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Author:

Larson, Rhett; Holley, Cameron; Bowman, Diana

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THE ENERGY/WATER/FOOD NEXUS —AN INTRODUCTION

**Rhett B. Larson, Cameron Holley,
and Diana M. Bowman***

ABSTRACT: The Fall 2018 issue, and the forthcoming Winter 2019 issue, of *Jurimetrics* are a compilation of articles from scholars who participated in the PLuS Alliance's workshop from January 11–12, 2018—entitled Rethinking Law in a Nexus Future: Governing Energy, Water, Food, and Climate Change. The PLuS Alliance is a collaborative relationship between Arizona State University (ASU), Kings College London (KCL), and the University of New South Wales (UNSW Sydney). The workshop brought together leading legal scholars from the PLuS Alliance universities, as well as universities from around the world, to discuss the challenges and opportunities surrounding the intersection of laws governing energy, water, food, and climate change. The articles selected for this symposium were presented, discussed, and critically evaluated at the workshop, and the authors and participants hope this workshop and resulting *Jurimetrics* symposium constitute the beginning of an ongoing dialogue and collaboration on the critical and interconnected issues surrounding the use of natural resources in the face of climate change.

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*Rhett B. Larson is Richard Morrison Fellow in Water Law and Associate Professor of Law, Arizona State University Sandra Day O'Connor College of Law and Senior Research Fellow, Morrison Institute of Public Policy's Kyl Center for Water Policy. Cameron Holley is a Professor at UNSW Law, and member of the leadership team for the Global Water Institute and Connected Waters Initiative Research Centre at UNSW Sydney, Australia. Diana M. Bowman serves as *Jurimetrics* faculty editor and holds joint faculty positions at Arizona State University. She serves as Associate Dean for International Engagement at the Sandra Day O'Connor College of Law; Associate Director for Students at the School for the Future of Innovation and Society; and Co-Director for the Center for Smart Cities and Regions. The workshop and Cameron Holley's research for this article was supported by the PLuS Alliance and an Australian Research Council Discovery Grant (DP170100281).

The ecologist Garrett Hardin is best known for being the author of *The Tragedy of the Commons*.¹ But he also articulated his First Law of Ecology: “W[e] can never do merely one thing.”² If we import cane toads as a natural form of pest control instead of harsh pesticides, we may avoid chemical contamination, but we will get an invasive species that will harm the environment.³ If we build wind turbines to reduce air pollution and reliance on fossil fuels, we will kill some migratory birds.⁴ Every policy choice involving natural resources necessarily includes trade-offs that inevitably precludes doing merely one thing, or even merely good things.

In many instances, these inevitable trade-offs and multiple effects result because of the interrelated nature of natural resources, often referred to in terms of the water-food-energy nexus.⁵ Because water and energy are required “to produce virtually all goods,” the costs of developing water and energy are “embedded in all goods.”⁶ Water is embedded in our energy—approximately sixty gallons of water are used “for every ton of coal mined.”⁷ Energy is embedded in our water—“[t]he energy required to run a faucet for five minutes is equivalent to the energy used to power a 60-watt light bulb for 14 hours.”⁸ Water and energy are embedded in our food—“85 percent of electricity on [most] farms is used to pump groundwater for crop irrigation.”⁹

The relationship between energy, water, and food is at once both obvious and complex. This complexity can be illustrated in the growing global demand for a very small seed. Hydraulic fracturing—or “fracking”—is an increasingly relied upon method for extracting natural gas from shale formations.¹⁰ Fracking is often highly water intensive, requiring millions of gallons of water to frack a

1. Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968).

2. GARRETT HARDIN, *LIVING WITHIN LIMITS* 199 (1993) (emphasis omitted).

3. Sophie Riley, *A Weed by Any Other Name: Would the Rose Smell as Sweet If It Were a Threat to Biodiversity?*, 22 GEO. INT’L ENVTL. L. REV. 157, 160 (2010).

4. See generally Meredith Blaydes Lilley & Jeremy Firestone, *Wind Power, Wildlife, and the Migratory Bird Treaty Act: A Way Forward*, 38 ENVTL. L. REV. 1167 (2008) (discussing the trade-offs between development of wind energy and impacts on migratory bird populations).

5. Rhett B. Larson, *Reconciling Energy and Food Security*, 48 U. RICH. L. REV. 929, 932 (2014).

6. *Id.* at 932–33; see also J.A. (Tony) Allan, *Virtual Water—The Water, Food, and Trade Nexus: Useful Concept or Misleading Metaphor?*, 28 WATER INT’L 106, 111 (2003).

7. Bandana Kaur Malik, *Like Water for Energy, and Energy for Water*, ENVTL. & ENERGY STUDY INST. (Aug. 1, 2009), <https://www.eesi.org/articles/view/like-water-for-energy-and-energy-for-water> [https://perma.cc/QQ3R-GAH3].

