Transnational Environmental Law, 2:1 (2013), pp. 15–44 © 2013 Cambridge University Press
doi:10.1017/S2047102513000010

ARTICLE

Epistemic Institutions and Epistemic Cooperation in International Environmental Governance†

Timothy Meyer*

Abstract
Under what conditions should epistemic institutions (institutions that provide policy-relevant scientific advice) be integrated into international legal institutions – for example, the Conference of the Parties to the United Nations Framework Convention on Climate Change? Following work in law and economics on the theory of the firm, this article argues that where states will not implement environmental policies absent a collective decision to do so, greater hierarchical control of epistemic institutions by legal institutions may be necessary to ensure the credibility and availability of a usable scientific record. Hierarchy creates credibility because it allows all states necessary for cooperation in the legal institution to oversee the production of the scientific record that provides the basis for international legal rules. Hierarchy thus enhances the effectiveness of international law as a coordination tool, even at the expense of the autonomy of the scientific process. By contrast, where collective action is not necessary because states will unilaterally regulate an environmental problem once scientific uncertainty has been reduced, epistemic and legal institutions should be fragmented to ensure the unbiased production and dissemination of scientific information. In such situations, the credibility of the scientific record is demonstrated by decentralized adoption of science-based regulation.

Keywords: Uncertainty, Technology Transfer, Scientific Cooperation, Renewable Energy, Transaction Costs, International Organizations

1. INTRODUCTION

Ludwig Wittgenstein wrote that '[c]ertainty is as it were a tone of voice in which one declares how things are, but one does not infer from the tone of voice that one is justified'.[1] He meant that a declaration that a proposition is true does little more than convey the declarant's state of mind regarding the proposition. It does not justify to others the declarant's certainty; it does not by itself create shared knowledge.

† This contribution is part of a collection of articles from the Symposium 'Global Environmental Risk Governance under Conditions of Scientific Uncertainty: Legal, Political and Social Transformations', held at Bar Ilan University (Israel) in May 2012.

* University of Georgia School of Law, Athens, GA, United States (US).
Email: tlmeyer@uga.edu.

I am grateful to Robert Cooter, Andrew Guzman, Oren Perez, Reut Snir, two anonymous reviewers for comments on earlier drafts, and Lawrence Winsor for research assistance.

1 L. Wittgenstein, *On Certainty* (Oxford University Press, 1969).

States face a similar problem of certainty and knowledge when they try to cooperate over transnational environmental problems such as climate change, air pollution, energy policy, the environmental effects of trade in hazardous waste or endangered species, the health consequences of tobacco control, or the sustainable management of fisheries. International environmental cooperation – the process of coordinating environmental laws and policies across countries to tackle transnational problems – is often held hostage to uncertainty about the severity of environmental problems, the consequences of remedial policies, and the feasibility of technological solutions. The problems created by uncertainty are compounded by the fact that effectively dealing with many transnational environmental problems requires that environmental laws and policies be coordinated across a broad range of countries, but only a subset of those countries are able to participate in the development, or directly assess the validity, of a scientific record that makes more certain what environmental laws and policies are actually in the interest of states.

International environmental cooperation thus involves a mismatch. A small group of states possess the scientific and technical capacity to reduce uncertainty and identify evidence-based cooperative policies that are collectively in their interest. But actually implementing those policies across countries – either through decentralized diffusion of environmental policies or through international legal rules – requires that a much larger group of states believe that the scientific record justifying the proposed policies is credible and accurate. International environmental cooperation thus requires processes or institutions that allow states with limited scientific capacity nevertheless to have confidence that coordinating their environmental laws and policies is in their interest.

In this article I argue that the optimal organization of international scientific and expert bodies depends on whether states face a collective action problem in coordinating their regulation of transboundary environmental harms. Where resolving scientific uncertainty is enough to cause states to regulate unilaterally, scientific bodies should be independent. The credibility of the scientific record is demonstrated to those states that are unable to verify it directly by the decentralized adoption of evidence-based environmental policies. Where states face a collective action problem, however, resolving scientific uncertainty does not change state incentives to regulate unilaterally. Instead, international legal rules are often necessary to coordinate state regulation. States unable to verify the credibility of the scientific record may be reluctant to agree to international legal rules, however. In these situations, greater hierarchical control of scientific bodies by international rule-making bodies may be necessary. Hierarchical control can reassure states that the scientific process is producing credible results by allowing them closer oversight of international scientific cooperation. Hierarchy has costs for the autonomy of the scientific process, but where collective action is necessary to coordinate state policies those costs may be justified. Hierarchy can improve the effectiveness of international lawmaking as a coordination tool.

I term the way in which states organize the process of creating shared scientific knowledge pertinent to environmental cooperation *epistemic cooperation* and the international institutions involved in creating shared scientific knowledge *epistemic*

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

institutions. My notion of an epistemic institution is broad. While epistemic institutions do not make international law, they include any organization that assimilates basic scientific and technical research and applies it to specific legal or policy problems. An epistemic institution might, for example, provide advice to legal institutions about the state of science in a particular area or create technical standards based on scientific research.[2] As such, my definition of an epistemic institution tracks the definition by Ayal, Hareuveny and Perez of regulatory scientific institutions in this volume.[3] Examples include organizations like the Intergovernmental Panel on Climate Change (IPCC), the Scientific Committee of the International Whaling Commission (IWC) which provides data as to what constitutes a sustainable whaling catch, as well as institutions like the World Health Organization (WHO) or the Codex Alimentarius Commission (CAC) which formulate recommendations about scientifically sound health and safety policies. I would also include institutions involved in technology transfer, such as the Technology Mechanism of the United Nations Framework Convention on Climate Change (UNFCCC).[4] These institutions' missions involve, in part, the compilation and dissemination of research about technological solutions to environmental problems, a task similar to the compilation and dissemination of other kinds of scientific research.[5]

I distinguish epistemic institutions from *legal institutions*, which are institutions empowered to make legal rules and adopt cooperative policies. As with epistemic institutions, the key feature of a legal institution, as I define that term, is its function as a body empowered to make legal rules, and not its institutional form. Examples of legal institutions would therefore include institutions that are embedded in larger regimes, such as the Conferences of the Parties (COP) to any number of international environmental agreements or the World Trade Organization (WTO) Dispute Settlement Body (DSB), as well as relatively autonomous institutions such as the International Court of Justice (ICJ).

The relationship between epistemic and legal institutions varies considerably among regimes.[6] Some regimes, such as the IWC, include epistemic institutions and legal institutions within the same larger organization. Other regimes, such as the WTO or the COP to the Framework Convention on Tobacco Control (FCTC), outsource the development of science-based policy recommendations to organizations such as the CAC or the WHO. Although this widespread variation in institutional relationships has consequences for the effectiveness of efforts to reduce uncertainty through the

[2] My use of the term 'institution' is not meant to convey any particular kind of organizational form, such as an independent institution. Rather, my definition is functional. An epistemic institution is a body that collects, formats, directs, or applies basic scientific research to legal or policy problems.

[3] A. Ayal, R. Hareuveny & O. Perez, 'Science, Politics and Transnational Regulation: Regulatory Scientific Institutions and the Dilemmas of Hybrid Authority' (2013) 2(1) *Transnational Environmental Law*, pp. 45–68.

[4] New York, NY (US), 9 May 1992, in force 21 Mar. 1994, available at: http://unfccc.int.

[5] Although in this article I focus primarily on scientific and technical research, the framework I propose could be applied to other kinds of expert body, such as the International Law Commission (ILC), that provide advice to lawmaking authorities.

[6] See Ayal, Hareuveny & Perez, n. 3 above.

development of shared knowledge, it has gone largely unremarked upon in the legal literature.

