth	Industrial	Market	Industrial, green	Civic, green	Civic	Domestic, green	Green, civic	Green, industrial, market
Basis for worthiness	Technical, efficient, reduced use in production/ services rendered	Price, supply, demand	Technical, ecological integrity	Collective-behavioral, reduced energy demand	Equitable distribution of risk and benefit	Divinely or spiritually ordained; responsibility to "steward" God's creation	Needs focus and social and environmental well-being via de-growth	Techno-scientific innovation, markets, ecological integrity
Test/ justification	Rationalized uses and reductions	Competitiveness	Reduced social and environmental impacts	Reduced consumption; increased availability	Distributive and retributive justice	Sustain and nurtures life based on spiritual precepts	Downscaling of energy use (production, consumption, waste)	Prosperity and sustainability
Proof/ evidence in support	Measurable reductions in energy use; scientifically evaluated, statistically verified	Optimal selection, diffusion, natural allocation	Measurable reductions in undesirable impacts; scientifically evaluated, statistically verified	Disciplined consumption, measurable reductions	Rates of unequal access and distribution	Consumption in line with well-being of earth and moral fitness of human inhabitants	Needs met, maximized well-being/minimized energy consumption (small is beautiful)	Intensified energy availability; shrinking ecological footprint
Focal objects	Infrastructure, production processes, methods, products	Free exchange, choice, individual liberty	Infrastructure, ecological systems	Energetic services, energy independence, cost savings, ecological systems	Equal access, equal protections	Interpretation of doctrine/beliefs in support of sustainable living	De-growth, steady-state economy, overdevelopment, collective well-being	Techno-science, innovation, energy availability, ecological systems
Focal timeframe	Continuous	Short-term	Long-term	Short/long-term	Short/long-term	Ongoing	Long-term	Long-term

opportunity, then, to see contestation, negotiation, and resolution as it emerges out a previously legitimate, stable, and largely taken-for-granted ideas and practices. Importantly, we also assert the importance of understanding this process for energy insofar as there is no social world – state, religious, industrial, market, or civic – that is absolved from confronting the meaning, practices, and material consequences of energy: *its forms, production, distribution, and use*.

In this article, we do four things. *First*, we discuss how social science has approached the issue of energy in light of energy's role in society. We suggest that conventions theory can play a strong role in our understanding of where energy fit in past regimes of worth and the recent changes that are rapidly taking place. *Second*, we map the energetic bases of pre-modern, modern, and contemporary society showing that energy has always performed a constitutive role in human organization, valuation, and practice. We recount the socially critical transformation made possible by concentrated and moveable fossil fuel energy and argue that the industrial revolution was above all an energy revolution. Despite its centrality to the idea and material foundations of "progress" and the transformative power energy holds, over time it became a force largely subsumed within the practices of industry, commerce, and transportation. *Third*, we describe the recent weakening and subversion of the fossil fuel regime and with it conventionalized notions of energy-in-society. We use the regimes of worth concept to aid in our analysis and identify the emergent energy frameworks and the principles, values, and proofs that animate them as distinctive justification as new, energetic ways forward. *Finally*, we discuss how new social and material understandings of energy will likely affect multiple regimes of worth.

SOCIAL SCIENCE, THEORY, AND ENERGY

For the most part social science takes note of energy only when daily life is interrupted by energy scarcity or a perceived threat associated with a type of energy, for example, nuclear power in the 1970s or carbon-based energy today. Even where social scientists have noted the importance of an energy infrastructure for economic development, it has mainly been approached as an aspect of modernization or industrial capitalism (Chase-Dunn & Hall, 1994; Frank, 1969; Rostow, 1990; Smelser, 1964; So, 1990; Wallerstein, 1974, 1980, 1984). Development scholars' treatment of energy therefore has been little different from those who ignore it; energy, while a requirement for prosperity, is a-taken-for-granted aspect of the development process and treated as largely subordinate to social, political, and economic factors. Rather than assuming energy is scarce, always tenuous, unequally distributed, and the product of several hundred years of rationalization, social scientists have in the main assumed the opposite: that the energy on which contemporary life is based is inviolable and infinitely sustainable, in both social and material terms.[2]

However, as forms of energy become associated with both environmental and health risks, and energy scarcity threatens to upend taken-for-granted ways-of-life, it is increasingly part of a public-sphere conversation. Initially among experts, but increasingly the (general) public at large, the dialogue and debate reflects conflicting value and moral positions regarding the "right" energetic basis for society, energy's role in society, and the energy types that might fuel society given their costs, benefits, and risks.

Put another way, these conversations reflect energy's varied interpretations as elements of different "regimes of worth" as identified by Boltanski and Thevenot, their collaborators, and like-minded scholars who claim membership in a French "pragmatic turn" (Boltanski & Chiapello, 1999; Boltanski & Thévenot, 2006; Thévenot, Moody, & Lafaye, 2000). Assessments of this kind therefore reflect justifications regarding what kinds of energy are and are not in the best interest of a community, society, and the planet and therefore what constitutes the common good. Arguments focused on the common good, according to conventions scholarship, tap higher order principles associated with different "worlds of worth," such as *industrial, market, civic, entrepreneurial*, and even *green* regimes. As different value positions are articulated in conjunction with different "proofs," the views have clashed. For instance, the principles that justify energy in industrial production where techno-science, mass production, and efficiency are guiding rationales run counter to those "green principles" that assert that the energetic bases for society must be in harmony with nature (see Table 1).

Emerging from discomfit with the static character of structuralist sociology and particularly Bourdieu's version with its emphasis on actor habitus, disposition, and fixed social hierarchies, French pragmatism has sought to understand social change and negotiation in social life, something difficult to explain via critical structuralism. In contrast to Bourdieu's focus on the assumed, largely tacit logics that track ordinary social actors into predictable social actions and positions, Boltanski and Thevenot (2006) instead represent the conscious logics that ordinary social actors use to interpret, argue, and justify their actions, especially those at odds with the status quo. French pragmatic social science addresses, at the very least, variation, and the critical arguments of ordinary social actors who through dialogue and contestation attempt control over the discussion at hand.

Those who pursue the pragmatic turn are not only interested in the world of assumptions, taken-for-granted beliefs, and hegemony but also in the conscious, often public logics that social actors use to justify their actions and even resist those with whom they disagree. The conventions school focuses on the deliberate arguments social actors make in the context of verbal dialogue and dispute, and how they articulate, prove, and validate their beliefs, claims, and actions.

These observations emerged from Boltanski's and Thevenot's (2006 [1991]) investigations where they found that claimants' arguments did not reflect an infinite number of possible variations, but rather clustered around a limited number of broad-based philosophically grounded conceptual formations each of which was a distinctive rendition of what constitutes the "common good." These further reflected basic principles that were operationalized in rhetorical disputes and mobilized when confronted with other, competing philosophical formations. Boltanski and Thevenot identified six "regimes of worth" that articulates different justifications for evaluating social and material conditions in society. Each of the different regimes refers to a particular and distinctive kind of "prudence" or good judgment that permits one to seek benefit and avoid risk given the context and scenario encountered.

The regimes of worth that Boltanski and Thevenot initially identified include the *inspired world*, in which creativity is the key quality; the *domestic world*, in which the logic of good human relations is stressed and inherent hierarchy is emphasized, such as in the family; the *world of opinion*, where fame, promotion, and public relations holds sway; the *civic world* in which social contracts, membership, and human rights are deemed paramount; the *market world* where money, supply and demand, strategic behavior, and individual accomplishment are central; and the *industrial world*, where techno-science, productivity, and their corollaries efficiency and effectiveness dominate the discourse and therefore the material aspects that prove correctness. Two further worlds subsequently developed by Boltanski and Thevenot focus on *entrepreneurialism* in which project and actor are synonymous and therefore one's life is articulated as a kind of capital endeavor (Boltanski & Chiapello, 1999). Another world stresses environmental themes where nature-harmony, preservationism, and sustainability are deemed supremely worthy in a "*green world of worth*" (Thévenot et al., 2000).