8. *Id.*

9. *Id.*

10. Marc Lallanilla, *Facts About Fracking*, LIVESCIENCE (Feb. 9, 2018 8:37 PM), <https://www.livescience.com/34464-what-is-fracking.html> [https://perma.cc/AU4C-XVH2]; *What Is Fracking and Why Is It Controversial?*, BBC NEWS (Oct. 15, 2018), <https://www.bbc.com/news/uk-14432401> [https://perma.cc/4APV-39AN]; see GRAHAM SUSTAINABILITY INSTITUTE, *HIGH VOLUME HYDRAULIC FRACTURING IN MICHIGAN: INTEGRATED ASSESSMENT FINAL REPORT* 19 (2015), <http://graham.umich.edu/media/pubs/HF-IA-Final-Report.pdf> [https://perma.cc/Q4WA-FTQ7]; *How Fracking Changed the World*, BLACK MTN. SAND (July 10, 2018), <https://www.blackmountainsand.com/how-fracking-changed-the-world/> [https://perma.cc/S498-KXAG].

single well.¹¹ To limit impacts on local water supplies, some fracking operations rely on a gel fracking method that uses less water.¹² However, the gel used in these fracking operations requires an emulsifier produced from the tiny guar seed.¹³ The increasing global demand for this more water-efficient fracking method has resulting in a rising demand for guar, with the international price of guar seed rising from US\$4 per kilogram to US\$30 in less than two years.¹⁴ Consequently, thousands of acres of crop land in India and Pakistan that were otherwise devoted to the production of food have been converted to growing guar.¹⁵ This shift from food production to guar not only impacts local food markets and global energy markets, but results in the fracking jurisdiction externalizing the costs of water scarcity to another region of the world. Fracking operations in the United States may conserve water by using the gel-fracking method in its own region, but the shift from more water-efficient food crops to guar aggravates water scarcity in another region.¹⁶ The guar example typifies the global energy-water-food nexus and is the quintessential example of Hardin's warning that, in natural resource policy, no effort aimed at conservation, sustainability, or environmental protection will come without some unintended consequences.

Inaction to avoid making such trade-offs is simply not a realistic option. Population growth, economic development, and global climate change will increase global demands for energy by 45 percent, water by 30 percent, and food by 50 percent by 2030.¹⁷ Part of meeting this challenge will require new governance tools and approaches that can better account for and manage the energy-water-food nexus and other interconnected natural resources.

Fortunately, there has been a substantial amount of thinking (and to a lesser extent, practice) addressing the issue of natural resource integration. Various ideals of holistic, integrated, joined-up, cross-sectoral, ecosystem-based and

11. David B. Spence, *Federalism, Regulatory Lags, and the Political Economy of Energy Production*, 161 U. PA. L. REV. 431, 441–42 (2013).

12. See Christopher Helman, *Fracking Boom Means Good Times for India's Guar Farmers*, FORBES (July 17, 2012, 11:01 AM), <https://www.forbes.com/sites/christopherhelman/2012/07/17/fracking-boom-means-good-times-for-indias-guar-farmers/#10b7906d624c> [<https://perma.cc/4TR6-GAZ9>].

13. *Id.*

14. Hilary Hylton, *Why the U.S. Fracking Industry Worries About the Weather in India*, TIME (July 17, 2012), <http://world.time.com/2012/07/17/why-the-u-s-fracking-industry-worries-about-the-weather-in-india/> [<https://perma.cc/J3RQ-UAJ8>].

15. Larson, *supra* note 5, at 944.

16. *Id.* at 944–45.

17. U.N. SECRETARY-GENERAL'S HIGH-LEVEL PANEL ON GLOBAL SUSTAINABILITY, RESILIENT PEOPLE, RESILIENT PLANET: A FUTURE WORTH CHOOSING, at 11, U.N. Sales No. E.12.I.2 (2012), https://en.unesco.org/system/files/GSP_Report_web_final.pdf [<https://perma.cc/G5FK-HQ9U>]; see also Patricia Wouters, Sergei Vinogradov & Bjorn-Oliver Magsig, *Water Security, Hydrosolidarity, and International Law: A River Runs Through It*, 19 Y.B. INT'L ENVTL. L. 97, 98 n.6 (2008) (quoting Professor John Beddington, U.K. Government Chief Scientist, who refers to the stress caused by economic development, population growth, and climate change as the “perfect storm” of sustainability challenges).

polycentric approaches have been explored in legal and governance literatures.¹⁸ While the concept of the energy-water-food nexus arguably represents the most recent wave in this “line of flight,”¹⁹ academic scholarship on the nexus has tended to be dominated by the economic, science, and engineering disciplines, with scant attention to law and governance approaches, challenges, and achievements.²⁰ This is surprising given that the energy-water-food nexus (and related “signs” such as energy-water-food-climate nexus)²¹ imply a critique of existing government agency silos and human-defined jurisdictional boundaries on which traditional natural resources law tend to be based. Moreover, law and governance are likely to rest at the heart of attempts to address the energy-water-food nexus, which possibly call for cooperation and policy coherence between sectors, nations, subnational jurisdictions, and public and private governors.²²