Drawing on work in law and economics on the optimal size of the firm,[7] I argue that the most effective way to organize epistemic cooperation depends on the incentives that resolving uncertainty has for decentralized coordination of environmental policies. I assume that states face a range of problems in which their understanding of the best legal or policy outcome depends in part on the resolution of some uncertainty about the state of the world. For example, states' understanding of what kinds of quota on fish catches are in their interest depends on the answers to scientific questions such as how quickly the fish reproduce. In these situations, states establish epistemic institutions to resolve uncertainty that may impede their ability to coordinate on cooperative solutions to environmental problems.[8]

Resolving uncertainty may not be sufficient to incentivize states to coordinate their environmental policies, however. In situations such as the governance of common pool resources like fisheries, resolving uncertainty does not, by itself, change states' incentives to coordinate policies. Instead states face a collective action problem in which they only wish to change their environmental policies if other states do so as well. In such situations, epistemic and legal institutions should be integrated. Because environmental coordination can only occur through a collective decision by an international legal institution, the process of preparing the scientific record must be tailored to the goal of obtaining the consent to regulation of the diverse range of governments that participate in international environmental institutions. Integrating legal and epistemic institutions provides the best way to ensure that the scientific record produced by the epistemic institution is both usable, in the sense of being relevant to the environmental problem, and credible to states that are unable to directly assess the validity of the scientific research. In such cases, the ability to oversee the work of the epistemic institution provides scientifically disadvantaged states with some assurance that the scientific record is unbiased.

In other cases – such as health and safety issues, the extraction of natural resources, or the adoption of renewable energy policies – the preparation of a scientific record can encourage states unilaterally to adopt environmental policies without the need for international legal rules. In these situations, epistemic institutions should be independent of legal institutions. The credibility of the scientific record can be demonstrated to scientifically disadvantaged states through the widespread adoption of evidence-based policies at the national level. Integration does not improve the credibility of the scientific record. Integration would, however, have potential costs. In particular, where a legal institution has deep normative or distributive divisions, integrating legal and epistemic institutions can dramatically raise the governance costs of efficiently operating either

[7] See O.E. Williamson, *The Economic Institutions of Capitalism* (Collier Macmillan, 1985).

[8] This is not to say, of course, that states always sincerely wish to resolve uncertainty or that states do not behave opportunistically. In some situations, states' incentives may not depend at all on the resolution of uncertainty. But, as discussed in Section 3 below, institutional form can be used to mitigate the possibilities for opportunism with the aim of coordinating environmental policies to the mutual advantage of states.

institution. In these situations, fragmentation can animate the work of epistemic institutions by ensuring they have the incentives to produce and disseminate high quality scientific information that can be the basis for unilateral regulation by states.

These prescriptions run counter to much of the prevailing scholarship on international scientific cooperation. The scientific process is often conceived of as a decentralized network, which resists the kind of institutional analysis employed here.[9] At the same time, studies of the relationship between knowledge production and policy focus on the ways in which epistemic institutions can be integrated into policy-making institutions to maximize the development and impact on policy of scientific knowledge. Thus, scholars have called for scientists to engage with policy-makers so that scientific research is applicable to policy,[10] while at the same time calling for scientific bodies within international institutions to remain free from government efforts to influence the shape of science.[11] But these studies often overlook the contingent value of fragmenting legal process. In situations in which resolving uncertainty is enough by itself to drive coordination, independence is desirable. On the other hand, where resolving scientific uncertainty does not affect state incentives to regulate unilaterally, hierarchical control of epistemic institutions by legal institutions can ensure the credibility and availability of a usable scientific record. Hierarchy thus preserves the effectiveness of international lawmaking as a coordination tool, although at the expense of the autonomy of the scientific process.

In Section 2, I explain the problem of epistemic cooperation and how epistemic institutions help states to cooperate in the creation of shared, credible, and usable scientific knowledge. I argue that the decision to fragment legal and epistemic institutions is a species of vertical fragmentation in international law, namely the fragmentation of institutions involved in different stages of legal process regarding the same legal rules. Many studies of fragmentation focus on the problem of horizontal fragmentation, with its emphasis on issue linkages and its concern for overlapping authority and pluralism.[12] A discussion of vertical fragmentation is interesting because it focuses our attention on a different set of concerns – namely the costs and benefits of creating linkages between different aspects of legal process and the role of hierarchy and independence in the relationship between institutions in different stages of the lifecycle of international cooperation.

---

9 See Ayal, Hareuveny & Perez, n. 3 above.

10 A. Underdal, 'Science and Politics: The Anatomy of an Uneasy Partnership', in T. Skodvin, A. Underdal & J. Wettestad (eds.), *Science and Politics in International Environmental Regimes* (Manchester University Press, 2000), pp. 1–21.

11 T. Skodvin & A. Underdal, 'Exploring the Dynamics of the Science-Politics Interaction', in Skodvin, Underdal & Wettestad, ibid., pp. 22–34; P.M. Haas & C. Stevens, 'Organized Science, Usable Knowledge, and Environmental Governance', in R. Lidskog & G. Sundqvist (eds.), *Governing the Air: The Dynamics of Science, Politics, and Citizen Interaction* (The MIT Press, 2011), pp. 125–61.

12 E.g., W. Burke-White, 'International Legal Pluralism' (2004) 25(4) *Michigan Journal of International Law*, pp. 963–79; N. Krisch, 'Pluralism in Postnational Risk Regulation: The Dispute over GMOs and Trade' (2010) 1(1) *Transnational Legal Theory*, pp. 1–29; E. Benvenisti & G.W. Downs, 'The Empire's New Clothes: Political Economy and the Fragmentation of International Law' (2007) 60(2) *Stanford Law Review*, pp. 595–632; L. Helfer, 'Regime Shifting: The TRIPs Agreement and the New Dynamics of International Intellectual Property Lawmaking' (2004) 29(1) *Yale Journal of International Law*, pp. 1–83.

In Section 3, I set out the theory of epistemic institutions. I argue that where collective action is necessary to address a transnational environmental problem, hierarchy is the optimal relationship between legal and epistemic institutions, because hierarchy is the best means of ensuring the availability of a scientific record that is credible to the states negotiating in the international legal institution. By contrast, fragmentation is likely to be the optimal mode of organization when policy coordination can occur without collective decision-making in international institutions, and in particular where legal institutions are driven by distributive considerations that may paralyze epistemic cooperation. States, of course, have mixed motives when designing epistemic institutions. I assume states are rational and thus wish to maximize their own individual welfare. Sometimes this interest will lead states to want to create institutions with the sincere purpose of reducing uncertainty. In other situations, states' policy preferences will not depend on the answers to scientific questions. In these situations, states may try to establish institutions to deliberately distort the scientific process. Knowing that epistemic cooperation is prone to opportunism by states in the same way that other kinds of cooperation are, we would predict that states will try *ex ante* to limit the possibilities for opportunism. Indeed, the theory of the firm on which I draw predicts exactly this.[13] My theory is thus descriptive in the sense that it helps us understand how states actually do design epistemic institutions. It is also normative in that it helps us think about how institutions can be designed to restrain opportunism.

Finally, in Section 4, I illustrate the argument by discussing how the International Renewable Energy Agency (IRENA), an intergovernmental organization founded in 2009, reduces uncertainty about the potential of renewable energy by promoting research into, and the diffusion of, renewable energy technology among member states and particularly developing countries. Demand for information about renewable energy technologies is spread among a variety of market and governmental actors across a range of countries. Therefore, unlike other intergovernmental bodies, IRENA is organized as an independent epistemic institution, without any formal connection to policy or lawmaking organizations. Rather, IRENA focuses on developing networks of renewable energy investors and policy-makers that cross international boundaries in an effort to lower the barriers to the diffusion of renewable energy technology.

2. EPISTEMIC COOPERATION

The purpose of epistemic cooperation is to remove uncertainty as a barrier to beneficial regulation and to encourage the diffusion of scientific knowledge in order to promote optimal environmental policies. Epistemic cooperation encourages scientifically informed governance by trying to ensure that scientific information available to regulators is both usable and credible.

Firstly, basic scientific research – the kind performed in university laboratories – has to undergo a process of translation before it can be used in law and policy-making.