Until recently the regimes – the understanding, practices, and the material outcomes – associated with energy production and consumption have been relatively stable, taking form through industrial and market worlds and their energy corollaries "energy efficiency" and "priced energy" views (see Table 1). However, we believe that energy and understandings of it have entered a contemporary "era of ferment" – *a period of time in which competition between alternative energy discourses reflect distinctive values and technical proofs regarding how energy should be managed, distributed, and consumed.*[3] Pressure from environmental concerns surrounding climate change as well as those focused on scarcity are pressing the dominant fossil fuel regime's justifications. For instance, based on outcomes associated with different energy types the green world of worth is being parsed into multiple variants that have different understandings of what is "green" and what values are at stake. The period of ferment will presumably stabilize when social and political dynamics in conjunction with material conditions result in dominant or conventionalized "energy regimes" and are "proven" worthy in the face of rival claims, debate, and denunciation.

Tracing new, competing notions of what energy represents and a possible consolidation of prevailing views can expose how energy is currently understood and acted upon. A retrospective accounting also reveals potentially new hybrid treatments that reflect current energy problematics and the new circumstances, risks, and benefits they reflect.

THE ENERGETIC FOUNDATIONS OF SOCIETIES

In pre-industrial societies, both historic and contemporary, energy is mostly derived from human and animal labor, wind, water and biomass such as wood. Historically energy has been difficult to find and store in adequate amounts as well as to harness for useful purposes. Acquiring and using energy for needs such as nutrition, cooking, heating, and locomotion requires time, effort, and often organization. Indeed, for most of human history it has taken a majority of a person's time to secure energy in the form of calories to survive and labor, let alone prosper.[4] What is more, the energy provided by a primary food source, from the grains in the Middle East to the salmon of the Pacific Northwest, often predicted a peoples' health, vitality, and dominance over other groups (White, 1995). Energy in pre-industrial societies was and remains uncertain, episodic, and dependent on availability – when the sun is up, when the winds blow, when tides are favorable, when dried wood is near, or when animals for food are available – then usable energy is immediately at hand. In such contexts, energy is explicit; it is a function of available fuels and the ability to work, and not a mechanical abstraction.

Historians and anthropologists note that civilizations have arisen, prospered, and fallen as a consequence of their access to reliable sources of energy, including the caloric energy in food.[5] For hunters and gatherers, access to reliable sources of calories often predicted the size and virility of their tribe or clan and therefore their relationship to other tribes and clans in a given region (cf. White, 1995).[6] For ancient civilizations, such as Egypt and Mesopotamia, the energy and nutrients of major rivers also created the basis for a 3,000-year run of dynasties.[7] For Athenian Greeks, the human energy of slaves freed citizens to pursue democracy. Feudal Europe was founded on a social system where energy flowed from the peasants to aristocrats (Pilcher, 2012). For the colonial European powers of the 17–19th centuries, the search for new and more potent lands from which to generate new sources of energy in order to dominate European social and political relations was an impetus for rapid global expansion.

Energy has *always* been an elemental organizing factor of social life. As societies moved toward industrialized and service-oriented economies, however, and energy itself became produced conveniently by industrial providers and infrastructure energy became a less difficult-to-obtain input of economic production alongside labor and capital. The salience, benefit and risk of that energetic input has over time, however, become increasingly exposed, politicized, and contested.

Concentrated Energy Enables Industrial Society, Changes Justifications

Social science is often traced to the industrial revolution, that critical break with agrarian society made possible by the systematic and large-scale application of energy to mechanical systems of production and propulsion and that, in doing so, reorganized the type and application of human labor as well as the distribution and concentration of human settlements. In a word, it *reorganized* society (Mitchell, 2013). The language, ideas, and even value of traditional labor were transformed as new justifications emerged at the behest of intellectuals, the new capitalist class, and growing forms of populism that devalued idle landed aristocracy and connected new moral and material meanings to the economic nexus of human and machine work. Weber, Durkheim, and Freud "each remained convinced, albeit differently, that labor, defined in largely energeticist terms, was central to their enterprise" of understanding the effects of joining human labor to technology (Rabinbach, 1992). Marx's concept of labor referred to the entire capitalist production system as alienating and unjust that both estranged the worker from the object of his or her labors (applied energy) and therefore from his or her natural "species being" and collected the surplus energy (i.e., value) of that labor concentrating it in the private hands of a very few (Marx, 1967, 2007 [1844]). The new forms of energy available to elites led them to reorganize their efforts, which further socially and materially reorganized society at large. The reorganization demanded new justifications and therefore regime of worth that was reflected in the rise and dominance of the "industrial regime" (Boltanski & Thévenot, 2006).

Textile production was the first to industrialize in the West. The "putting out system" of aggregated small cottage production yielded to a factory production system when reliable forms of energy were linked to new technologies and production techniques. Hydro-powered mills clustered along rivers and streams in places such as Lancashire England and New England in the United States (Copeland, 1884). Windmills were energy sources in areas of France, England, and Holland also, but useful only when meteorologically available. Waterpower and wind were fixed energy sources when applied and these energy forms demanded settlement nearby changing land use patterns. Like wind and waterpower, the use of fossil fuels is not new (Henderson, 2001). However, the widespread industrialization that occurred in the late 18th and through the 20th centuries reflected the application of fossil fuel energy. The successful development of improved coal extraction methods through safer deep pit mining, particularly the development of steam powered water pumps, enabled coal to become an economical fuel for industrial use in the early 19th century in Britain and the United States.[8]

With transportable energy-rich coal, manufacturers could use steam-driven mills, coal-powered locomotives, and a range of other technologies that enabled the mass production and distribution of goods and services to places without naturally occurring or dependable fossil fuel energy sources. The successful drilling of oil wells in Eastern Europe and Pennsylvania in 1854, and soon after in other regions of the United States like California, Oklahoma, and Texas produced a liquid, portable, and even more energy-intense fuel especially suited for use in transportation (Williams, 1997; Yergin 1997).

Concentrated high-energy fuels enabled large and efficient production equipment but reduced the number of workers needed to produce any given amount of output and required workers to relocate their labor power inside the factory to work. Furthermore, large industrial equipment was both expensive and required larger more expensive buildings to house it (Beamish & Biggart, 2010). Energy-intensive production therefore required more capital-intensive machinery and buildings, and later drayage systems and roads (Freiburger, Biggart, & Beamish. 2013). The institutional infrastructure to support such capital requirements, including a banking and the cadastral system of property rationalization, enabled the further concentration and application of capital to transportation, construction, and manufacturing, which in turn further increased the energy requirements of this system of production and consumption.

Along with advances in energy intensification was the root rationale for the system, capital accumulation. Increasing levels of capital investment were required to harness the energy-intense types of emerging mass manufacture that were simultaneously making bigger profits from such investments possible. However, conflating energy intensity with capital accumulation obscures a crucial process in the social and material transformation that took place, and similarly fails to understand a transition currently taking place in the meanings and values – moral and material – attributed to energy and its forms.

For their part, social scientists have mostly failed to articulate and explain this connection, focusing instead on the organizational, social, and cultural impact of these 19th century engineering infrastructural and mobility developments, not the role energy and engineered material environments played and continue to play. Indeed, social theorists from Comte to Marx, while they disagreed on many issues regarding society, were fixated on Enlightenment ideas regarding "human progress" as if they were incontrovertible fact.