In light of the above, the articles in this edition of *Jurimetrics* seek to contribute to the scholarship on the energy-water-food nexus by contrasting and interrogating different problems, flashpoints, and law and governance responses in the United States, Australia, and internationally. Befitting the complexity of the energy-water-food nexus, our contributors included lawyers, as well as a cohort of multidisciplinary regulatory scholars, economists, and engineers, who collectively brought fresh insights to bear on a range of law and policy issues arising in marine, terrestrial, climate, energy, water, food, and other resource contexts. In the remainder of this introduction, we summarize the nine articles, spread across two journal issues, that comprise this symposium before drawing out some general insights, as well as future research directions, that arose from the various contributions.

The symposium commences with an article by Christine Parker, Fiona Haines, and Laura Boehm in which the authors explore the potential employment of ecologically responsible regulation within the global animal agriculture

18. See, e.g., CAMERON HOLLEY, NEIL GUNNINGHAM & CLIFFORD SHEARING, *THE NEW ENVIRONMENTAL GOVERNANCE* (2012); JULIA M. WONDOLLECK & STEVEN L. YAFFEE, *MAKING COLLABORATION WORK: LESSONS FROM INNOVATION IN NATURAL RESOURCE MANAGEMENT* (2000); Asit K. Biswas & Cecilia Tortajada, *Future Water Governance*, 26 INT’L J. WATER RESOURCES DEV. 129 (2010); Karen Hussey, Jamie Pittock & Stephen Dovers, *Justifying, Extending and Applying “Nexus” Thinking in the Quest for Sustainable Development*, in CLIMATE, ENERGY AND WATER: MANAGING TRADE-OFFS, SEIZING OPPORTUNITIES 1 (Jamie Pittock, Karen Hussey & Stephen Dovers, eds., 2015); Bradley C. Karkkainen, *Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism*, 21 VA. ENVTL. L.J. 189 (2002); Elinor Ostrom, *Polycentric Systems for Coping with Collective Action and Global Environmental Change*, 20 GLOBAL ENVTL. CHANGE 550 (2010).

19. See generally GILLES DELEUZE & FELIX GUATTARI, *A THOUSAND PLATEAUS: CAPITALISM AND SCHIZOPHRENIA* (Brian Massumi trans., Univ. of Minn. Press 1987) (1980).

20. See generally Nina Weitz et al., *Closing the Governance Gaps in the Water-Energy-Food Nexus: Insight from Integrative Governance*, 45 GLOBAL ENVTL. CHANGE 165 (2017).

21. See generally Caroline King & Hadi Jaafar, *Rapid Assessment of the Water-Energy-Food-Climate Nexus in Six Selected Basins of North Africa and West Asia Undergoing Transitions and Scarcity Threats*, 31 INT’L J. WATER RESOURCES DEV. 343 (2015).

22. See Matthias Leese & Simon Meisch, *Securitising Sustainability? Questioning the ‘Water, Energy and Food-Security Nexus’*, 8 WATER ALTERNATIVES 695, 700 (2015). See generally Antti Belinskij, *Water-Energy-Food Nexus within the Framework of International Water Law*, 7 WATER 5396 (2015).

system.²³ Intensive meat production, the authors note, is placing increasingly significant economic, human health, and environmental burdens on current systems, the combination of which threatens, among other things, ecological and human health. The complexity of designing effective regulatory interventions—to strategically reduce intensive meat production and the harms that it gives rise to—is not lost on the authors who note, for example, that this form of farming “generates problems that cut across regulatory domains.”²⁴ Such complex regulatory challenges are, as Parker and her coauthors suggest, the perfect targets for new regulatory tools that have been designed, and refined, as part of a global push towards responsible regulation. Their case study of the global meat industry shows that only through radically reconceptualizing how food systems are regulated, including the use of multi-dimensions regulatory tools, will stakeholders be able to address some of the detrimental challenges created by this form of food production.²⁵

Food, specifically fishing and Indigenous rights to fishing in the Northern Territory of Australia and how traditional food practices may be conceptualized in the water-food nexus, is the focus of the second article. In her piece, Lauren Butterly traces the history of traditional fishing by the Indigenous community in this region of Australia, highlighting its importance in terms of subsistence and culture.²⁶ Drawing upon the High Court of Australia’s landmark decision in the *Blue Mud Bay* case, Butterly’s piece highlights the complexities of crafting regulatory systems within the food-water nexus that respect competing interests such as Indigenous rights as they relate to traditional food-consumption practices, food sovereignty and security, commercial aqua/agricultural activities, and broader environmental considerations. The case study presented by Butterly illustrates the inherent tensions created by independent regulatory frameworks; frameworks that fail to take into account, or blatantly ignore, the existence of the other, and seek to actively encroach on the rights created by parallel framework(s). Tensions, that Butterly suggests, are more likely to be resolved through ongoing negotiations rather than legislative intervention.²⁷