[13] See Williamson, n. 7 above, at pp. 29–32.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

Detailed statistical information about the rate at which Atlantic tuna reproduce under varying environmental conditions, for example, is of little direct use in establishing legal rules governing sustainable catches. Instead, negotiators and regulators need access to information relevant to the specific decisions that confront them in a form that is understandable to non-experts. Scholars have used a variety of names to refer to the body of scientific knowledge upon which non-expert policy-makers rely,[14] but the idea is the same. Basic scientific knowledge is not developed in a vacuum and then injected into legal institutions for use. Rather, following Haas and Stevens, what I shall call 'usable scientific knowledge' is the result of an institutionalized process in which basic research is put into a form relevant to particular legal and policy questions and comprehensible to non-experts.[15]

Secondly, because they are non-experts, legal decision-makers – such as negotiators, diplomats, domestic regulatory authorities, and judges – are usually unable directly to assess the credibility of the scientific information that comes before them. This credibility issue is compounded in international negotiations because scientific information is not evenly distributed among states and non-state actors. Information tends to be concentrated in developed states and among economic interests that are vested in particular outcomes. Epistemic cooperation thus requires that the information be produced in a way that is credible to negotiators and regulators unable to directly assess its validity.[16]

In some situations, the credibility of the scientific record may be addressed through the norms of an 'epistemic community', which is 'a network of professionals with recognized expertise and competence in a domain and an authoritative claim to policy relevant knowledge within that domain or issue-area'.[17] As the definition suggests, however, the ability of epistemic communities to vouch for the credibility of the scientific record is limited to those who actually recognize the community's authority. Thus, while epistemic communities may create credibility among relatively similar countries – for example, developed countries – that have citizens that participate in the epistemic community, the epistemic community's authority may not be recognized by states that are outsiders to the community or distrust its work. Boycotts by three states in Nigeria of efforts by the WHO to eradicate polio are but one illustration of a situation in which epistemic communities may fail to create trust in the scientific basis for globalized policies.[18] Yet, in order to effectively address many environmental problems, including truly global ones, these states – developing states that often have relatively little scientific capacity compared to developed states – must participate.

---

14 E.g., 'regulatory science', in H. Selin & N. Eckley, 'Science, Politics, and Persistent Organic Pollutants: The Role of Scientific Assessments in International Environmental Co-operation' (2003) 3(1) *International Environmental Agreements: Politics, Law and Economics*, pp. 17–42, at 21; and 'usable knowledge', in Haas & Stevens, n. 11 above, at p. 128.

15 Haas & Stevens, ibid.

16 Ibid., at p. 129; Selin & Eckley, n. 14 above, at p. 19.

17 P.M. Haas, 'Introduction: Epistemic Communities and International Policy Coordination,' (2013) 46(1) *International Organization*, pp. 1–35, at 3.

18 A.S. Jegende, 'What Led to the Nigerian Boycott of the Polio Vaccination Campaign?' (2007) 4(3) *PLOS Medicine*, pp. 417–22.

To solve these two cooperative problems in the absence of epistemic communities that reach all affected countries, states often create institutions ('epistemic institutions') that govern the translation of basic scientific research into usable and credible scientific information and its subsequent dissemination to decision-makers. Epistemic institutions vary greatly among regimes in terms of the kind of rules and procedures they establish. Most basically, rules governing the form and admissibility of research shape the kinds of scientific information used by tribunals and international regulatory bodies. The International Commission for the Conservation of Atlantic Tunas (ICCAT) Standing Committee on Research and Statistics noted, for example, that 34 out of 182 scientific papers that were presented to the Committee in 2011 were not in the proper format.[19] Alternatively, what might be termed 'environmental trade agreements', such as the Stockholm Convention on Persistent Organic Pollutants (POPs Convention)[20] and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (PIC Convention),[21] have spelt out specific rules governing the kinds of scientific information that must be shared between states in order to facilitate rule-making within the Conventions.

Epistemic institutions also vary greatly in the extent to which they are integrated into legal institutions. The institutions described above integrate legal and epistemic functions within a single institution. Other regimes rely on independent epistemic institutions. The WTO, for example, accords presumptive weight under the Sanitary and Phytosanitary Agreement (SPS Agreement)[22] to the otherwise non-binding food safety standards established by the CAC, an intergovernmental institution formally unaffiliated with the WTO. Similarly, the WHO's Tobacco Free Initiative (TFI) produces recommendations to states on scientifically sound tobacco regulation. While these recommendations are addressed to states at large, TFI works with the FCTC COP, which adopts guidelines for tobacco regulation and disclosure.[23] Like the CAC and the WHO, IRENA is an independent institution that has no formal law-making authority. Instead, IRENA produces a wide range of information, from studies on the economic feasibility of different kinds of renewable energy to a database on national renewable energy policies and a searchable database of renewable-relevant patents.[24]

This variation in the relationship between epistemic and legal institutions is an unremarked upon yet noteworthy example of the fragmentation of international law. Fragmentation refers to 'the emergence of specialized and (relatively) autonomous

---

19 International Commission for the Conservation of Atlantic Tunas, 'Biennial Report of the Standing Committee on Research and Statistics for the Period 2010–2011' (2011), Part 5, at p.2, available at: http://www.iccat.es/Documents/Meetings/Docs/SCRC2011-Report-ENG.pdf.

20 Stockholm (Sweden), 22 May 2001, in force 17 May 2004, available at: http://www.pops.int.

21 Rotterdam (The Netherlands), 11 Sept. 1998, in force 24 Feb. 2004, available at: http://www.pic.int.

22 Punta del Este (Uruguay), 15 Apr. 1994, available at: http://www.who.int/mta/Doc7.pdf.

23 See Report of the Secretary General on the Ad Hoc Inter-Agency Task Force on Tobacco Control, UN Doc. E/2012/70, 9 May 2012, para. 16, available at: http://www.un.org/en/ecosoc/docs/adv2012/tobacco_or_health_sg_report_to_ecosoc_29_may_12.pdf; see also Arts. 9 and 10 FCTC.

24 See Section 4 below.

rules or rule-complexes, legal institutions and spheres of legal practice'.[25] For example, rules that restrict trade in environmentally harmful substances are often created in multilateral environmental agreements, such as the Montreal Protocol on Substances that Deplete the Ozone Layer,[26] which instruct parties to apply trade sanctions against non-complying non-members. Generally, applicable rules on free trade are established within the institutions of trade law, most notably the WTO.[27] These rules arguably conflict with each other. Moreover, there is no institution authorized to definitively reconcile differences between international legal systems, and no commonly agreed set of principles to establish hierarchy among legal rules of equal pedigree. Forests have been felled in an effort to make sense of fragmentation.[28] While some scholars have extolled fragmentation on the grounds of pluralism,[29] organizations like the International Law Commission (ILC) have tried to impose order on the anarchic landscape of international law.[30]

These approaches to fragmentation, although differing in terms of their estimations of its value, are similar in that they focus on the problem of *horizontal fragmentation*. The concern is about two institutions or sets of legal rules that are redundant, overlapping, conflicting, or complementary. The focus on horizontal fragmentation obscures the equally important phenomenon of *vertical fragmentation*, by which I mean that international legal institutions often do not provide all of the stages we normally associate with legal process – bargaining, rule creation, verification of compliance, dispute resolution, and enforcement. Instead, international law frequently fragments authority for different stages of legal process among different institutions.[31] Most obviously, sanctions in international law are usually applied by states individually, rather than by the legal institution that creates the rules.[32] Dispute resolution bodies may also be

---

25 ILC, Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law, UN Doc. A/CN.4/L.702, 18 July 2006 (Report of the Study Group) (ILC Report), para 6, available at: http://untreaty.un.org/ilc/documentation/english/a_cn4_l702.pdf.

26 Montreal (Canada), 16 Sept. 1987, in force 1 Jan. 1989, available at: http://ozone.unep.org/new_site/en/montreal_protocol.php.

27 D. Hunter, J. Salzman & D. Zaelke, *International Environmental Law & Policy* (Foundation Press, 2011), at p. 582.

28 E.g., N. Krisch, *Beyond Constitutionalism* (Oxford University Press, 2010); M. Young (ed.), *Regime Interaction in International Law: Facing Fragmentation* (Cambridge University Press, 2012); Benvenisti & Downs, n. 12 above; H. Cohen, 'Finding International Law, Part II: Our Fragmenting Legal Community' (2012) 44(4) *New York University Journal of International Law and Politics*, pp. 1050–107.