> It was only too easy, given this faith in progress and given also the more fundamental faith in the unity and irreversibility of historical development, to conclude that such phenomena as industrialism, technology, urbanism, and rationalization were the infallible stigmata of beneficence and that in the further development and diffusion of these phenomena lay the greatest hope of the future. (Nisbet, 1966, p. 267)

Even traditional forms of leisure and consumption were replaced with new amusements in the rapidly expanding urban areas (Biggart, 1994). Perhaps most importantly, new forms of social identity and status centered on the control of industrial capital, private accumulation of wealth, and with it conspicuous consumption of goods and services all of which reflected a deeper and largely invisible quickening of the energy intensification of society (Veblen, 1998 [1899]).

Western societies became super-consumers of commodities and with it voracious consumers of the energy required to produce and consume those goods (Rostow 1969). The success of industrialization in creating a pervasive and energy-intensive culture centered on consumption largely reached new heights in the post-WWII societies of the West (Biggart, 1989). As it ran its course, by the late 20th century there were increasing signs that this state off affairs was unsustainable and energy became increasingly exposed, politicized, and contested.

What has concerned much social science, then, has been an interest in the social fall-out from what was the energy revolution of the 18th and 19th centuries over how the spoils of intensively applied energy would be distributed in newly emergent national societies. When we study labor, stratification, families, and inequality, we often trace changes back to the concentration of capital that accompanied and made possible industrialization and with it new social arrangements. Yet, capital and capital accumulation can be thought of as simply proximate expressions of the energetic transformation that enabled industrialization itself. Highly associated, but not identical, capital and energy should not be confused with one another – association is not causation. Reflecting this, energy is currently emerging as its own complex phenomenon and must be valued and evaluated separate from associations that obscure its role in social organization.

AN ENERGY PROBLEMATIC

Assuming that one could have energy if one had capital may have been a defensible presumption in times of stable arrangements where energy was commoditized and normalized as part of ongoing social and political arrangements. Increasingly, however, energy has become both visible and problematic in developed economies where fuel prices have destabilized, access to reliable long-term supplies have become uncertain, and new forms of energy are challenging established fossil fuel sources. Energy once again is in the news as a political, social, economic and moral choice.

The process of bringing energy out from under the shadow of capital, and then further understanding its social impact began after WWII. There were several important contributors to energy's problematization with each factor reinforcing an emergent understanding that energy is more than merely an industrial lubricant. We highlight four phenomena that have pushed energy toward greater public awareness and scrutiny: *satellite imagery, ecological thinking, oil dependence and strategic vulnerability*, and the *visible impact of industrial pollution* and *climate change*. Each has played an indelible role in making energy more socially and materially visible, connecting its extraction, use, and the outcomes associated with these to issues of risk as well as benefit. Each of these also brought energy into the foreground, making it more than a function of industrial capitalism or simply a reflection of market forces like supply, demand, and price showing energy of different kinds to hold different positive and negative implications for societal life. Each of these has therefore also stirred a good deal of ferment around precisely what energy is, relative to emerging higher order principles like justice, green, de-growth, and stewardship as applied to energy use and consumption practices.

Looking at the Earth: Satellite Imagery Changes Perception

In the 1930s balloons took pictures of the earth from 13.7 miles, high enough to detect the curvature of the planet. At the end of WWII, the U.S. Army launched captured German missiles from White Sands NM in a series of experiments, including taking photographs of the earth from an altitude of 65 miles on October 24, 1946. Stitched together, the black and white photos made it possible to see the earth as an object against the black void of space. For the first time, people could view their home planet as a physical body, spherical with areas of water, land and clouds in its atmosphere. Today, there are many government and commercial satellites collecting weather, communications, atmospheric, and biological among other data that are available to the public and that show the earth to be finite and suspended in space. In 60 years, then, the earth went from being hypothetically spherical to one that is now routinely viewed by most educated humans as round and inhabited.

That imagery was an important precursor to an understanding of earth as imperiled by human activity. Satellite pictures show humans' direct impact on the earth's systems, for example, a view of the earth at night artificially illuminated that reveals the impacts of human-developed energy infrastructure on the planet and its inhabitants. Similarly, maps and satellite images depict global changes wrought by such energy-intense chemistries including chlorofluorocarbon-derived ozone-holes over the Antarctic and the accumulation of green house gases (GHG) shown in maps, plots, and photography of global heat variation, de-glaciation, ocean temperature and current changes, and atmospheric jet stream variation(s). Images like these of the earth have lent perspective to anyone with Internet access, providing millions with a view of human development patterns and their impacts on the planet. This has reinforced understandings of earth as a finite and interconnected (or ecological) system and problematized the dominant fossil fuel energy regime destabilizing its conventional status and control. As a consequence, carbon-based fossil fuels have become increasingly seen as a global ecological risk.

Ecological Thinking and the Environmental Movement

If satellites increased awareness and an ability to visualize the material impact of human civilization, the rise of ecological thinking joined this planetary view to the biology on the ground. Inspired by Charles Darwin's *On The Origin of Species*, biological phenomena like species were not viewed individualistically nor out of their environmental context, but now as connected to and influenced by other species and the environments within which they co-evolved (Darwin, 1859). Darwin's work is most popularly thought of as foundational to evolutionary thought, but it was equally important to the development of ecological understanding: the study of how life forms interact as a *system*.

In the 19th century, air pollution was at times an obvious and visible problem that resulted from coal use for industry and home heating in England and America. It resulted in substantial pulmonary health disease for decades. Yet, commitments to prosperity and the move toward modernity had industrial smog, oil gushers, and open pit mines among other such consequences framed as monuments to progress not as "pollution" or environmental abuse (Beamish, 2002). After WWII, however, ecological thinking led to an increase in concern via a wholesale reinterpretation of what progress, society, and nature meant from which emerged the contemporary environmental movement (Brulle, 2000). With the publication of *Silent Spring*, a book by marine biologist Rachel Carson (Carson, 1962a), it became more widely acknowledged that humans were both a primary cause of environmental disorganization while also being harmed by it, as were other species and the earth's total ecological system. Carson described the environmental damage of chemical pesticides, particularly DDT, and wrote in a way that promoted public empathy for the environmental cause. The book became a bestseller and sparked public debate in the United States and was serialized in *The New Yorker* magazine (Carson, 1962b). *Silent Spring* is credited with being a major force behind increased public demands for environmental reform and government regulation of the environment. It was a stimulus to the environmental movement that now routinely includes a critique of the chemicals and genetic modifications associated with the modernity including pesticides, fungicides, fertilizers, plastics, and glues as well as agricultural biotechnology and gene modification (i.e., CRSPR genome editing) and their effect(s) on both human and non-human health and vitality (Gottlieb, 1993, 2001).

Critiques of energy types and sources including nuclear, petroleum-based plastics and fertilizers, and other modern chemistries as well as the biological manipulation of the natural world fueled varieties of ecological movements that reacted to "reform environmentalism" and foreboding environmental trends (Bullard, 1994; Freudenberg & Steinsapir, 2000; Kroll-Smith & Floyd, 1997).

The contemporary ferment regarding energy – its sources and outcomes associated with its extraction and use – began in earnest when concerns about environmental decline and conservation were coupled with a rising environmental-preservationist ethic in the United States. Focused primarily on rectifying visible forms of pollution and the conservation of wild lands in the United States through policy-based legal reform, early in the 1960s mainstream environmental critique largely left capitalism – *the stimulus for industrialism* – and energy – *the material force that fuels it* – outside the purview of its challenge (Brulle, 2000). Yet, in the 1970s a movement emerged to challenge nuclear power as a viable means of fueling societies based on the risks associated with nuclear fission and waste storage. The anti-nuclear movement, populated by many self-described environmentalists, sensitized the nation to the energetic basis of contemporary society and also put the main source of energy – fossil fuels – under scrutiny too as nuclear advocates used the excesses of petroleum and independence from it as a core justification for their ambitions to expand nuclear power (Bauer, 1995; Jasper, 1990).