Robin Kundis Craig, in her article, shifts our focus from the water-food nexus to the often overlooked, albeit very important, marine food-water-energy-climate nexus.²⁸ As Craig eloquently articulates, the ever-increasing expansion of offshore wind farms as an alternative to coal generated energy is creating a new flashpoint for conflict—that between innovative new energy producers and an aggressively expanding marine aquaculture industry. In illuminating some of the competing interests at play, Craig also shows the heterogenous nature of

23. See generally Christine Parker, Fiona Haines & Laura Boehm, *The Promise of Ecological Regulation: The Case of Intensive Meat*, 59 JURIMETRICS J. 15 (2018).

24. *Id.* at 17.

25. See generally *id.*

26. See generally Lauren Butterly, *Fishing for Rights: The Water-Food Nexus and Indigenous Fishing in Australia’s Northern Territory*, 59 JURIMETRICS J. 43 (2018).

27. See generally *id.*

28. See generally Robin Kundis Craig, *Harvest the Wind, Harvest Your Dinner: Using Law to Encourage an Offshore Energy-Food Multiple-Use Nexus*, 59 JURIMETRICS J. 61 (2018).

each industry and thus, the inability, to create a one-size fits-all regulatory response. This does not mean, as suggested by Craig, that the two cannot co-locate and mutually benefit from co-location; for this to happen, though, as Craig points out, the regulatory approval process must be reframed to be “as much a siting and planning issue as it is a technological one.”²⁹ A robust regulatory framework that recognizes and embraces the importance of the marine food-water-energy-climate nexus and integrates tools that encourage multiuse activities will, she argues, allow both activities to thrive simultaneously within marine environments.³⁰

Rhett Larson’s article focuses on the lessons international law can draw from the interstate management of the Colorado River.³¹ The Colorado River basin encompasses seven U.S. states, two Mexican states, and twenty-eight Native American territories,³² producing food and energy for millions. While there are many lessons to be drawn from both successes and failures in transboundary management on the Colorado River, Larson discusses four particular lessons for international law.³³ First, the role of the U.S. Department of the Interior (Bureau of Reclamation) demonstrates the potential benefits and risks of a “special master” who can impose water management requirements when jurisdictions fail to reach negotiated agreements.³⁴ Second, incentives for artificial groundwater recharge may facilitate integration of transboundary surface water management and groundwater sustainability, but such efforts can be frustrated if recharge competes with other uses, like energy and food production.³⁵ Third, legal mechanisms in the basin, at least ideally, recognize, quantify, and protect water rights to forests and indigenous people.³⁶ Fourth, transboundary water management challenges in the basin illustrate the importance of interjurisdictional governance institutions investing in accurate modeling and monitoring.³⁷

Part I of the symposium closes with an in-depth analysis of the water-food-energy-climate change nexus as it relates to groundwater in the United States, the governance of which, as Sharon B. Megdal and Jacob D. Petersen-Perlman set out, is highly decentralized and multifarious.³⁸ Even the term—*groundwater governance* is, as the authors point out, the subject of considerable debate, acting to further complexify the landscape in which multiple actors and agencies must operate in.³⁹ Megdal and Petersen-Perlman’s article focuses on U.S. govern-

29. *Id.* at 65.

30. *See generally id.*

31. *See generally* Rhett B. Larson, *Colorado River Lessons for International Water Law*, 59 JURIMETRICS J. 83 (2018).

32. *Id.*

33. *Id.* at 84.

34. *Id.*

35. *See id.* at 88–89.

36. *Id.* at 90.

37. *Id.* at 92.

38. *See generally* Sharon B. Megdal & Jacob D. Petersen-Perlman, *Decentralized Groundwater Governance and Water Nexus Implications in the United States*, 59 JURIMETRICS J. 99 (2018).