29 See P.S. Berman, *Global Legal Pluralism* (Cambridge University Press, 2012).

30 ILC Report, n. 25 above.

31 Vertical fragmentation, as I use the term here, is related to but differs from the concept of multilevel governance. Studies of multilevel governance usually focus on the fragmentation of lawmaking *authority* among different institutions (e.g., federal and state institutions or national and international institutions): e.g., Krisch, n. 28 above; E.U. Petersmann, 'International Economic Law, Public Reason, and Multilevel Governance of Interdependent Public Goods' (2011) 14(1) *Journal of International Economic Law*, pp. 23–76. Although clearly possessing a vertical dimension, the issues raised by multilevel governance are thus more akin to the issues raised by what I refer to as the horizontal fragmentation of international law. By contrast, I focus on the fragmentation of the stages in the lawmaking *process*, and specifically the decision to separate or integrate the fact-finding process and the lawmaking process at a single level of governance, the international level.

32 A notable exception is the UN Security Council, which has the authority to punish threats to international peace and security.

divorced from the institutions that create the underlying legal rules, such as when the International Centre for the Settlement of Investment Disputes (ICSID) hears investor-state matters arising under investment agreements in which it played no role in negotiating or enacting.[33]

In establishing legal rules and institutions, then, states choose not only to cooperate (or not) over substantive issues that confront them. They also choose whether and how to cooperate over different aspects of legal process, and the extent to which the different stages of legal process should be linked. These two kinds of fragmentation raise different sets of concerns. While horizontal fragmentation raises issues of redundancy and pluralism and creates the possibility of forum shopping,[34] vertical fragmentation implicates concerns about states exploiting linkages between different aspects of international legal process to undermine the cooperative objectives of an entire legal regime. A focus on vertical fragmentation thus shifts our attention away from the linkages between substantive issues and towards linkages, or the lack thereof, between aspects of legal process.

Because epistemic institutions exhibit so much variety, they are a useful place to begin thinking about when the vertical integration of international regimes should be expected and even desirable. In the context of epistemic cooperation, many scholars and commentators argue that epistemic institutions should have independence from legal decision-making bodies so that their work product is not unduly influenced by the agendas of the powerful.[35] States and industries, after all, often have preferences about regulation that do not depend on the resolution of scientific uncertainty. Nations that are members of the Organization of Petroleum Exporting Countries (OPEC), for example, have consistently opposed the regulation of greenhouse gas emissions in the UNFCCC. Reducing uncertainty about the link between climate change and manmade greenhouse gas emissions has been slow to change this stance because of the powerful economic interests that OPEC nations have in a petroleum-driven economy. Similarly, in the early years of the IWC, whaling nations were suspected of manipulating the scientific information they made available in order to induce the IWC to impose more liberal quotas on whaling catches.[36]

On the flip side, however, scientific knowledge does not by itself dictate legal decisions. Political and legal context are both key and, to a great extent, independent influences on outcomes.[37] The contextual nature of how scientific knowledge is deployed in the policy-making process means that some ability for legal institutions to direct policy institutions is likely to maximize the responsiveness of policy in at least some situations.[38]

---

33 Again, there is variation in this kind of vertical fragmentation. Some institutions create their own tribunals, such as the UN Convention on the Law of the Sea (UNCLOS), Montego Bay (Jamaica), 10 Dec. 1982, in force 16 Nov. 1994, 1833 UNTS 3, available at: http://www.un.org/depts/los/convention_agreements/convention_agreements.htm.

34 See Benvenisti & Downs, n. 12 above.

35 See, e.g., Haas & Stevens, n. 11 above.

36 S. Andresen, 'The Whaling Regime', in Skodvin, Underdal & Wettestad, n. 10 above, pp. 37–69, at 45.

37 Underdal, n. 10 above, at p. 5.

38 Ibid., at p. 11.

To date, theoretical predictions about when the vertical fragmentation of epistemic and legal institutions should emerge, and prescriptions about when it is desirable, have been relatively sparse.[39] In Section 3, I derive such prescriptions. Section 4 then uses the establishment of IRENA to demonstrate that states are sensitive to the considerations described in Section 3 when setting up epistemic institutions.

3. EPISTEMIC INSTITUTIONS

When should epistemic institutions be independent of legal institutions? To answer this question, I look to the literature in law and economics on the optimal size of the firm.[40] International environmental institutions are akin to firms. Ultimately, the product that international environmental institutions try to deliver is coordination in environmental policies across nations. Coordinating policies – whether through outright harmonization of legal rules, the adoption of legal rules reflecting common goals but differentiated commitments, or joint funding of scientific research or international organizations – allows states to mitigate or adapt more effectively to the consequences of environmental harms that have transboundary causes (including the activities of multinational corporations) or effects. Coordination can be achieved through either decentralized adoption of policies at the national level or top-down imposition of standards through the creation of international legal rules.[41] Usable scientific information is a key input into the process of coordination because it reduces scientific uncertainty in a way that helps decision-makers choose on which policies states should coordinate. International legal institutions that try to coordinate policies across countries by creating and enforcing international legal rules thus find themselves with the same basic choice that firms face: whether to make necessary inputs or acquire them through an arms-length transaction.[42]

Drawing on this analogy, I argue that epistemic institutions should be independent of legal institutions when there is a wide range of actors – international organizations, states, and non-state actors – that are incentivized to act individually on the basis of scientific or technical information produced by an epistemic institution in a way that will result in coordination without the need for legal rules. From a policy standpoint, this suggests that epistemic institutions engaged in the development and transfer of commercially viable technologies designed to address a particular environmental problem should be independent of the legal institutions that create rules governing the same problem. For example, institutions working on technology transfer to deal with climate change problems should be independent of institutions like the UNFCCC in

[39] Ibid. (noting that the question of whether autonomy for scientific bodies is compatible with responsiveness to political processes is 'a complex one, and calls for a somewhat different kind of analysis than we can offer here').

[40] M. Gilligan, 'The Transactions Costs Approach to Understanding International Institutions', in H.V. Milner & A. Moravcsik (eds.), *Power, Interdependence and Non-State Actors in World Politics: Research Frontiers* (Princeton University Press, 2012), pp. 50–65.

[41] D. Bodansky, 'A Tale of Two Architectures: The Once and Future U.N. Climate Change Regime' (2011) 43(3) *Arizona State Law Journal*, pp. 697–712.

[42] There are, of course, many possibilities in between, such as long-term contracts.

which international legal rules regarding climate change mitigation measures are being negotiated. Likewise, epistemic institutions producing information about health and safety measures – as the WHO does in relation to the FCTC, or the CAC does in relation to food safety standards incorporated by reference into the WTO's SPS Agreement – should be independent because states can and do act individually upon the information produced by these bodies.

By contrast, epistemic institutions should be integrated into and subordinated to legal institutions in situations in which the provision of information does not change states' incentives to regulate unilaterally, and therefore some collective decision is required to coordinate policies across countries. Thus, epistemic institutions aimed at the production of information about common pool resources such as fisheries should be relatively more integrated into legal institutions.

These prescriptions run counter to much of the literature on the optimal design of epistemic institutions and to the actual design of a number of international environmental institutions. On the one hand, scholarship on the relationship between science and international environmental institutions tends to emphasize the need for autonomy for scientific research.[43] On the other hand, institutions working on technology transfer are often subordinated in some way to legal institutions when, in fact, greater independence of such institutions would be optimal. In the remainder of this section, I explain why epistemic institutions should be subordinated to legal institutions only in situations in which collective decision-making is necessary to coordinate policies.