By the 1980s and 1990s, social critique of economic development and modernization had taken hold across the developing and developed world where the promise of an energy-intensive lifestyle either remained elusive or once delivered, did not live up to expectations (Davis, 1962; Gurr, 1970; Walker & Smith, 2001). The massive infrastructural projects that would fuel the energy needs of modernizing societies took shape as power plants, electrical grids and mines, oil wells, and hydroelectric dams. Developing nations incurred massive debts from international lenders in order to pay for them. Yet, energy infrastructure projects such as these both enabled rapid increases in prosperity, for some, but also large-scale displacement and impoverishment for others. The result was conflicting accounts of the best means of securing the common good. Foremost among these, the pre-cursors to contemporary claims of climate and energy justice, were claims and denunciations of the southern hemisphere's "dependent development" (Faber, 1993, 2008; Frank, 1969; Pellow, 2007; Wallerstein, 1989).

Hydrocarbon and Strategic Interests

The political roots of fossil fuel energy, particularly petroleum, are found in the energetic force it can provide for military and economic competition. In the late 1800s, England used domestic coal to fuel the Royal Navy but coal propulsion was no competition for rival Germany's oil-propelled ships that were faster, required less labor, and could be refueled at sea. Petroleum oil has twice the thermic content of coal, and England could only maintain its dominance of the seas if it switched from British coal to oil. Securing a reliable oil supply therefore quickly became a national priority. The story of Churchill's 1911 decision as First Lord of the Admiralty to switch to oil from coal is well described in Daniel Yergin's *The Prize* (1991). That decision led to deals and alliances with Middle Eastern countries that continue today to shape global geopolitics.[9]

Petroleum oil quickly became the dominant fuel for transportation and still is for cars, trucks, planes, and boats. Dependence on oil for automobiles and in some areas heating has prompted grumbling and political transformation when prices rise and fall. But in the United States and Western Europe it became a matter of great distress in October 1973 when the oil cartel Organization of Petroleum Exporting Countries (OPEC) embargoed shipments in retaliation for their support of Israel in the Yom Kippur War. The price of oil went from $3 to $12 per barrel, disrupting the economies of the West and the lives of ordinary people. There were panics and rationing followed by a global recession.

Perhaps most importantly, given our purpose in this article, the embargo had a lasting effect on the status of fossil fuels as the dominant energy regime; the embargo, recession, and rhetoric of the day thoroughly politicized oil in a way it had not been until this time.[10] Domestic oil supplies were touted as "independent." Non-oil fuels such as coal, and the development of nuclear energy took on urgency, spurred investment, and in reaction to them and global events, social movements in favor of alternatives grew. The idea that some forms of energy had different political content became obvious and a part of social and political discourse of the day.

Industrial Pollution Becomes Visible and Problematic

The application of intensive energy forms, particularly fossil fuels, to manufacturing, society-wide electrification, and transport solved and then generated new social problems – especially pollution of air, water, and soil. The problem was particularly noticeable in the major industrial cities and regions of Europe and North America, as they became dense enclaves of workers and factories. Cities at this time both had inadequate infrastructure to handle pollution such as sewers to handle human wastes and the externalities industry produced such as soot, smoke, and coal ash. It was simply too much for local ecosystems to assimilate, making the air at times unbreathable and water undrinkable. Indeed, as late as 1952, 4,000 Londoners died from what has become known as "The Great Smog" (Wise, 2001).

After WWII, as problems like those associated with coal and oil reached critical proportions and soon thereafter the oil embargo and petroleum dependence increasingly vexed European and U.S. elites, a new energy choice emerged alongside fossil fuels. Nuclear energy was promoted as a clean and "independent" alternative. Nuclear power, which does not emit particulate materials, visible air pollution, or greenhouse gases and involves fissile materials available in the United States, Canada, and Europe, quickly became a politically divisive energy source. The risks associated with spent fuel and the problem of controlling fissile materials used to power nuclear reactors made this a controversial alternative. Opposition to nuclear power emerged in the 1960s as some members of the scientific community expressed their concerns related to the possibility of nuclear accidents, nuclear proliferation, high costs, and radioactive waste disposal. By the 1970s, large protests emerged in Germany over nuclear power and inspired opposition in other Europe countries and in North American (Jasper, 1990).

Even given the popular protest, France currently gets nearly 80 percent of its electricity from nuclear reactors; after a period of intensive plant construction, Germany is now removing reactors and switching to renewable energy sources in the aftermath of Chernobyl and more recently Fukushima. Japan, a country with few natural energy resources, is with great difficulty moving away from domestically produced nuclear power because the accident at its Fukushima nuclear plant turned public opinion.

Dramatic pollution events have even taken on the names – similar to "natural disasters" like hurricanes and earthquakes – of the companies, facilities, and places where they have occurred like "Love Canal," "Santa Barbara Oil Spill," "Bhopal," "Exxon-Valdez," "Gulf Spill," "Three Mile Island," "Chernobyl," and "Fukushima." The social and environmental costs of toxic pollution, often from activities directly involved with energy or enabled by sustained energetic production, are visible even if subject to debate about responsibility for damage (Beamish, 2002). The detritus of an energy-intensive mass-production-based global economy has made pollution endemic to all habitats, including those of the world's oceans such as the Great Pacific Vortex or Gyre, which is composed of trashed plastics, sludge, and other products from illegally dumping petroleum-based waste and other marine debris.

Not all energy waste is left on the surface of the earth. Atmospheric remains of natural and industrial processes – greenhouse gases (GHGs) – have collected in a way that reflects heat back to the planet. There is substantial scientific evidence from the fossil record, tree rings, ice sheets, and other natural phenomena that the climate of the earth has changed, even dramatically, over a relatively short time and that those changes are currently accelerating. Contemporary climate change – the warming of the earth's atmosphere because of the gases produced by human activities that trap sunlight "like a greenhouse" – is now accepted in the scientific community as the product of industrial activity and the ways-of-life enabled by industry, such as industrial scale agriculture and mass transportation. Climate change is fundamentally a scientific narrative, but increasingly it has become a way of tying together a range of historic phenomena and practices to understand how they are linked with one another and interact. The climate change narrative has played a decisive role in problematizing the fossil fuel regime and leveraged a range of competing narratives and justifications for a change away from it.

In truth, the four factors we have discussed represent bundles of sub-factors that include the development of more precise scientific measurement and graphical imagery that was unavailable even a decade ago. They also represent new or newly emphasized ideas, ideals, and their justifications that grew with them such as ecology and risk analysis that have problematized Cartesian, particulate, and modernist thinking for newer views that stress interconnections, systems, and the Catch-22 of economic development wherein benefit is always mixed with tradeoffs that involve significant risks. The question increasingly asked of energy like other phenomena is who gains the benefit and who, in turn, the risks associated with them.

RE-VALUING ENERGY: COMPETING CONCEPTIONS OF ENERGY'S ROLE IN SOCIETY

In the narrative we shared, energy has gone from something people and collectives of different scales scrambled to gather for many hours every day, to the vital force behind modern life in the developed world that was hiding in plain sight — it was there to be seen, but largely assumed to be infinite and controlled or controllable (Mitchell, 2013). In the developed world, the transition from scarcity to a stable fossil fuel energy regime is now destabilized by the threat of scarcity — fossil fuels are predicted to have reached their peak or will soon as demand continues to soar — by climate change, and calls for energy justice among others.