39. *Id.* at 10.

ance, noting that the “lack of national groundwater policy makes it more difficult to contemplate addressing nexus challenges with the management of transboundary aquifers, whether across states lines, tribal nations, or international boundaries.”⁴⁰ While this landscape, for the most part, has operated as an impenetrable barrier to scholars and policy makers seeing to better understand and refine the system, Megdal and Petersen-Perlman have sought to better understand the landscape through qualitative research. In this article, the authors report on two U.S. state-level surveys conducted in 2013 and 2017, and a “three-case-study analysis of illustrative, regional approaches in the U.S. Sun Belt.”⁴¹ The work further illuminates the need for cross-jurisdictional cooperation to better—or more effectively—regulate groundwater, and to manage unintended consequences associated with ground and surface water allocation policies.⁴²

Darren Sinclair’s article, the first piece in Part II of the symposium, in turn focuses on the climate-energy-financial nexus, and the growing opportunities that exist within this space for addressing climate change.⁴³ “[T]he absence of substantive national government action,”⁴⁴ as Sinclair notes, for addressing this so-called wicked problem has created a regulatory vacuum in which “mainstream financial regulators, in particular, prudential regulators”⁴⁵ have been able to play a leading role in the development and implementation of what Sinclair labels “climate finance regulation.”⁴⁶ Risk—central to the climate change discourse—and the need to effectively mitigate climate related risks has been, as Sinclair argues, a catalyst for the development of climate finance regulation. This has been particularly so, Sinclair argues, in relation to the action of prudential regulator such as, for example, the Australian Prudential Regulatory Authority. Sinclair goes on to map the way which stakeholders have responded to this intercession and articulates a number of tools available to financial regulators that would strengthen their regulatory toolbox for addressing climate change.⁴⁷

In her article on “energy in-betweens,” Emily Hammond examines the climate-energy nexus as it relates to the U.S. wholesale energy market and climate change activities.⁴⁸ Hammond’s critique of the current wholesale electricity markets in the United States depicts an increasingly out-of-date regulatory framework that exhibits a lack of flexibility, reflexivity and responsiveness—all of which, along with entrenched economic models on which the systems were built, have, as Hammond contends, contributed to multiple market failures.

40. *Id.* at 103.

41. *Id.* at 111.

42. *See generally id.*

43. *See generally* Darren Sinclair, *Speak Loudly and Carry a Small Stick: Prudential Regulation and the Climate, Energy, and Finance Nexus*, 59 JURIMETRICS J. (forthcoming Winter 2019).

44. *Id.* (manuscript at 8).

45. *Id.*

46. *Id.*

47. *See generally id.*

48. *See generally* Emily Hammond, *The Energy In-Betweens*, 59 JURIMETRICS J. (forthcoming Winter 2019).

Energy in-betweens which are, as Hammond explains, the “energy innovations in non-energy sectors that fit only awkwardly into [the] existing [U.S.] federal-state regulatory regimes” and include, for example, many of the initiatives being designed to help mitigate climate change.⁴⁹ While energy in-betweens often provide greener power options, their primary purpose may not be energy generation per se; agricultural operations are, as noted by Hammond, cases in point.⁵⁰ Her critique of the federal and state regulatory regimes, and the inherent tensions within when faced with these alternative sources of energy, serves to further highlight the need for regulatory reform. State policy makers intent on crafting more sustainability regulatory approaches should, for example, better engage with nontraditional actors and institutions as part of a shift to reconceptualizing the energy market.⁵¹

The Australian energy-water-food nexus is the focus of Janice Gray’s article, which traces the social and economic importance—and impact—of the sectors within the broader Australian economy, providing the reader with a taste of the distinctive nature of the regulatory regimes that have been crafted to govern them.⁵² Gray notes, however, that the governance frameworks have been crafted in media-specific silos “despite their obvious intersections and overlaps.”⁵³ The operation outcome of this approach, she argues, is “overexploitation and overconsumption” of the three nexus resources.⁵⁴ Gray argues that a new regulatory frame is needed; one that draws on the notion of “ecological integrity” and employs a systems approach to its design.⁵⁵ This approach would allow for, she suggests, a more sustainable utilization of all three resources, while building on the foundations of public and environmental health. Her article provides a critique of key tools that could be integrated into any such governance framework including, for example, public trust and legal personhood for natural resources. While not suggesting that she holds all the answers, her article articulates a path forward for policy makers, and suggests how some of the more challenging obstacles may be best navigated by the relevant policy makers.⁵⁶

Concluding Part II of the symposium, Cameron Holley and Amanda Kennedy empirically examine the energy-water-food nexus in the context of unconventional gas developments in Queensland, Australia.⁵⁷ They identify and critically examine four nexus governance approaches, namely (1) private site-specific governance, (2) assessment and approval-based processes, (3) cumulative management, and (4) enforcement and compliance.⁵⁸ Each approach is

49. *Id.* (manuscript at 3).

50. *Id.* (manuscript at 19).

51. *See generally id.*

52. *See generally* Janice Gray, *Ecological Integrity as an Alternative Frame for the Water, Unconventional Gas, and Food Nexus*, 59 JURIMETRICS J. (forthcoming Winter 2019).

53. *Id.* (manuscript at 2).

54. *Id.* (manuscript at 1).

55. *Id.* (manuscript at 3).

56. *See generally id.*

57. Cameron Holley & Amanda Kennedy, *Governing the Energy-Water-Food Nexus: Regulating Unconventional Gas Development in Queensland, Australia*, 59 JURIMETRICS J. (forthcoming Winter 2019).