3.1. *Scientific Information as an Asset*

Scientifically usable information can be analogized to an asset for which legal institutions must transact. States, negotiators, international legal institutions, and judges are information consumers. The International Convention for the Conservation of Atlantic Tunas (ICCAT),[44] for example, is empowered to, '*on the basis of scientific evidence*, make recommendations designed to maintain the populations of tuna and tuna-like fishes' in the area covered by the Convention.[45] ICCAT's own rules thus require it to obtain scientific information before making decisions as to what constitutes a sustainable catch. Similar examples of international agreements requiring that legal decisions be made on the basis of scientific information are rampant and include the UNFCCC, the Montreal Protocol, the POPs Convention, the PIC Convention, and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (CPB).[46]

Scientific and technical bodies, for their part, are information producers. ICCAT has a Standing Committee on Research and Statistics. The Committee's mission is 'to ensure that the Commission has available at all times the most complete and current

[43] See, e.g., Underdal, n. 10 above.

[44] Rio de Janeiro (Brazil), 14 May 1966, in force 21 Mar. 1969, available at: http://www.iccat.int/Documents/Commission/BasicTexts.pdf.

[45] ICCAT, Art. VIII(1)(a) (emphasis added).

[46] Montreal (Canada), 29 Jan. 2000, in force 11 Sept. 2003, available at: http://bch.cbd.int/protocol.

statistics concerning fishing activities in the Convention area as well as biological information on the stocks that are fished'.[47] Other epistemic institutions have more general information production mandates. For example, the WHO is charged with, inter alia, 'furnish[ing] appropriate technical assistance' to governments and 'stimulat[ing] and advanc[ing] work to eradicate epidemic, endemic and other diseases'.[48]

Like all assets, the value of usable scientific information to a particular consumer is determined in part by whether the characteristics of the information – including not only its substance, but also the form in which it is presented and the credibility of the process that produced it – make it suitable for the particular use the consumer has in mind.[49] For example, a study about the reproduction rates of Atlantic bluefin tuna is more useful to ICCAT, which is engaged in the management of Atlantic tuna populations, than it is to the Commission on the Conservation of Southern Bluefin Tuna, which performs the same task for related species of tuna in the South Pacific, a different ocean with different characteristics that might impact on reproduction rates. This characteristic of an asset – the extent to which it has more value to one consumer (or transaction) than other alternative consumers (or transactions) – is called *asset specificity*.[50] Asset specificity is said to be low when an asset has roughly the same value to a number of possible consumers.[51] By contrast, asset specificity is said to be high when an asset has a higher value to one consumer than to others.[52]

One of the central insights of the law and economics literature on the size of the firm is that, all else being equal, firms should integrate when asset specificity is high.[53] This prediction is based on comparing the costs of two different ways of organizing the relationship between producers and consumers. At one extreme, consumers and producers may interact in the complete absence of any institutional relationship between them – that is, transactions between them can occur at arm's length, governed by the forces of the market. This form of organization – the equivalent of fragmentation in international law – is optimal when asset specificity is low. Letting the market govern transactions for an asset saves administrative costs – including those stemming from the existence of a bureaucracy and the imposition of hierarchical controls – that arise from institutionalizing relationships.[54] At the same time, when asset specificity is

47 ICCAT Standing Committee on Research and Statistics, available at: http://www.iccat.es/en/SCRS.htm.

48 Constitution of the World Health Organization (Oct. 2006), Art. 2, available at: http://www.who.int/governance/eb/who_constitution_en.pdf.

49 The value of the information would also vary with other factors, including, e.g., how widely available similar information is.

50 Williamson, n. 7 above, at p. 78.

51 More precisely, asset specificity is low when the investments made to support a particular transaction – that is, the investments in producing the asset for which the parties are transacting – can be redeployed relatively easily to another equally valuable use: ibid., at pp. 54–5.

52 Ibid.

53 Ibid., at p. 78.

54 Ibid., at p. 91.

low, the producer has the proper incentive to produce the asset in question. If one consumer does not wish to use the asset, another consumer will.[55]

At the other extreme, producers and consumers may be integrated into a single institution in which their relationship is governed by institutional rules and hierarchies rather than by market forces.[56] Integration is the optimal form of organization when asset specificity is high, because in that situation producers and consumers may try to exploit each other.[57] Because neither can reallocate its assets to another equally valuable use, they are locked in a dependent relationship in which each may have the opportunity to distort the other's ability to achieve its objectives.[58] Most relevantly for the present study, the possibility of exploitation may mean that producers refuse to make assets with high asset specificity. They do not expect investing in such assets to be in their long-term interest. Where asset specificity is high, vertical integration – the imposition of hierarchical controls – can solve the incentive problems created by asset specificity.[59]

In the remainder of this section, I apply this insight from law and economics – that high asset specificity leads to integrated institutions while low asset specificity leads to fragmented organization – to the relationship between epistemic institutions and legal institutions. I begin by discussing the institutional environment in which usable scientific information has greater value to particular regulators and the characteristics of those situations – the importance of providing institutional mechanisms to demonstrate credibility of the scientific record to scientifically disadvantaged states, the political salience of an environmental issue, and the governance costs that can arise from integration – that counsel in favour of fragmentation versus integration. I then analyze each of these influences on asset specificity to see how it affects whether to fragment or to integrate epistemic and legal institutions.

3.2. *Asset Specificity and Usable Scientific Information*

What does it mean in the context of international environmental law for usable scientific information to have high asset specificity? Information has high asset specificity when there is only one institution (or at most a few) in a position to regulate based upon the information produced. This institution is the primary 'consumer' of the scientific information, and therefore the supply of information must be tailored to the decision-making processes of that consumer if it is to affect regulation.

---

55 Technically, the asset and the investments supporting its production can be deployed to another equally valuable use.

56 These two forms represent extremes. There are, of course, many hybrid forms of organization that combine different features of market transactions and institutionalized transactions: Williamson, n. 7 above, at pp. 131–62. The same is true of epistemic institutions, in which independence can be thought of as a continuum. A relationship's place on the continuum is a function of a number of different features of institutional arrangements, including legal control (the ability to direct a subordinate to take a particular action); personnel control (the ability to choose another entity's managers and staff); and budgetary control.

57 Ibid.

58 Ibid.

59 Ibid.

In practice, this means that the asset specificity of usable scientific information often depends on whether states face a problem when coordinating their policies. Asset specificity is high when collective action is necessary because the collective decision-making process is the primary vehicle through which regulatory coordination occurs. Asset specificity is low when collective action is not necessary because information is useful in states' individual regulatory processes without the need for coordination.

To see this, consider that states may fail to coordinate environmental policies for at least two reasons.[60] Firstly, uncertainty may mean that states are unable to identify those environmental policies that are in their interest. Secondly, even in the absence of uncertainty states may not have an incentive to unilaterally adopt environmental policies because the individual costs of such policies are outweighed by the benefits unless a large number of states agree simultaneously to coordinate their policies – a collective action problem.[61] Where states face a pure problem of scientific uncertainty, the provision of usable scientific information clarifies policies that are in states' best interest and therefore provides them with an incentive to regulate unilaterally. But where an international environmental problem presents both a problem of uncertainty and a collective action problem, resolving uncertainty alone does not change states' incentives to coordinate their policies. Instead, action by an international legal institution is often necessary to clarify focal points for cooperation and create sanctions that incentivize states to implement internationally mandated regulations.[62]

Collective action problems therefore reduce the number of relevant information consumers because states individually will not regulate even if the informational problem is solved. For usable scientific information to affect regulation, it must be tailored to the dynamics and requirements of the only process capable of incentivizing states to regulate – the collective decision-making process. This fact makes usable scientific information particularly valuable to the international legal institution. By contrast, where resolving scientific uncertainty changes states' incentives to regulate unilaterally, usable scientific information has value in a variety of different regulatory processes. It thus does not need to be tailored to the needs of a single decision-making process in order to impact on regulation.[63]

The governance of common pool resources such as fisheries illustrates the point. Knowing what constitutes a sustainable catch of Atlantic tuna does not necessarily change a state's incentives to regulate its catch of tuna. A unilateral reduction in the

---

60 See J.D. Morrow, 'Modeling the Forms of International Cooperation: Distribution versus Information' (1994) 49 *International Organization*, pp. 387–423.

61 S. Barrett, *Environment and Statecraft: The Strategy of Environmental Treaty-making* (Oxford University Press, 2003).