How did the conventionalized understandings of fossil fuel energy go from being broadly conceived of as a function of industry, markets, and progress to multiple and competing energy types and companion justifications? And why, specifically, is it now emerging as contentious issue within and between communities, industries, and nations? Our brief social history highlighted a combination of contingent events and new developments in science and engineering that have fomented broader understandings of how the planet as a system connects its many parts. The energetic foundations of society are now exposed and contested.

The intensive use of energy that caused industrialization simultaneously supported new forms of warfare, new forms of social organization that is, class relations, as well as new forms of consumption and ways-of-life that quickly intensified the use of energy. Energy as a strategic input created volatile relations among developing nations. Social institutions, political relations, and engineered structures built for an agrarian society could not support or absorb those characteristics of industrial society. By the late 20th century, socio-political and material conditions politicized the dominant fossil fuel energy regime as its reliability was tested and its future clouded by scarcity, pollution, and climate change (Andrew, William, Meiners, & Dorchak, 2011; Mallon, 2006; Yergin, 2012).

Through the 18th and 19th centuries, the visible pollution made by smoke stacks and oil wells was so strongly associated with progress that it was accepted as a positive sign of modernity (Pratt, 1978, 1980). By the 20th century, however, observable pollution in the form of smog enveloped places like Donora, PA (circa 1948) and London (circa 1950) where dozens died of asphyxiation. Attention to events like these began to change both public and elite views. Air pollution, industrial accidents, spills, and biologically dead waterways increased awareness that industrialism was not only about progress and prosperity but also about environmental disorganization and risk. This laid the foundation for a persistent tension between contemporary ways-of-life and the forms of energy that made them possible.

Modern chemistries involving petroleum and other fossil fuels were repeatedly in the news following accidents and catastrophes but also as scientists began to test the impact on health and the environment of petrochemical innovations such as DDT, mercury, Dioxin, Polychlorinated Biphenyls, formaldehyde, and other chemical innovations. Over time it became increasingly clear that modern, industrial, post-industrial, and energy-intensive societies overload the carrying capacity of local and global environments. Indeed, based on this outsized human influence, some have labeled our contemporary high modern period as the "Anthropocene" (Clark, Crutzen, & Schellnhuber, 2005; Crutzen & Schwägerl, 2011) and others call it a "Risk Society" (Bauman, 1992; Beck, 1992; Freudenberg, 2000; Giddens, 1990, 1999; Short, 1984).

The distribution of energy also became increasingly controversial as the energy intensity associated with different ways-of-life became associated with negative outcomes (Ehrlich & Holdren, 1971; York, Rosa, & Dietz, 2003). Some people live in societies that consume a great deal more energy, and the material goods and services such as travel associated with it (Shiva, 2008; Sovacool & Dworkin, 2014). This does not only hold true for energy consumption, but also for energy waste. By the 1980s, the risky consequences of energy-intensive lifestyles – from waste dumps to CO_2 footprints – were recognized as disproportionately born by the poor (Faber, 1998; Pellow, 2007). In the United States and elsewhere, low income communities that typically consume a great deal less energy are much more likely to live in proximity to dangerous facilities and energy infrastructures than are wealthier communities who consume a great deal more (Agyeman, Bullard, & Evans, 2003; Bullard, 1994). Energy is recognized as a common denominator both within and between societies that allows for meaningful comparison of relative levels of consumption and differential social outcomes (York et al., 2003).

Recognition of unevenly distributed environmental risks gave rise to the environmental justice movement (Bullard, 1994; Szasz, 1994; Taylor, 2002). More recently, as the uneven distribution of climate change related risks them have become better understood, the emergence of "climate ethics" and "climate justice" has similarly gained momentum (Northcott, 2007). The principles that animate claims to climate justice and with them the moralization of energy types focus on the inequitable distribution of benefits and risks. This supported discourse and political action that emphasizes human rights and redistributive – and even retributive – forms of justice (Hernández, 2015).

As greenhouse gas concentrations reached the critical threshold of 400 parts per million, the scientific consensus on climate change has come to view it as an irreversible trend (Solomon, Plattner, Knutti, & Friedlingstein, 2009). For its part, the policy community has moved from a discourse focused on stopping climate change to an "adaptation discourse." Accepting the need to "adapt" because human societies cannot return to a former, lower carbon environmental state places energy choices at the center of the discussion and dispute. Issues of ethics and claims of human justice have credibility and political advantage given the need to decide future courses of action. What is more, according to critics, the adaptation discourse itself reflects a pragmatic turn with its own moral valence as it relates to energy choices. For instance, in the adaptation discourse natural gas is referred to as a "bridge" fuel and has become the pragmatic choice in the supposed transition away from fossil fuels. Yet critics from other energy justifications like de-growth, energy justice, and energy conservation have labeled the natural-gas-as-a-bridge argument as a kind of capitulation; while natural gas is not as destructive as coal or heavy oil it still involves high levels of GHGs compared to alternative fuels, conservation measures, and simple de-growth (Dernbach & May, 2015). Increasing dependence on natural gas leaves an end-use scenario far into an indeterminate future (Ehrlich & Holdren, 1971). In addition, the push for ethical standards for energy extraction, use, and distribution have stimulated opposition. Capital interests, especially the energy industry itself but also energy-intensive industries with financial stakes in lower environmental health standards, have organized to lobby political elites and the general public through public relations campaigns. Whatever their social, political, or financial interests, groups caught in this upheaval have organized and refined their arguments in an effort to control the discussion and with it decisions regarding energy. Whether it is eating beef, advocating nuclear energy, promoting renewables, or lobbying to install transcontinental shale oil pipelines, the turmoil now surrounding energy choices makes these and related decisions increasingly subject to competing justifications regarding what is of "value" or "worth" and how they may (or may not) satisfy the ultimate metric: serving the common good (Boltanski & Thévenot, 2006). That is, in the age of climate change, environmental risks, and vast energy inequalities, energy's meaning is no longer subsumed within notions of "progress" nor is it an assumed input of industry or simply subject to market dynamics. Energy is now broadly recognized as both the bases for achieving the common good and conversely a principal risk factor in society. In either case, energy now holds a central spot in a debate about the most expeditious way forward: competitively, pragmatically, ethically, environmentally, and so forth (see Table 1).

Global Politics and Justified Energy

As the fossil fuel energy regime has become problematized and with problems questioned, the risks and benefits associated with it have created advocates and opponents. The established players in the global fossil fuel industry are highly profitable, and financially and politically capable of mounting a vigorous defense. Seven of the world's 10 largest companies by revenue are conventional energy firms (https://en.wikipedia.org/wiki/Fortune_Global_500). The depths of their commitment to protect stakeholders and their massive capital investments in infrastructure are yet unknown. There is much at stake on all sides.

However, rapidly expanding consumer choices in energy options, particularly for residential use, which was largely unthinkable in the early and mid-20th century, is not only thinkable now, but reflects more than the price considerations long associated with coal, oil, and natural gas. Even if corporations make decisions largely based on economics, and carbon accounting is challenging that[11] cities, regions, communities, and individuals are incorporating other criteria. How much "green" or "socially ethical" energy should a person be willing to pay extra for? What is the socially responsible energy option for a community transit authority? Or perhaps one continues to believe price considerations should be primary. New business actors are also reshaping the discussion. For instance, an important sector of the financial community, insurance and reinsurance firms such as Munich Re and Swiss Re, is pressuring businesses to manage their carbon in order to reduce both climate risk and natural disasters and the stock price risk posed by climate activist investors.[12] However, regardless of the choices made regarding these and related concerns, energy decisions increasingly reflect varied value positions.