58. *Id.* at (manuscript at 5).

shown to have a unique framing and various strengths and weaknesses for responding to the challenges of the energy-water-food nexus.⁵⁹ Recognizing the need for improving descriptive and normative theories of nexus governance, Holley and Kennedy draw on their empirical findings to show that nexus governance in Queensland reflects “a hybrid governance architecture, where multiple instruments are used to respond to one or more nexus points.”⁶⁰ Taking a normative stance, they argue there is a lack of steering and complementarity amongst the multiple instruments, which leads them to identify “two pathways for better governing nexus issues: (1) building better governance hybrids that adapt existing approaches to ensure complementary policy responses to nexus issues [and] (2) pursuing new holistic and collaborative governance systems that can navigate the complex[ity of energy-water-food] problems.”⁶¹

The symposium articles’ interrogation of the interrelations between natural resources shows evidence of many different nexus issues, viewpoints, successes, and challenges. This diversity of vantage points is perhaps unsurprising given the nascent stage of inquiry into the legal and governance approaches needed for managing the nexus of energy-water-food and other natural resources. Even so, trying to synthesize some key generalizable insights shared by many of the articles is appropriate. To guide this analysis, we asked the following questions:

1. What are some of the current energy-water-food nexus problems and what types of law and governance approaches have been used to tackle them?
2. What law and governance mechanisms might be needed to better govern nexus challenges?
3. What are the implications of the nexus for future law and governance research?

While the diversity of responses and contexts examined across the articles produced few definite answers to these questions, there were intersecting themes, which have important implications for how law and governance scholars may approach thinking about and creating arrangements for governing the energy-water-food nexus. It is to these issues that we turn now.

I. WHAT ARE SOME OF THE CURRENT ENERGY-WATER-FOOD NEXUS PROBLEMS AND WHAT TYPES OF LAW AND GOVERNANCE APPROACHES HAVE BEEN USED TO TACKLE THEM?

There was general agreement across the articles that better understanding of, and responses to, the interconnections and relationships between different resource sectors remained a pressing need. As Parker and her coauthors nicely

59. *See id* at (manuscript at 1).

60. *Id.* at (manuscript at 23).

61. *Id.* (manuscript at 1).

put it: “Elegant solutions to multiple intersecting problems are desperately needed.”⁶²

Even so, there was far less agreement on precisely what defines an energy-water-food nexus problem. The articles examined a range of interconnections between different resources, with some starting with the traditional water-energy-food framing.⁶³ From this perspective, it was common for water to be given primacy in framing nexus problems and analysing governance responses.⁶⁴ Such an approach has been a frequent (and sometimes critiqued) occurrence in the wider nexus literature, where there has been a tendency to privilege certain perspectives over others (rather than adopt a whole-of-system approach).⁶⁵

Other authors, such as Craig and Butterly, nudged the energy-water-food frame from traditional terrestrial problems to the salty waters of the marine and coastal contexts. As Craig aptly explained: “Most scholars discuss the food-water-energy-climate nexus as it emerges on land. . . . Nevertheless, this marine nexus exists, and it is beginning to show some strains.”⁶⁶

A final set of articles in this symposium went beyond the common tripartite energy-water-food frame and stretched the nexus concept to new problems. Perhaps motivated by the concept’s integration ideals (and the earlier waves of thought on which it builds), these articles use the “nexus” to frame and pinpoint climate, energy, and market problems,⁶⁷ and at their broadest, the wider “enormity of intersecting ecological, social, and political challenges”⁶⁸ that we currently face.⁶⁹

Notwithstanding these variations, the articles broadly evidenced two main categories of existing law and governance responses to these various nexus problems. The first category, embodied in the articles by Sinclair and Hammond comprised a vacuity of governance.⁷⁰ Nexus problems essentially slipped through the cracks of traditional approaches, as Hammond’s turn of phrase, the “energy in-betweens,” aptly captured.⁷¹

The second main category of responses collectively evidenced a “regulatory pluralist”⁷² approach to nexus problems, involving multiple tools and parties that have been used to address the complexity of connections between

62. Parker et al., *supra* note 23, at 16.

63. See, e.g., Holley & Kennedy, *supra* note 57; Larson, *supra* note 31.

64. See, e.g., Holley & Kennedy, *supra* note 57; Larson, *supra* note 31; Megdal & Petersen-Perlman, *supra* note 38.

65. Morgan Bazilian et al., *Considering the Energy, Water and Food Nexus: Towards an Integrated Modelling Approach*, 39 ENERGY POL’Y 7896, 7897 (2011). See generally CLIMATE, ENERGY & WATER: MANAGING TRADE-OFFS, SEIZING OPPORTUNITIES, *supra* note 18.

