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Ancient discipline, modern concern: Geographers in the field of energy and society

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ABSTRACT

If energy and society are parts of the same cloth, geography is the thread that ties them together. As a social science, geography has become more critical than ever to our understanding of how inhabitants of our planet interact and how the quest for energy is affecting economic and political stability everywhere. There is no avoiding the important interplay of energy, geography, and society. More, importantly, when we bring the three together it helps us better understand what we have created and what we will be facing. Despite its growing value, however, we have directed only periodic attention to the contributions of geography. Future research needs to consider the expansive concept of energy security as a place and context-specific condition. Energy externalities, spillovers, leakages, and free riders loom large as policy challenges with geographic dimensions. Understanding spatial variations in the link between affluence and pollution is important, because increased prosperity may eventually enable sustainable development. Facilitating the spatial diffusion of energy innovations and the process of technology learning are also key to solving energy/society problems. Finally, optimizing polycentrism as an approach to “scaling up” energy and climate policy would also benefit from geographic analysis.

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Like energy, geography is deeply rooted in our lives. The relationships between energy and society are too numerous to fully enumerate, too ingrained to boldly stand out, and too significant to overlook. Yet, despite their importance, these relationships have heretofore lacked a scholarly journal suitably targeted for their collection and emphasis [1]. Among other social sciences, the perspective of the discipline of geography has been conspicuously underdeveloped [2]. At the same time, scholars in other disciplines increasingly use geographical perspectives to examine the energy issues facing our planet. This trend reflects a “spatial turn” that extends broadly across the physical, social, economic, and policy sciences [3,4]. As a result, we also weave into our review some of the key concepts and findings from other disciplines that have focused on geographical aspects of the nexus between energy and society. Our goal here is to illuminate how geography can enrich our understanding of energy and society, to identify what is unique

and helpful about combining geography with energy and society, to explain some of the techniques and applications that have come from the hands of geographers who focus their attention at this busy intersection, and to suggest areas of future research.

1. Geography in the study of energy and society

Across the long history of geographic inquiry, the most enduring goal has been to understand the surface of the earth as modified by human action, that is, the cultural landscape. Of all the cultural landscapes humans produce, some of the most idiosyncratic come from our need for energy. These landscapes have many shapes, forms, and functions, including coal mines, expansive fields of drilling rigs and wind turbines, hydroelectric dams, the rounded domes of nuclear power plants, and ever-present transmission lines that must connect those who supply power with those who consume it. Some of these energy landscapes, such as oil drilling derricks, are temporary. Others such as Alberta oil sands development, mountain-top removal in West Virginia, and the ‘dead zone’ near Chernobyl leave long-lasting imprints.

Whatever form they take, and wherever they exist, energy landscapes have often been a visible reflection of the society’s that creates them, a reference point in many cases to their economic

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status. While the lines are beginning to blur more and more, slash and burn agriculture suggests an agriculturally based economy, whereas massive strip mines and mountain-top removal suggest a fully industrial one. As they read the landscape, geographers are tuned to such differences and implications.

The attention that these altered landscapes attract from geographers conveys a natural curiosity about the form, function, distribution, evolution and permanence of the world around them, whether the territory in question is rural or urban. In rural energy locations, for example, geographers seek understanding about origins, purpose, temporal changes, culture and economic development, and likely post-energy disposition. In urban environments, geographers might seek amplification about clustering and agglomeration, human migration and relocation, public perceptions, transportation routes and means, urban morphology, and microclimates. Taken together, all phases of energy supply and demand are likely to attract the interest of geographers. Indeed, one might well argue that geography offers the most expansive and appropriate perspective in the study of energy, at any scale.

Of course, geography is not the lone social science interested in energy. Historians, economists, sociologists, anthropologists, lawyers, architects, planners—to name a few—all contribute to our understanding. The sphere of geography is, however, particularly helpful understanding environmental and geopolitical ramifications of the entire supply chain. In this way, the three elements we are discussing here—geography, energy, and society—form a triangle, one that embraces within its boundaries all the important activities that occupy our interest in today's world. Such importance has not always been so apparent.

Until roughly 1973, the topic of energy was mostly abstract, something we took for granted when we flipped on a light switch, squeezed the handle of a fuel pump, or pressed down the accelerator of our car. The Arab oil embargo changed that, shaking us awake to the economic, social, and political repercussions of our rising reliance for energy—especially oil—something that had escaped our notice when it was cheap and plentiful. Soon, we were talking about OPEC, transportation chokepoints, and the political vulnerability that had come while we were not paying attention. We had become overly dependent on imported oil.