In pragmatist terms, energy tradeoffs therefore increasingly reflect multiple and competing higher order principles that guide the choices, actions, and arguments of organizations, groups and individuals. Compromises reflect concerns regarding reliability, efficiency, sustainability, dependence, flexibility, price, supply, pollution, moral hazards, justice, and more. Therefore, different forms of energy and their different sources and methods of extraction, different uses, different means of distribution, and the outcomes associated with them provoke different responses based on material interests and interpretations of how they link-up with differing common good concerns and expectations. Whether one prefers non-renewables, renewables, or alternative forms of energy, whether one believes energy should be distributed by market principles or based on "need" therefore reflects the benefits, risks and values associated with each.

The relatively sumptuous lives of people in the developed world are now blamed for afflictions ensuing from exploitive colonial and imperial systems of the 19th and 20th centuries. The resulting unequal development, social unrest, pollution and environmental disorganization is part of the argument about who should cut back their carbon emissions. Only recently have some of the middle and upper class citizens of developing nations, such as the recent "BRICs" – Brazil, Russia, India, and China – achieved living standards enjoyed in North America for nearly 75 years. Indeed, the United States continues to consume more energy per capita than any other society in the world: representing 5 percent of the world's population, the United States consumes

20 percent of the world's total energy budget. By contrast to the world's well to do – United States, Europe, Japan, and the BRICs – nearly 3 billion people globally live in pre-industrial conditions and 1.5 billion more have no access to electricity and live in darkness after the sun sets. Many more only have intermittent access to concentrated energy via batteries and generators.[13] What is more, one in eight of the world's people partake of insufficient daily calories to sustain them – calories are the base energetic input for human health and exertion.[14]

Founded in claims such as these, some developing nations in U.N.-sponsored climate change negotiations charge that they should be exempt from international carbon abatement rules that would limit their energy use as they modernize their societies. Even though they are engaged in intensive energy-based development, strikingly similar to the path trod by the developed world, they claim that since they are not responsible for climate change given their historically low GHG emissions it would be "unjust" to limit their development potential now just as they are "taking off." They connect energy and their use of it not only to progress, but also to principles of justice, specifically remunerative justice, and argue for an exemption from international rules that would retard their development because – as they see it – of prior actions of the United States and other developed nations.

In response, many climate change advocates deliver a counter argument: ignoring environmental sustainability because preceding rounds of development and injustice involve longer-term environmental injustices that future generations will be forced to bear – both in the developed and underdeveloped world – based on the energetic choices that result from such exemptions (Posner & Weisbach, 2015). In this instance, then, social justice principles are linked to green principles in a manner that promotes just energetic choices that reflect less immediate relief for poor societies but longer-term sustainability.

Contrasting development trajectories and historic exploitation have further politicized the dominant fossil fuel energy regime. The increasing association of different kinds of energy with both societal benefits *and* risks has led to competitive and comparative claims-making in reference to regimes of worth that are used to express, advocate, denounce, and defend different energetic choices. Each argument for and against energy types, energy applications, and allocation and distribution systems reflect distinctive visions of how to best achieve the common good and avoid collective harm.

Competing value claims about how society's energetic needs should be secured and allocated center on issues as diverse as reliability, pricing, substitution, efficiency, justice, and even "de-growth" (i.e., the dramatic reduction in economic growth, consumption, and therefore energy use) (see Table 1). Each claim type represents a distinctive cluster of higher order social and ethical principles and therefore essentialist positions that are linked to energy types and strategies. These are further supported by reference to "tests" and the material outcomes or "proofs" associated with them. For example that access to energy should be a universal human right – reflecting an *energy justice* framework – is a view of energy as an aspect of membership in the human race that invokes "civic principles" with a focus on collective provision (Hernández, 2015). Therefore, the "test" for such a view of energy judges whether the benefits and burdens of energy are fairly distributed in society. The "proof" behind arguments focused on energy justice emphasize the rules and regulations that need to be in place to avoid the hardships and indignities suffered by those in the greatest need, such as their lack of access to light, heat, and reliable forms of transportation. The object of a view of energy as bound by issues of justice is of course equal access and equal protection for all members in which the timeframe is "forever" (see Table 1).

By contrast, others argue that energy needs to be distributed by way of demand for it as reflected by its *market value*. Energy according to this view is a commodity not a right and should be allocated via mechanisms like supply, demand, and competition. According to this regime of worth, a market organized via price avoids waste and ineffective use. The test of market value is discovered in the competition that takes place among individual producers, sellers, and consumers. Market arguments are "proven" through the efficient allocation of resources, goods, and services with energy going to its highest or best use as reflected in someone's willingness to pay. The object of energy as a commodity is its free circulation and opportunity for it to be socially useful as determined by "market forces."

Still others have recently championed a *downscaling energy view* that supports reduced energy intensities and a negative growth paradigm called "de-growth." This view justifies downscaling energy use and societal growth insofar as it maintains that energy is neither a "human right" nor a "commodity," but instead a requirement for both human and non-human nature whose availability should be limited by demonstrated need. De-growth advocates like Jackson or Daly claim that contemporary market capitalism must be refashioned into a steady-state economy where development – "to expand or realize the potentialities of; to bring gradually fuller, greater, or better state" – takes the place of growth – "to increase naturally in size by the addition of material through assimilation or accretion" (Daly, 1990, p. 45, 1996; Jackson, 2011). From a de-growth perspective, outside of distribution founded on needs, energy should be treated as an indulgence. Beyond necessity, then, the de-growth perspective maintains that humans have no "right" to take from future generations or nature what they require to survive or to use sources of energy – for instance, hydrocarbons – that threaten the survival of humans and non-human nature. De-growth, downscaling, downshifting, and steady-state economy advocates therefore highlight the need for the contraction of contemporary developed world energy appetites because energy-intensive societies are unsustainable, causing a majority of the world's environmental disorganization (Jackson, 2011, pp. 132, 150–151). The test used by de-growth advocates therefore would be the reduction of energy intensity at different scales from personal use to a society-wide energy diet. Heightened levels of environmental disorganization reflected in climate change, air, water, and soil degradation "prove" that energy as currently secured, distributed, and consumed is against the common (read "planetary") good. For advocates of de-growth, the timeframe of consequence against which contemporary choices should be measured are future generations of humans and non-human nature and therefore extends well beyond the immediate transaction, quarterly report, or annual return characteristic of market metrics.

While the industrial "energy efficiency" and market-based "priced energy" justifications on which the fossil fuel regime has largely been based are grounded primarily in materialist and economic utility considerations, a growing interfaith movement has been exploring the moral-spiritual and religious bases for energy use and consumption. This justificatory framework roughly articulates an "energy stewardship" view. Like the other justifications, the interfaith energy movement also represents a growing category of adherents with distinctive arguments of worth regarding energy's place in fomenting collective well-being. However broad the beliefs and doctrines represented by energy stewardship may be, they reflect a growing religious discussion about energy, environment, and social justice concerns (Francis, 2015). For example, in the U.S. context interfaith organizations representing a wide swath of beliefs, from Hinduism and Christianity to Judaism, are joining together to serve their god in caring for the planet in an expression of religious stewardship of a divine creation (Biscotti & Biggart, 2014).

The broad umbrella of religious interest represented in the interfaith movement tends to focus on the interrelationship of nature and humanity and humanity's obligation to be a guardian of the environment (Northcott, 2007; Wallace, 2010). Non-deist traditions, such as Buddhism and Confucianism, focus on the interdependence of humans and nature as a harmonic system; when any part is out of balance the entire system is at risk. Hinduism sees creation as divinely graded with humans at the top, but not apart from the earth and other forms of life. Indeed the forces of nature including the earth, sky, air, water, and fire are bound together and the divine is expressed through natural phenomena.[15]

By contrast, for the Abrahamic traditions such as Judaism, Christianity, and Islam who have taken a stewardship view, the earth is understood as divinely created and in a reinterpretation of scripture feel they must honor, respect, and maintain the creator's creation rather than defile it. From a stewardship position, anything that exploits, pollutes, or destroys nature is therefore an affront, a sin. In recent developments, such as Pope Francis's recent encyclical *Laudato Si: On Care for Our Common Home*, he raises new concerns morally connecting overconsumption and pollution to more than disrespecting God's creation, but also contributing to global poverty – a clear link to ideas of environmental justice frame (Frances 2015).