66. Craig, *supra* note 28, at 61–62.

67. See, e.g., Hammond, *supra* note 48; Sinclair, *supra* note 43.

68. Parker et al., *supra* note 23, at 26.

69. See, e.g., Gray, *supra* note 52; Parker et al., *supra* note 23.

70. See generally Hammond, *supra* note 48; Sinclair, *supra* note 43.

71. See, e.g., Hammond *supra* note 48.

72. See generally NEIL GUNNINGHAM ET AL., SMART REGULATION: DESIGNING ENVIRONMENTAL POLICY (1998); ELINOR ÖSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTIONS (1990).

energy-water-food and other resources. Indeed, the articles' catalogued a range of governance tools such as markets, environmental assessment, voluntary standards, guiding policies, rights and other approaches to manage energy-water-food and other resource problems. As discussed below, many of these instruments were deemed to fall short of optimally addressing nexus challenges, while others were identified as needed in their absence. This governance landscape is one where particular tools and actors are being applied in different ways to different problems, which is understandable given the complexity of the problems at hand, and the knowledge and capacity challenges they raise for any single governor (state or private) or single policy tool. Even so, such a pluralist approach can still be confronted by insularity and singularity, and as Parker and her coauthors caution in their article, may risk succumbing to instrumentalism and adhocery.

II. WHAT LAW AND GOVERNANCE MECHANISMS MIGHT BE NEEDED TO BETTER GOVERN NEXUS CHALLENGES?

The majority of the articles recognized that more work was needed to enhance law and governance to address the nexus between energy-water-food and other resources. This was true across a diversity of resource contexts, including electricity markets, river management, fishing, aquaculture and marine issues, unconventional gas extraction, and intensive meat production. However, there was far less agreement among our authors on precisely how to craft more optimal responses to these nexus challenges. Generally speaking, at least two pathways for pursuing improved nexus governance arrangements were evident across the articles—one proposed new or revised governance tools and institutions, the other argued for a radical rethink of the system as a whole.

First, for a number of the articles, the way forward rested with creating new arrangements that fill governance gaps or offer more optimal mixes of governors and tools. In terms of gap filling, Sinclair, for example, argues for harnessing private intervention in the climate finance sphere to address an absence of comprehensive governance, regulatory and policy infrastructure to bring about a transition to a low carbon economy. Private forms of governance and rights are also taken up in Butterly's analysis of competition for fish (food) and fish producing waters (water), where she points to the need for new approaches that can better account for Indigenous rights (commercial and subsistence) and redress imbalances of power. Craig's explication of the marine energy-water-food nexus (e.g., offshore wind farms as marine aquaculture facilities) similarly shines a light on the need for new laws and procedures to encourage the right kinds of co-located aquaculture, and incentivize a comprehensive approach for new wind facility developers that are willing to tolerate aquaculture operations.

A range of articles also drew on insights from the failings or promise of existing practices to propose new mixes of instruments and parties. For example, Larson developed insights from Colorado's transboundary nexus approach to highlight the importance of institutional competency in bodies adjudicating or mediating transboundary water disputes, encouraging collaborative cross-

border efforts to engage in artificial groundwater recharge, approaches for quantification of water rights and investing in accurate monitoring and modeling to inform sustainable water policy. Developing strong solutions to nexus problems, it was argued, also requires new methods and network understandings. It should be noted that these views were also echoed by Holley and Kennedy, Larson, and Parker and her coauthors as a call for better data and learning processes to underpin decision-making.

Extending their gaze to groundwater issues, Megdal and Petersen-Perlman diagnose partial and piecemeal consideration of the water-food-energy-climate nexus in the United States. This led them to recommend great policy collaboration between sub-state, federal, and neighbouring jurisdictions. Holley and Kennedy draw similar conclusions from their analysis of unconventional gas, water, and agriculture in Australia, leading them to note that “[w]hat will be needed are credible and complementary governance instruments that can operate in combination with existing arrangements.”⁷³

The second pathway for enhancing governance of nexus challenges was founded on a view that current systems are the source of the problem. What was needed is a radical rethink of the system as a whole. This view is most clearly spelled out (albeit in different ways) by Gray and Parker and her coauthors, who both pinpoint deeper problems with current laws and regulation (broadly conceived) for addressing nexus problems. For Parker and her coauthors, most regulation has been rooted in instrumentalism, addressing problems case by case instead of in an integrated form. This fragmented approach has created opportunities for political demands to dominate (rather than ecological ones), and thus advantage large well-resourced actors at the expense of the small. In Parker and her coauthors’ view, the solution does not lie with more (potentially piecemeal) law or regulation tools. Rather, a more responsive, more pluralist, and most importantly more ecological makeover is recommended to find sustainable solutions to nexus problems. Gray follows a broadly similar path, but arguably aligning with the broader critique of “extractivism” and new economies,⁷⁴ which suggest that society’s appetite for water, energy, and food must be reconsidered through an ecological integrity frame.

