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Front Matter



EDITORIAL



Editor's Introduction

Spencer Banzhaf

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SYMPOSIUM: THE COMING ENERGY TRANSITION



Global Energy System Transitions

Jae Edmonds, Shinichiro Fujimori, Gokul Iyer, Haewon McJeon, Patrick O'Rourke, Jiesper Tristan, Detlef van Vuuren, and Sha Yu

pp. 2–25

Abstract 



Energy systems power the world's economies. They are pivotal to providing sustained economic prosperity that provides the goods and services that humans desire. Climate change is intimately linked with energy systems because CO₂ from fossil fuel use is the most important anthropogenic greenhouse gas (GHG) emitted to the atmosphere, and cumulative anthropogenic emissions determine Earth's concentration of CO₂. Limiting climate change therefore means that global energy systems must reduce net CO₂ emissions to zero and stabilize emissions of other GHGs. We compare energy system pathways as they are currently evolving with alternatives that have the potential to limit climate change over the twenty-first century. The differences are profound. We also discuss some frontier research issues that can provide a better understanding of potential pathways and their implications for decision makers.



The Limits and Costs of Full Electrification

David Rapson and James Bushnell

pp. 26–44

Abstract 



Electrification is a centerpiece of global decarbonization efforts. Yet there are reasons to be skeptical of the inevitability, or at least the optimal pace, of the transition. We discuss several underappreciated costs of full, or even deep, electrification. Consumer preferences can operate in favor of and in opposition to electrification goals, and electrification is likely to encounter physical and economic obstacles when it reaches some as-yet-unknown level. Although we readily acknowledge the external benefits of decarbonization, we also explore several

underappreciated external costs. The credibility and eventual success of decarbonization efforts will be enhanced by foreseeing and ideally avoiding predictable but nonobvious costs of promising abatement pathways. Thus, even with all of its promise, the degree of electrification may ultimately reach a limit.



The Next Wave of Energy Innovation: Which Technologies? Which Skills?

David Popp, Francesco Vona, Myriam Grégoire-Zawilski, and Giovanni Marin

pp. 45–65

Abstract ▾



The costs of low-carbon energy fell dramatically over the past decade, leading to rapid growth in its deployment. However, many challenges remain to deploy low-carbon energy at a scale necessary to meet net-zero carbon emission targets. We argue that developing complementary technologies and skills must feature prominently in the next wave of low-carbon energy innovation. These include both improvements in physical capital, such as smart grids to aid in the integration of intermittent renewables, and human capital, to develop the skills that workers need for a low-carbon economy. We document recent trends in energy innovation and discuss the lessons learned for policy. We then discuss the need for complementary innovation in both physical capital and human capital. We provide guidelines for identifying appropriate policy tools to promote enabling technologies, and we show how a focus on job tasks can inform policy and research on the worker skills needed for the energy transition.



The Economics of Power System Transitions

Mort Webster*, Karen Fisher-Vanden, and Ian Sue Wing

pp. 66–87

Abstract ▾



Electricity generated by fossil fuels is dispatchable, meaning that generators can be turned on when needed. By contrast, renewable energy tends to be intermittent because of the variability of natural sources such as wind and sunlight. New approaches are needed to solve the challenges to electricity systems posed by the growing share of variable renewable energy (VRE) in these systems. Specifically, how should the physical power system and markets for electricity be structured to deliver electricity at low cost and reflect consumers' preferences for reliability? Current power systems have largely achieved these two goals through a competitive market for generation based on marginal cost pricing and through mandated overcapacity to ensure 100 percent reliability to consumers. Decarbonization-induced increases in the share of generation from nondispatchable VRE create operational challenges: ensuring 100 percent reliability in a VRE-dominated system will be costly and inefficient. Preferences for reliability are heterogeneous, as some consumers will insist on 100 percent reliable energy, whereas others may be willing to forgo reliability for lower cost. In this article, we discuss ways to design a power system and electricity market that can address this inefficiency.

FEATURE



The Promise and Peril of Carbon Neutrality Goals

Abstract ▾



The carbon neutrality goal has emerged as the most popular way for institutions to frame policy responses to climate change, largely because of its flexibility as a net-zero emissions target. We highlight two desirable features arising from this flexibility: the potential for reducing emissions at a lower cost and the potential for promoting distributive justice. To demonstrate the role of cost-effectiveness, we report estimates of average emissions abatement cost of solar electricity plants located (hypothetically) in each of the 48 states of the conterminous United States. We then explain how institutions may pursue distributive justice by targeting cobenefits of emissions-reducing projects to specific areas or groups. We also describe the two primary concerns with carbon neutrality goals: additionality and ethics. To allay these concerns, we suggest improvements to the basic integrity of carbon markets and ways in which institutions can commit to local decarbonization in tandem with carbon neutrality.