62 A. T. Guzman, *How International Law Works* (Oxford University Press, 2008), at p. 33.

63 This is not to deny that scientifically usable information affects decisions made by states in situations in which collective action is necessary for regulation. For example, information produced by an epistemic institution may change states' views about the desirability of regulation, spurring them to create an international legal institution. Notice, though, that even the act of creating a legal institution is a form of collective action. The specific value of usable scientific information flows from the fact that, in order to affect regulation, the information must be tailored to the rules and dynamics of a specific, collective decision-making process, even if part of that process involves institutionalizing the decision-making process at the international level.

tuna catch is costly to a state in economic terms, but may not preserve the tuna population from overfishing; it will simply leave more fish for other nations to catch. Effective environmental coordination in fisheries requires not only resolving uncertainty about what constitutes a sustainable catch, but also requires collective action through an institution such as ICCAT that can establish legal rules binding on all the affected parties. A usable scientific record as to what counts as a sustainable catch thus has much higher value to ICCAT than it does to individual nations because ICCAT has the strongest incentive to adopt legal rules based on the scientific record.

By contrast, where states have an incentive unilaterally to coordinate environmental policies once uncertainty is removed, asset specificity is low. The scientific record in these cases has similar value to a number of different regulators, including both states and international legal institutions. There are at least two situations in which individual actors will have an incentive to adopt measures unilaterally: (i) when the costs and benefits of regulation are felt primarily domestically, as with health and safety measures; and (ii) when environmental coordination can occur through the diffusion of economically viable technologies. The second category is illustrated by the case of institutions working on technology transfer, where states and non-state actors have a clear incentive to adopt commercially viable environmentally friendly technologies. In the first category, the problem may still be one of international concern because health and safety regulations affect multinational corporations (such as large tobacco or agricultural companies) or because coordinating policies across borders helps to build mutually reinforcing norms against certain kinds of environmentally harmful activity.[64] The relationship between the WHO and the FCTC illustrates the point. Articles 9 and 10 of the FTCT deal with the regulation of tobacco products and tobacco product disclosures. Rather than specify particular measures that member states should adopt, however, Articles 9 and 10 stipulate that the COP should adopt specific measures in conjunction with 'competent international bodies'. In practice, this institutional arrangement has meant that the COP looks to the WHO and its Tobacco Free Initiative to provide scientifically informed recommendations. The WHO's recommendations, however, have value beyond just the FCTC COP. Regardless of whether the COP decides to adopt the WHO recommendations, individual states have an incentive to regulate on the basis of the recommendations because they internalize most of the benefits from regulation.

The effect of resolving scientific uncertainty through the creation of a usable scientific record on the incentives to unilaterally regulate an environmental problem is thus a proxy for asset specificity. But the mere fact that usable scientific information has higher value in some contexts than in others does not tell us how integrating epistemic and legal institutions improves upon the usefulness of the scientific record when states face a collective action problem, or why fragmentation is the appropriate form of governance when they do not. Where collective decision-making is necessary for environmental coordination (i.e., where asset specificity is high), integrating

[64] See K. Linos, *Benchmarks from Abroad: Selling Voters on Health and Family Reform* (Cambridge University Press, 2013), at pp. 75–7.

epistemic and legal institutions into a single institution is desirable for two reasons. Firstly and foremostly, when collective decision-making is necessary for coordination, integration counter-intuitively best enhances the credibility of the scientific record in the eyes of states bargaining over the creation of legal rules. Secondly, if asset specificity is high in part because the problem has low political salience, integration can correct an incentive problem in which independent epistemic institutions will not produce a usable scientific record.

Integrating legal and epistemic institutions creates governance costs, however. Legal institutions may use hierarchical control to distort the kind of work epistemic institutions do and the extent to which scientific information is disseminated. These distortions represent a particularly large governance cost in situations in which states would otherwise be incentivized to coordinate environmental policies without the need for international legal rules. I discuss each of these considerations in turn below.

3.3. *Credibility*

The credibility of scientific information is often a key component of international environmental governance. Legal decision-makers are usually not scientific experts and thus have to have confidence that the scientific record upon which they are asked to decide legal and policy questions is reliable. Moreover, in international environmental governance, raw scientific and technological information is often in the hands of a small group of states that wish to persuade other states to regulate on the basis of the scientific information in their possession. In many cases, information- and technology-rich states are developed states that push for environmental rules that impede the development objectives of information- and technology-poor developing states. For example, the ultimate objective of the UNFCCC is for all states to reduce their greenhouse gas emissions, regardless of whether those states have participated in the research demonstrating the need for the reduction of greenhouse gas emissions or whether such reductions might hamper economic objectives. International legal institutions thus often ask developing states to agree to economically disadvantageous measures on the basis of a scientific record that developing states have not had a significant hand in compiling and cannot themselves directly interpret. This bilateral dependency may create concern among developing states that developed states will try to manipulate the scientific record to bring about their desired legal outcome.[65]

Where states have an incentive to unilaterally adopt environmental regulations supported by scientific evidence in the absence of international legal rules mandating coordination (i.e., when asset specificity is low), states that have not participated in the scientific assessment process can observe whether scientifically supported environmental regulations are adopted. The decentralized adoption of scientifically supported regulations provides the necessary signal about the credibility of the scientific record. States not able to directly assess the scientific record may still infer based on the actions of scientifically advantaged states that the scientific record supports regulation. Unilateral

[65] See Morrow, n. 60 above.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

regulation thus has positive spillover effects in terms of providing assurances about the credibility of the scientific process.

But where collective action is necessary to address an environmental problem (i.e., where asset specificity is high), the signal provided by decentralized regulation will not exist. This absence creates the possibility of opportunism by scientifically advantaged states, which may try to get international legal institutions to adopt rules based on research slanted to accord with their independent policy preferences. Scientifically disadvantaged states that are critical to environmental governance thus have to be reassured in some other way that the scientific record is credible. To give an illustrative example, in its early years the IWC's Scientific Committee consisted primarily of scientists from only a few governments. Most of the research on whaling was undertaken outside the IWC by whaling nations, which were not trusted to be impartial in reporting scientific research.[66] As a consequence, the IWC strengthened its internal scientific capacity by bringing independent scientists within the IWC's scientific process.[67]

Integrating epistemic institutions with legal institutions facilitates credibility by offering scientifically and technologically poor states the opportunity to monitor the work of the epistemic institution. Even if they are unable to participate fully in the scientific assessment, the chance to oversee the institution's work provides such states with assurances that the scientific record is not being distorted in order to make developing states believe that environmental regulation is in their interest when in fact it is not. Oversight provides this reassurance through a number of different mechanisms. Firstly, even if developing countries are unable to directly assess the underlying research, their diplomats and legal advisers may be able to use the processes through which the institution prepares reports to assess whether the research process is being manipulated. They may, for example, be able to see whether dissenting voices are being marginalized using procedural tactics, even if they are unable to assess whether the majority or minority view within the epistemic institution is correct. Secondly, as in the example of the IWC, oversight allows governments to monitor each other's behaviour and push to ensure that dissenting scientific views are represented. Thirdly, even if developing states never actually choose to participate, the ability to use oversight to monitor and potentially slow down the work of an epistemic institution may serve as a costly signal from scientifically sophisticated states to those less well equipped that the epistemic institution is functioning in a relatively unbiased fashion.