We in the US were not alone. Other countries, such as Japan and the UK had also become heavily dependent on oil imported from distant places like Saudi Arabia. As dependency rose, so too did concerns about national security and trade imbalances. As these concerns increased, so too did military presence in the area, meant to ensure oil deliveries were not interrupted. Oil became central to the lives of those living in the First World and to those who aspired to join it. As we struggled to adjust to a new reality, we were driven to become more knowledgeable about the geography of oil, paying particular attention to supplying countries, routes of transportation and distribution, applications and uses of oil, and what all these factors would mean in a changing, shrinking, more competitive global marketplace.

At about the same time, early in the decade of the '70s, concerns about energy resources other than oil began bubbling to the surface. It was also a time of rising consumer demand, rapid population growth, unprecedented environmental laws, increasing intolerance for environmental damage, and quickened messaging. No energy resource was immune from increased public scrutiny, and coal became a major target of attention. Although we had been using coal for over a century, it took until the 1970s for us to publically acknowledge the high price it was having on our health and safety, plants and animals, water supplies and, indeed, the landscape itself [5]. Geographers started contributing to studies about the socio-economics of coal, coal mining, power plant siting, and downwind impacts of power plant emissions [6–8]. What oil had become on

the international stage, coal became within our borders, and we started turning more and more to nuclear power to generate our electricity without the traditional emissions and other dangers of coal. The peak of enthusiasm for nuclear power came in the late 1970s, when the world total of commercial reactors came to more than 400.

As never before, geography and energy converged in the late 1970s and early 1980s. The reason was apparent: energy demand—with all its repercussions—was rising at unprecedented rates, and the questions that surfaced were fundamentally geographical in nature. The range of topics was wide, but initially attention focused on appropriate site selection, fuel transportation routing, and a wide assortment of environmental impacts, particularly those from coal mining and air pollution [9]. Much of the work on these problems took place in universities, but the national laboratories ramped up their attention as well. Oak Ridge National Laboratory, for example, came to eventually employ about a dozen PhD geographers in its energy division. Universities, national laboratories and the public sector came together to form the Energy Specialty Group (now the Energy and Environment Specialty Group) of the Association of American Geographers in Philadelphia 1979.

At almost the same time, just two hours' drive to the northwest, the partial meltdown of a nuclear reactor at Three Mile Island was to have a smothering effect on the ambitions of nuclear power advocates, and catalyze energy geographers as never before. Quickly, geographers were contributing to our understanding of many of the spatial issues uniquely linked to nuclear power. Ironically, it turned out to be preparation for the far more serious accident just 7 years later at Chernobyl, 90 miles northwest of Kiev, Ukraine.

These two accidents more than any other events raised public attention to the human costs of nuclear power and resulted in a burst of geographical studies, particularly the overlooked matters of downwind dispersal of radioactivity, public responses to emergencies and perceptions of risk, limitations to nuclear power plant siting, long-lasting warning markers, nuclear power plant decommissioning, global proliferation, energy ethics, and social justice [10–20]. Many of these were brought together in 1984 with the publication of *Nuclear Power: Assessing and Managing Hazardous Technology* in 1984 [21].

These accidents emphasized several core geographical considerations, such as siting, dispersal, distribution, evacuation behavior and many other themes. The question might be asked: Why did it take so long? The answer, in part, is found in an educational system that had stripped geography from the curriculum in secondary education and even universities [22]; influential policymakers often lacked geographic perspective or even the most basic geographic knowledge; that is, knowing more than just where things are, but understanding the economic and demographic workings that hold the inhabited world together. Fortunately, the tide has turned and geography has been gradually making its way back as a module of possessed knowledge expected of an educated person. In part, this renaissance occurred because understanding the geography of energy has obvious importance to international affairs and business opportunities. Politicians need such knowledge in order to effectively and appropriately enact laws and allocate resources. Businesses need that information in order to make money.

2. Cities as energy creations

As nodes of convenience, trade and mutual protection, cities rely on steady and reliable supplies of energy. The more successful cities, at least the early ones, controlled water as well. In such places, as agriculture provided food surpluses, people became

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