III. WHAT ARE THE IMPLICATIONS OF THE NEXUS FOR FUTURE LAW AND GOVERNANCE RESEARCH?

Notwithstanding the utility of the various proposals for enhancing nexus governance noted above, it was clear across the symposium that there is significantly more work needed on energy-water-food nexus issues. At the broadest level, there is a need to further examine and refine the concept of the energy-water-food nexus. Given the diversity of views on what defines a nexus problem, future work could seek to hone the boundaries and meaning of the concept

73. Holley & Kennedy, *supra* note 57, (manuscript at 24).

74. See generally NAOMI KLEIN, *THIS CHANGES EVERYTHING: CAPITALISM VS. THE CLIMATE* (2014); Bronwen Morgan, *Telling Stories Beautifully: Hybrid Legal Forms in the New Economy*, 45 J.L. & SOC’Y 64 (2018).

in the context of law and governance scholarship. This may involve examining its relationship to earlier thinking on integrated management, as well as identifying its advantages and drawbacks as an orienting and problem-framing device.

At least four other possible lines of empirical, doctrinal, and theoretical research arose from the various articles. First, given the complexities of nexus solutions are likely to confound the capacity and knowledge of governments, further descriptive research is arguably warranted to better understand the roles and relationships between nontraditional and traditional (e.g., private) energy-water-food governors. Building on this descriptive theory, research could also examine and critically compare the legal ties and governance auspices and providers that are responding to nexus challenges, to identify more optimal solutions for different nexus problems. As the symposium articles have shown, there are many fruitful areas where this work is needed to improve governance, including energy and finance, marine, aquaculture and energy developments and sources of greener power whose “capacities, industrial sectors, and business models fit poorly within the existing legal frameworks.”⁷⁵

Larson and Holley and Kennedy also point to the need for a second area of investigation, namely learning and information generating processes for energy-water-food nexus problems. This could draw on the now rich literature on facilitating learning in governance (e.g., adaptive management, experimentalism, and reflexive law)⁷⁶ and explore its application to nexus issues. Interdisciplinary projects could also explore the role of law in enhancing data collection, modeling, and information collection to assist decision makers and help them better understand the complex impacts and interactions of the energy-water-food sectors.

A third line of research is signalled by Butterly and Larson’s articles, which point to the need for understanding how to better integrate rights, values, sense of place, and institutions of knowledge, tenure, and practice with the concerns of energy-water-food and other resource sectors. As Larson notes, because water “is not simply an ecologic and economic resource, but also a cultural resource and essential to human life and human dignity,” we must explore not only how to more effectively integrate science and sectors in water law, but also rights and culture for “true integration” of resource management.⁷⁷

A fourth and final area for future research exemplified by Parker and her coauthors as well as Gray centers around the framing of a new “wave” of more ecological and holistic governance. This research could test whether and how instrumental logics exacerbate problems, as well as explore potential solutions (e.g., responsive regulation, ecological regulation, and ecological integrity) to

75. Hammond, *supra* note 48, (manuscript at 30).

76. See, e.g., Barbara Cosens et al., *The Adaptive Water Governance Project: Assessing Law, Resilience and Governance in Regional Socio-Ecological Water Systems Facing a Changing Climate: Introduction to NREL Edition of the Idaho Law Review*, 51 IDAHO L. REV. 1 (2014); Michael C. Dorf & Charles F. Sabel, *A Constitution of Democratic Experimentalism*, 98 COLUM. L. REV. 267 (1998); Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism*, 87 MINN. L. REV. 943, 961–63 (2003); Gunther Tuebner, *Substantive and Reflexive Elements in Modern Law*, 17 LAW & SOC’Y REV. 239 (1983).

77. Larson, *supra* note 31 at [prepublication manuscript p. 15].

the “system” itself generating multiple interacting harms.⁷⁸ The need for advancing such a metamorphosis in governance is likely to become all the more pressing as attention continues to turn to the enmeshment (and nexus) of humans and the environment at multiple temporal and geographic scales, as signified in the naming of the Anthropocene.⁷⁹ Indeed, as our interdependent social and ecological systems continue to be confronted by planetary risks, exploring these and other energy-water-food nexus issues raised across this symposium of *Jurimetrics* is likely to remain of paramount importance to the globe.⁸⁰

78. See, e.g., Parker et al., *supra* note 23, at 28, 29–31.

79. See, e.g., Eric Biber, *Law in the Anthropocene Epoch*, 106 GEO. L.J. 1 (2017); Frank Biermann et al., Down to Earth: Contextualizing the Anthropocene, 39 GLOBAL ENVTL. CHANGE 341 (2016); Cameron Holley et al., *Environmental Security and the Anthropocene: Law, Criminology, and International Relations*, 14 ANN. REV. L. & SOC. SCI. 185 (2018).

80. See generally ULRICH BECK, *RISK SOCIETY: TOWARD A NEW MODERNITY* (1992).