The evolution of the regime governing persistent organic pollutants (POPs) illustrates the importance of integration as a means of reducing concerns about the credibility of the scientific information. Because one of the main issues with POPs is their transboundary movement through natural processes such as the water cycle, individual action by states cannot solve the overall environmental problem. Initially, POPs were addressed through the negotiation of a protocol to the Convention on

66 Andresen, n. 36 above, at pp. 42–4.

67 Ibid.

Long-Range Transboundary Air Pollution (CLTRAP).[68] The CLTRAP COP was thus the relevant international legal institution. The scientific record for that protocol was prepared internally by a CLTRAP Task Force and Working Group.[69] Most of the scientific work within CLTRAP's Task Force was performed by a handful of developed Western states.[70] But because the scientific assessment was carried out within CLTRAP, Eastern European countries – which were at the time in the process of transition to market economies and thus lacked the resources to conduct scientific assessments independently – were provided access (including financial support) to the scientific process. The ability to participate and oversee the scientific assessment process eased concerns about the credibility of the scientific record – a problem that Western states such as the US identified during negotiations[71] – and Eastern European states ultimately ended up accepting the results of the Western-driven scientific process.[72]

3.4. *Low Political Salience*

A related reason to prefer integrating epistemic and legal institutions is that some environmental problems have low political salience, which leads to low demand (or a small number of consumers) for research related to the problem. In such situations, independent epistemic institutions are unlikely to produce usable scientific information to address the issue. Free-standing epistemic institutions have mandates and funding constraints that may prevent them from reallocating scarce resources to answer scientific questions raised by environmental problems that have only narrow constituencies eager to address them. Epistemic institutions may lack the resources, both financial and human, to study new problems even when those problems fall within their broader mandate. In such situations, fragmenting epistemic institutions and legal institutions has clear costs. Low salience problems are unlikely to be addressed by states individually. Moreover, epistemic institutions lack the ability or the incentive to produce the scientific information for international legal institutions charged with addressing low salience environmental problems.

Integrating legal and epistemic institutions can solve this incentive problem in two ways. Firstly, it allows the legal institution to limit the discretion of the epistemic institution to choose its own projects, thus ensuring that the information produced by the epistemic institution is directly responsive to the legal institution's needs. Secondly, by giving the legal institution budgetary control over the epistemic institution, the legal institution can ensure that there is an adequate level of funding available to produce the required scientific information, and that the funding is not diverted to study problems not immediately germane to the legal institution's mandate.

---

68 Geneva (Switzerland), 13 Nov. 1979, in force 16 Mar. 1983, available at: http://www.unece.org/env/lrtap.

69 Selin & Eckley, n. 14 above, at p. 25.

70 Ibid.

71 Ibid.

72 Ibid.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

By way of example, consider the Paris Convention for the Prevention of Marine Pollution from Land-based Sources (Paris Convention)[73] and its successor, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention).[74] Concern about land-based marine pollution originated in part with a 1960s report from the International Council for the Exploration of the Sea (ICES), the oldest intergovernmental body dealing with marine science issues.[75] Despite the importance of ICES in developing the scientific record that spurred the creation of these two environmental regimes, the Commission that governed the Paris Convention decided in its early years that it could not obtain usable scientific information from ICES. Firstly, ICES had traditionally spent most of its resources on fisheries issues. Because of its economic importance, the law and science of sustainable fishing has long occupied a prime place in international environmental law.[76] ICES's decision to focus on fisheries makes sense given the demand for fisheries-related scientific knowledge from states and other international organizations. Secondly, the Paris Commission (created by the Paris Convention) found ICES reports to be too technical and not sufficiently related to the practical decisions they faced.[77] For this reason the Paris Commission looked instead to an internal scientific and expert apparatus made up of a Technical Working Group and a Joint Monitoring Group.[78] Thus, in the early years of efforts to control land-based marine pollution, greater integration between epistemic and legal institutions was made necessary by the fact that the requisite scientific knowledge was too specialized to be acquired from free-standing epistemic institutions such as ICES.

Where demand is high for policy-relevant science, however, the production of usable scientific information is best governed by decentralized, market-like forces. The WTO, for example, incorporates through the SPS Agreement international health and safety standards developed by free-standing institutions.[79] The WTO cannot tell international standard-setting bodies such as the CAC the issues on which it should work. Instead, the WTO relies on the demand from the global community at large to provide epistemic institutions with the incentive to produce scientifically based standards that the WTO can deploy in assessing health and safety standards.

---

73 Paris (France), 4 June 1974, in force 6 May 1978, available at: http://sedac.ciesin.columbia.edu/entri/texts/marine.pollution.land.based.sources.1974.html.

74 Paris (France), 22 Sept. 1992, in force 25 Mar. 1998, available at: http://www.ospar.org. The OSPAR Convention unified the Paris Convention and the Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft (Oslo Convention), Oslo (Norway), 15 Feb. 1972, in force 7 Apr. 1974 (available at: http://sedac.ciesin.org/entri/texts/maine.pollution.dumping/ships/aircraft.1972.html) into a single convention governing efforts to control marine pollution in the North-East Atlantic.

75 J. Wettestad, 'Dealing with Land-Based Marine Pollution in the North-East Atlantic: The Paris Convention and the North Sea Conferences', in Skodvin, Underdal & Wettestad , n. 10 above, at pp. 70–94.

76 Ibid., at p. 82.

77 Ibid.

78 Ibid., at p. 72.

79 SPS Agreement, n. 22 above, Art. 3.1.

Significantly, the political salience of a problem can change over time, which in turn suggests that the optimal degree of integration or fragmentation may change over time as well. Moreover, states appear to be willing to adjust institutional relationships over time rather than simply accepting existing institutional arrangements. With regard to this latter point, one might argue that a new legal institution does not require its own epistemic institution if there is already a well-respected independent epistemic institution working in the area. The UNFCCC, for example, did not need to create a new epistemic institution because the IPCC already existed.

But while path dependence of this kind surely plays some role in the initial relationship between epistemic and legal institutions, states appear willing to design and calibrate that relationship in response to changed circumstances or the perception that a pre-existing epistemic institution does not meet the needs of the legal institution. As the political salience of a problem rises, for example, free-standing epistemic institutions may be more suitable than hierarchically subordinate ones. They become more willing to invest in studying a highly salient issue and outsourcing the epistemic function reduces the governance costs that come with a hierarchical relationship. To return to the OSPAR Convention, when land-based marine pollution became a more important issue, ICES made a commitment to 'giving higher priority to marine pollution issues, and to the greater accessibility of its work', which in turn made it possible for the OSPAR Commission to rely on ICES to a much greater extent than in the early years of the Paris Convention.[80] The development of the POPs regime is a similar story. Initially, POPs were addressed through the negotiation of a protocol to the CLTRAP. The scientific record for that protocol was prepared internally by a CLTRAP Task Force and Working Group.[81] This integrated structure was in part a result of the fact that the UN Environment Programme (UNEP) and other free-standing epistemic institutions initially declined to work on POPs.[82] But as regulation of POPs gained political traction in the 1990s, UNEP began independent scientific assessments that played a role in the negotiation of the POPs Convention.[83] In short, institutional arrangements were adjusted to meet changed conditions.

3.5. *Governance Costs*

While integration may increase the credibility and availability of usable scientific information when asset specificity is high, integration also creates a set of governance costs that push towards fragmentation when asset specificity is low. Most notably, legal institutions may be captured or held hostage by particular interests as a result of distributive concerns about regulating a particular environmental problem. This fact leads to two kinds of governance cost. Firstly, greater control by the legal institution may affect the quality of the scientific record put together by an epistemic institution.

80 Wettestad, n. 75 above, at p. 91.
81 Selin & Eckley, n. 14 above, at p. 25.
82 Ibid., at p. 32.
83 Ibid.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

Science is the process of exploration, in a sense, and giving control of scientific exploration to non-experts can warp the results. Thus, while hierarchy may address credibility concerns by giving scientifically impoverished states the opportunity to oversee the epistemic institution, if the legal institution itself is captured or gridlocked the scientific record may be distorted nonetheless. Secondly, legal institutions may limit (or fail to encourage) the dissemination of scientific and technical information when doing so would either encourage environmental regulation to which they are adverse or negatively impact on the economic interests of their controlling members, such as by undermining intellectual property protection.