ARTICLES

OPEN ACCESS

Inequality Aversion for Climate Policy

Stellio Del Campo, David Anthoff, and Ulrike Kornek

Abstract ▾



A sizable body of literature on climate economics uses the notion of inequality aversion. This is the idea that a society will give up some personal benefits or economic efficiency to achieve greater equality. We review and synthesize published estimates of inequality aversion to guide this literature. We review both normative studies (which treat ethical values as axioms from which good behavior is deduced) and empirical studies (which try to infer a society's beliefs about inequality from its public policy decisions). In the normative case, a variety of ethical principles underlie the recommendations for inequality aversion. The empirical studies use various methods to present estimates based on some form of "revealed ethics," in which a society's actions or individuals' responses unveil preferences to reduce inequality. Examples include progressive income tax schedules or the level of foreign aid. In these empirical studies, we find strong support for the view that people are averse to inequality, but only to a limited degree. Studies that look at domestic policies support values between one and four (where zero indicates no aversion toward inequality). By contrast, studies that look at foreign aid find lower values, ranging from above zero to one.



Recent Findings and Methodologies in Economics Research in Environmental Justice

Lucas Cain, Danae Hernandez-Cortes, Christopher Timmins, and Paige Weber

Abstract ▾



This review synthesizes economics-oriented research in environmental justice with a focus on the last decade. We first categorize this literature into broad areas of inquiry and review main findings. Then, we review recent advances in data and methodologies that have allowed for new study designs and research questions. After identifying breakthroughs, we offer some guidance on how to continue to advance research in this area.



Environmental and Natural Resource Economics and Systemic Racism

Amy W. Ando, Titus O. Awokuse, Nathan W. Chan, Jimena González-Ramírez, Sumeet Gulati, Matthew G. Interis, Sarah Jacobson, Dale T. Manning, and Samuel Stolper

pp. 143–164

Abstract ▾



This article highlights some ways in which scholarly work in environmental and natural resource economics may be affected by, and may unintentionally further, racial inequity. We discuss four channels through which these effects may occur. The first is prioritization of efficiency over distribution. The second is inattention to procedural justice. The third involves abstraction away from crucial historical or social contexts. The fourth is a narrow focus on problems that fit neatly within existing analytical and empirical frameworks. We follow these threads through three areas in which we offer examples of how environmental and natural resource economics work may further racial inequity. The first involves methods of evaluating and measuring human and social welfare. The second relates to policy modeling choices. The third centers on analysis of management of the commons. We document opportunities to improve the field by better considering how racial inequity may affect, and be affected by, environmental and natural resource economic analysis. Scholars in this field have tools that can mitigate systemic racism in access to natural resources and a clean environment, but work must be done before that potential is realized.



The Effects of Norms on Environmental Behavior

Astrid Dannenberg, Gunnar Gutsche, Marlene C. L. Batzke, Sven Christens, Daniel Engler, Fabian Mankat, Sophia Möller, Eva Weingärtner, Andreas Ernst, Marcel Lumkowsky, Georg von Wangenheim, ... See all authors ▾

pp. 165–187

Abstract ▾



The study of norms is of paramount importance in understanding human behavior. An interdisciplinary literature, using varying definitions and conceptions, shows when and why norms emerge and spread, what form they can take, and how they are enforced. Here, we focus on theoretical and empirical literature that treats norms as a factor influencing human behavior. We first present a new taxonomy of norms, which builds upon and merges previous taxonomies, to distinguish between different types of norms and enforcement mechanisms. We then provide a conceptual framework that identifies reasons for the effects of norms. This framework is based on psychological theories, which serve as a foundation for much of the empirical economic literature measuring norm effects. Finally, we present an overview of empirical economic papers that study the effects of norms on environmentally relevant behavior, as a particularly relevant area for the study of norms. The aim of this overview is to highlight which effects have been insufficiently studied and to give a sense of the potential of norms. This can help policy makers intervene in a more targeted way to address environmental problems.





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