There are a number of other emergent energy justifications that also clash with the historically dominant view of energy in general and the fossil fuel regime specifically. Each energy justification we identify in Table 1 seeks to gain rhetorical control over how energy is understood and therefore managed in the present and presumed future. The competing claims take form as arguments for energy efficiency, priced energy, alternative energy, energy conservation, just energy, energy stewardship, downscaled energy (de-growth), and eco-modern energy (see Table 1). They have both overlapping and unique justificatory principles, but differences are often in the clustering of principles rather than in completely divergent perspectives and beliefs about what is right and true. For example, energy efficiency can concern reducing economic waste, saving energy so there is more to serve human needs (justice) and less destructive to the environment (conservationism and de-growth) and simultaneously about saving energy and the environment for moral reasons (stewardship) (Table 1).

DISCUSSION AND CONCLUSIONS

Energy choice debates are arguments over what kind of energy is "good" – socially, politically, economically, morally, and environmentally – or less good, or not good at all. They are not "just" political or economic debates, but fundamentally epistemic arguments founded in beliefs about what is true and morally right and the justifications that stand behind them. For instance, the merits of fossil fuels like coal, oil, and natural gas, for some, outweigh their risks because they have provided a highly reliable energy source that has promoted prosperity and material comfort that would have otherwise been impossible, and may be in the future as fossil fuel use is by choice or circumstance prohibited. Indeed, until after WWII few reflected on the disadvantages associated with fossil fuels, if they considered energy as a political issue at all. For example, as far back as 1896 Swedish scientist Svante Arrhenius suggested the burning of fossil fuels was causing global warming and then in the 1930s American scientist G. S. Callendar did too, but to little effect on the consensus of the day. They were arguing with the dominant means and rationale the underlay modern life: the fossil fuel regime. Other hydrocarbon supporters, reliant on efficiency and priced views of energy (see Table 1), find the fossil fuel energy's relatively low-costs, which reflect existing infrastructure as well as efficiencies associated with portability, ease of storage, and the variety of forms and uses of petroleum-based fuels are unchallengeable economically. For those who advocate for fossil fuels, the benefits simply outweigh the risks given the principles they pay homage too such as efficiency, effectiveness, and supply, demand, and price as the means by which they are distributed.

Lower GHG fossil fuels, like natural gas (NG), which emits about half the GHG content of heavy oil when burned, has seen a rapid rise in development and use in the last decade. Natural gas now comprises 28 percent of U.S. energy demand and heats 51 percent of U.S. households (API, 2015). Indeed, natural gas has proliferated so quickly that it has also significantly changed priorities in the energy generation industry, undermining the role of coal and crude oil in these applications. Advocates of natural gas – which adheres to the fossil fuel regime precepts of industry and market – have also coopted aspects from both "energy conservation" and "green" justifications to find their claims (see Table 1). To promote increased reliance on natural gas, advocates highlight its cleaner GHG profile and suggest that it represents a potential "bridge fuel" that can move society away from coal and oil and toward cleaner alternative sources of energy.

For those who believe rapid transition away from fossil fuels and decreasing atmospheric GHGs, the bridge analogy conveys a false premise: if it is a bridge, it is a bridge to nowhere. This, they contend, is because reliance on fossil fuels – even natural gas – does not build the necessary infrastructure, processes, or mentality required for alternatives and renewables to take off. For instance, natural gas, according to "green" and "de-growth" positions (see Table 1), while producing fewer GHGs than coal or oil, is simply the next GHG-producing hydrocarbon and involves a new set of controversies over its extraction and expanding use (Levi, 2013). Critics contend that in the context of seeking to stabilize levels of CO_2 to under 450 ppm, using natural gas as a bridge is of very limited value. What is more, given the methane leakage associated with natural gas operations, it is even less likely that a climate benefit from substituting natural gas for coal – using it as a "bridge" – is realizable. Finally, critics point out, given the environmental excess associated with extraction methods such as fracking and its contamination of local water sources and causing local earthquakes as well make it a "risky" fuel even if its carbon footprint were smaller than coal and oil. Society must, such critics contend, develop cleaner alternatives.

Perhaps the most controversial alternative energy, nuclear fission, has recently made a comeback as the risks of climate change – and therefore fossil fuels – have for some begun to outweigh the risks associated with nuclear energy. In the 1970s the anti-nuclear movement was largely successful in the United States and to some extent in other developed societies at resisting large-scale nuclear reactor deployment (Jasper, 1990). Many contemporary advocates for nuclear energy rightly point out that it is GHG-free. Many also now claim they are new "green converts" to the nuclear option, adhering to an ecomodernist energy view. Given the urgency of reducing GHGs in the atmosphere, these advocates – some whom were even former high-profile nuclear power critics because of nuclear power's catastrophic potential and long-term waste storage issues – now view it as preferable to coal, petroleum, and other fossil fuels. They argue that if one accounts for the risks and losses attributable to coal mining, coal burning, and coal inspired climate change such as measured in human lives lost that the costs dwarf those posed by nuclear power. This is the case, they claim, even when the losses caused by past and recent nuclear accidents from Chernobyl to Fukushima are included (Kloor, 2013).

For their part, nuclear power's critics also rightly point out, reliant on higher order principles derived from *alternative energy, energy justice, energy* *stewardship*, and *downscaling energy* views, that storing of nuclear waste fuels is prohibitively expensive, unpredictable, and dangerous and the timeframes involved simply untenable – they say a 50,000-year half-life for some spent fuels is impossible for our civilization to plan against. What is more, the catastrophic potential posed by nuclear meltdown (or near meltdown) and radioactive releases at Three Mile Island, Chernobyl, and Fukushima while low probability events present catastrophic risks that at least locally rival those posed by climate change. Still others argue, in a non-environmentally focused critique and therefore set of principles, that the potential capture of fissile materials for bombs by rogue groups adds another unpredictable risk factor to nuclear power's already risky profile.[16] Something, they claim, will be worse by the proliferation of nuclear facilities and therefore fuels, but to be used and already in waste form. The downside risk of nuclear energy, say those who are against it, then, is just too high even given its upside with regard to climate change and societies' desire to be energy-intensive. Besides, critics typically add, there are alternatives.

Advocates of alternative, renewable energy sources such as biofuels like palm oil, switch grass, and green algae extol their virtues as low environmental impact(s) substitutes for fossil fuels. Yet, the reality of scaling-up biofuels for general use has proven more difficult than anticipated as it has required converting a great deal of arable land currently used to grow food crops for human consumption (food energy) and the destruction of wilderness so that large-scale agricultural biofuel production can take place. This has prompted a debate about what matters most: human food energy and free-nature or cleaner burning alternative and renewable fuels? This has recently been further complicated in a fuel versus food and forests debate (Elliott, 2015; Evans, Ramage, DiRocco, & Potts, 2015). The latest science has shown another trade-off, one between "carbon-capturing free standing forests" versus achieving "cleaner fuels" via clearing such forests for large-scale agricultural production. The carbon capture potential of native forests has been found to complicate the positives of cleaner fuels grown in this manner. Ultimately, a decision regarding the worth of this as a collective good reflects value-based principles and justifications.

Other alternative, renewable energy sources also have their advocates in the current period of energy ferment. Solar tops the list, with its infinite potential and seeming lack of downside risk. Yet, like alternative fuels, when scaled-up, solar too has gained its detractors who claim it is expensive, unreliable, and imperfectly sustainable. Manufacturing solar panels requires a great deal of energy, typically from hydrocarbons. Indeed, solar panels use of plastics derived from petroleum and other forms of energy are required to bridge-use when solar is not available.[17] What is more, while solar and renewables including wind, hydropower, geothermal, and tidal hold infinite potential pursuing them at industrial scale requires vast infrastructures that often colonize enormous geographies, displacing people (hydro), natural environments (solar and hydro), ruining view-sheds (wind and solar), cutting off animal migrations (wind and hydropower), and killing animal and plant life (hydro, solar, wind).

Renewable energy sources such as these are also often far from their final destinations, where they are used in homes and industry, and therefore require distribution through complex grids, channels, and other engineered conveyances.

For their part, de-growth advocates also criticize many alternative and renewable advocates for suggesting that we can grow our way out of climate change or any of a number of vexing environmental troubles via such alternatives or renewable energy sources. The only way out and toward sustainability, they emphatically claim, is less-intensive extraction, transmission, and use of energy (see Table 1).

Back to the Future

The application of intense forms of energy, particularly movable forms such as petroleum and coal, transformed both the material and social life of societies wherever that application took place. In Europe and North America it led to new forms of industry and material goods and redistributed populations away from fixed energy sources such as hydropower. Intense energy enabled and required large-scale infrastructure that in turn demanded larger capital investment. Large capital investments in factories and railroads enabled the manufacture and distribution of goods across much wider markets. Importantly, large investments in both capital-intensive factory production as well as single-sources of energy like coal, oil, and natural gas produced (and continue to produce) exceptionally large profits and contributed to the formation of investor classes and new social strata.

The seminal role of energy in enabling this move toward an industrial and post-industrial society is rarely framed in this way. Rather it is the role of technological development and with it capital accumulation that is assumed to be the precipitating factor in moving society toward modern forms of economic organization and culture. But energy in new forms came *first* and enabled the world that capital has built. Energy and capital have been entwined ever since, but in an era dominated by fossil fuel energy infrastructures the role of it was if not a background factor in the public consciousness one that was conflated with key terms like progress, modernity, civilization, and "our way of life" (Mitchell, 2013).

This has changed rapidly. The justification for fossil fuel energy as the foundation of our economy is no longer a settled matter, but one that is increasingly political and involves competing justificatory frameworks. Scientific advances in the understanding of the earth as a finite physical object subject to the laws of physics and chemistry, the environmental movement with its concern with the planets well-being and the health implications associated with pollution and toxins, and the moral implications of energy development, distribution, and the externalities contained therein no longer allow energy, and the higher order principles associated with it, to be glibly associated with foundational concepts like progress and civilization. Indeed, these developments have destabilized the dominant narrative associated with the fossil fuel regime and with it the unquestioned reliance on fossil fuels that characterized the 19th and a majority of the 20th century.

It is its capacity to break down these narrative justifications that conventions theory and the orders of worth typology provide such an insightful means of comparative analysis. In this article, we have used it to compare and contrast competing energy justifications that reflect a contemporary energy polemic and through it have identified eight competing regimes of worth. We would add, there are surely others that are emerging or that reflect hybrids of those currently in circulation and that are competing for "conventionalization." Each energy-focused regime of worth we identified involves and reflects distinctive principles and therefore claims on "reality" that involve distinctive clusters of values, tests, and proofs that animate them as stand-alone justifications for new energetic pathways.

In the U.S. context, conventions theory remains an underutilized means of observing, comparing, and understanding both conventional practice and social transformation as reflected in public arguments and the material objects and conditions that are brought to bear to test and prove their worth or by contrast to undue them. In our analysis, the orders of worth typology helped to expose the multiple and competing regimes of worth that focus on differing kinds of energy, differing means of extracting and distributing energy, and differing ends associated with the use of energy and therefore the moral positions taken and the stakes attributed to differing kinds of energy by different stakeholder interests. Each position is founded on both moral-ethical and material "truths." Which of those become conventionalized as dominant modes of understanding and justifications will both reflect and shape our social, material, and spiritual relations and therefore the future of our civilization.

NOTES

1. Cited in Dolores Greenberg, *Energy, Power and Perceptions of Social Change in the Early Nineteenth Century*, Vol. 95, No. 3 (Jun.2990), pp. 693–714. This content downloaded from 169.237.100.72 on Wed, 30 Mar 21:35:19 UTC.

2. There are exceptions though. Also, development professionals do understand the role that energy infrastructure can have on enabling for example girls to go to school rather than collect wood or water. For instance, Annette Lareau's (2011) work reveals the critical role that transportation access has on social and economic access for lower and working class people in the U.S.

3. We borrow the "era of ferment" concept from Tushman, Anderson, and O'Reilly (1997) who develop it in their treatment of innovation in organizational contexts.

4. The energy required to gather but especially to grow, harvest, dry, store and otherwise prepare foods is substantial and varies a great deal depending on the type of food

and where in the food chain it is consumed. Energy is used more efficiently when humans eat grains and other plants directly as the "primary consumer." Eating meat from animals that have been fattened on grains is very inefficient (Pimentel & Pimentel).

5. A calorie is the amount of energy needed to raise the temperature of a gram of water 1 degree C.

6. Richard White concisely describes the role of river power and food energy from fish as it is influenced by colonialism and conquest. He discusses the caloric impacts of the John Jacob Astor expedition to set up a fur-trading network.

7. Social scientists have long argued the role of agriculture in promoting or inhibiting different forms of social organization such as family and tribal structure. Karl Wittfogel's (1957) hydraulic theory explained the development of the centralized state in places such as Egypt and Mesopotamia as attempts to control irrigation and food supply. Carneiro's circumscription theory argued that when mountains or deserts environmentally circumscribed agricultural land, warfare was a means of dealing with population pressure on the food supply (Carneiro, 1970).

8. High-energy anthracite coal was also discovered in Pennsylvania in the 1850s.

9. BP, formerly British Petroleum, is the legacy of the Anglo-Persian Oil Company formed to secure Iranian oil under Churchill's leadership and critical to England's WWI successes.

10. In the U.S. President Nixon lowered the speed limit to 55 mph in order to conserve fuel, extended daylight savings hours, and small cars became more popular.

11. Formerly the Carbon Disclosure Project, CDP encourages companies to share emissions data. About 2000 firms are reporting GHGs as of 2016. http://CDP.net

12. Accessed June 20, 2016, http://www.swissre.com/rethinking/climateand_natural_disaster_risk/)

13. Two billion people need modern energy services by 2015 to accelerate the achievement. For information, the UNDP/WHO 2009 report, "The Energy Access Situation in Developing Countries, A Review Focusing on the Least Developed Countries and Sub-Saharan Africa," can be viewed at http://www.undp.org/energy.

14. See 2013 World Hunger Poverty Facts and Statistics at http://www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm

15. Prince Philip, the Duke of Edinburgh, head of the World Wildlife Fund in 1986 convened leaders of five world religions in Assisi Italy. *The Assisi Declarations* were messages from leaders of Buddhism, Christianity, Hinduism, Islam and Judaism on the relationship of their beliefs to the natural world. Additional faiths including Jainism, Baha'i and Taoism, contributed to a subsequent book *Faith in Conservation* published by the World Bank. The larger group formed the secular organization Alliance of Religions and Conservation http://www.arcworld.org that continues to promote interfaith dialog on the environment. In addition, community-level faith networks are growing to turn belief into social action. For example see Green Faith http://www.greenfaith.org and Interfaith Power and Light http://www.interfaithpowerandlight.org These groups do everything from helping to insulate places of worship to lobbying to disinvest from carbon-based fuel assets.

16. For example see The Fissile Material Working Group report at http://www.fmwg.org

17. This is a problem, electricity storage, that will be further mitigated with better batteries should they be developed.

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