Legal institutions may use control over epistemic institutions to manipulate scientific information in order to muster support for particular kinds of policy result. The use of scientific information within the IWC to set whaling quotas illustrates the point. The IWC established at its first meeting in 1949 a standing Scientific and Technical Committee, which has largely survived as the central body for science within the IWC.[84] By the late 1960s and 1970s, there was widespread dissatisfaction with the way in which the IWC obtained and processed its scientific information, most notably the concern that 'most research was still done by some of the whaling nations, not always trusted to be impartial'.[85] This problem was compounded by the fact that in its early decades the scientists on the IWC's Scientific Committee were overwhelmingly from whaling nations, further raising questions about whether the Scientific Committee's work was independent of the member states that effectively controlled the IWC decision-making apparatus.[86]

Relatedly, the politicization of science through the integration of epistemic and legal institutions can create governance costs in the legal process as well.[87] Where there are deep distributional tensions among states within a legal institution and state preferences for environmental regulation do not depend on the state of scientific knowledge – for example, the preferences of oil-exporting states about climate change measures – epistemic institutions can become an alternative vehicle for contesting legal outcomes. Where legal and epistemic institutions are institutionally linked, conflict over epistemic issues may make bargaining over legal rules more difficult than it would be in the absence of the epistemic institution. This negative effect of institutional linkages occurs in part because the legal institution has signalled that it will obtain its scientific information from a particular source and the legal institution is often required to consider the information before making a decision. Hampering the epistemic institution's work thus becomes a strategy to slow down the pace of a legal institution's work. Although not directly a use of hierarchical controls, efforts to discredit the work of the IPCC based on internal emails among researchers from East Anglia in the United

84 Andresen, n. 36 above.

85 Ibid., at p. 45.

86 Ibid., at pp. 42–5. Later years have seen an increase in the internal capacity of the Scientific Committee as well as the inclusion of scientists from non-whaling nations, resulting in improved credibility for the work of the Scientific Committee: ibid., at p. 51.

87 T. Meyer, 'Global Public Goods, Governance Risk, and International Energy' (2012) 22(3) *Duke Journal of Comparative & International Law*, pp. 319–48, at 330.

Kingdom (UK), and therefore to slow down the pace of negotiations within the UNFCCC, provide an example of this strategy.[88]

Hierarchical control of epistemic institutions can also negatively impact on the dissemination of usable scientific knowledge. Legal institutions may not wish for certain kinds of scientific information to be disseminated, either because the information works against the policy interests of states that control the institution by making environmental regulation seem more or less desirable, or because it works against the states' economic interests. Technology transfer mechanisms are perhaps the clearest example in which distributive tensions can lead legal institutions to slow the pace of dissemination of usable scientific information by epistemic institutions. Legal institutions such as the UNFCCC COP create a framework for the transfer of commercially viable technology to developing states. Commercially viable and environmentally friendly technologies can be adopted unilaterally if they are made available to developing states and business interests operating in those states. Not surprisingly, however, developed states often wish to maintain tight control of technology transfer mechanisms in order to ensure that the monopoly profits available through the enforcement of rigid intellectual property rights are not dissipated. The result is that policy responses that are predicated on expensive technological solutions, rather than legal rules crafted by legal institutions, can be disadvantaged by the integration of legal and epistemic institutions. Notably, while this governance cost argues for fragmentation as a normative matter in order to increase the spread of technology, as a descriptive matter it may in some instances lead to integration. Precisely because developed states do not wish to yield control of the terms of technological dissemination, they may be reluctant to agree to fragmented governance.

The widespread dissatisfaction with the pace of technology diffusion and information sharing in a wide range of areas – including research into biodiversity under the Convention on Biological Diversity (CBD),[89] green technologies under the UNFCCC, and pharmaceutical research under the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)[90] – attests to how developed nations use legal institutions to ensure that the diffusion of commercially useful research occurs on commercial terms. Divorcing institutions such as the UNFCCC's Technology Mechanism from the UNFCCC itself thus offers a way to enhance the viability of technology transfer as a decentralized method of environmental governance. In short, fragmentation can facilitate decentralized, bottom-up environmental governance in the technology transfer area precisely because asset specificity is low and the demand for usable technical information from governments and non-state actors is high.

---

88 See Ayal, Hareuveny & Perez, n. 3 above, at p. 57. The UNFCCC does not institutionally control the IPCC. Thus, while the strategy of hampering epistemic work is the same, the mechanism used in the IPCC example was not legal control of the epistemic institution.

89 Rio de Janeiro (Brazil), 5 June 1992, in force 29 Dec. 1993, available at: http://www.cbd.int/convention/text.

90 Marrakesh (Morocco), 15 Apr. 1994, in force 1 Jan. 1995, available at: http://www.wto.org/english/docs_e/legal_e/27-trips.pdf.

4. RENEWABLE ENERGY COOPERATION

In this section, I illustrate the theory of epistemic institutions through an analysis of the creation of the International Renewable Energy Agency (IRENA). The diffusion of renewable energy technology is one of the most important environmental issues today. Recent projections have put the growth in carbon emissions at 130% and the growth in oil consumption at 70% by 2050.[91] Keeping global warming to the 2-degree Celsius increase that scientists tell us is needed to avert disaster while supplying the energy to power economic growth thus requires a global shift in the way we produce energy.

The future of renewable energy is, however, hampered by uncertainty about the economic feasibility of different forms of renewable energy, and also in some instances by safety risks. For example, IRENA member countries have indicated the need for better and objective cost data on different forms of renewable energy technology (including biomass fuels, wind, hydropower, solar power, and solar photovoltaics) in order to allow them to adopt targeted policies to encourage the spread of renewable energy.[92] Where nuclear power is concerned, safety risks in the wake of the recent disaster in Fukushima (Japan) have led both Germany and Japan to forego nuclear energy.[93]

Part of the need for this information relates to its availability. Where scientific and technical information is not widely available, if it even exists, uncertainty may needlessly prevail. Scientific research into renewable energy exhibits the kind of distributional problem that can lead to concerns about the credibility of the scientific record. Eighty per cent of clean energy innovation comes from just six countries – the US, Japan, Germany, Korea, France, and the UK.[94] Seventy-five per cent of exported innovations in clean energy are between developed countries, and the lion's share of technology export to developing countries goes to just three – China, India, and Brazil.[95] Clean energy technology thus requires translation and redistribution in order to be policy-usable around the globe. Deploying clean energy technology globally is imperative to addressing climate change as well as energy poverty issues. The projected emissions from non-OECD countries account for the majority of long-term greenhouse gas emissions. With cheaper labour and conversion costs, these countries are able to meet their increasing energy demands through the installation of renewable energy, provided that renewable energy technology and investment are available at an affordable

91 E. Burleson, 'Energy Policy, Intellectual Property and Technology Transfer to Address Climate Change' (2009) 18(1) *Transnational Law & Contemporary Problems*, pp. 69–94, at p. 70.

92 See IRENA Working Paper, 'Renewable Energy Technologies: Cost Analysis Series', Vol. 1, June 2012, Preface, available at: http://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-BIOMASS.pdf.

93 T. Inajima, 'Japan Draws Curtain on Nuclear Energy Following Germany', *Bloomberg*, 14 Sept. 2012, available at: http://www.bloomberg.com/news/2012-09-14/japan-draws-curtain-on-nuclear-energy-following-germany.html.

94 UNEP, EPO and ICTSD, 'Patents and Clean Energy: Bridging the Gap between Evidence and Policy', 2010, at p. 58, available at: http://www.unep.ch/etb/events/UNEP%20EPO%20ICTSD%20Event%2030%20Sept%202010%20Brussels/Study%20Patents%20and%20clean%20energy_15.9.10.pdf.

95 Ibid.

cost. Indeed, the OECD reports that renewable energy comprises a larger portion of the energy mix of non-OECD countries as compared with OECD countries.[96] Brazil, for example, obtains 46% of its energy from renewable sources, while Indonesia gets 34% and India gets 26%.[97]

IRENA was created to reduce uncertainty about renewable energy by developing and disseminating both relevant technical and policy information. The information produced by IRENA has low asset specificity. While it can be used by legal institutions such as the UNFCCC or the OECD to formulate collective policies, the information is also valuable to national regulators who have an incentive to unilaterally adopt renewable energy policies and to businesses that might make use of technologies disseminated by IRENA. Moreover, the development and dissemination of renewable energy technologies have distributive consequences that can increase governance costs where legal and epistemic institutions are integrated, as evidenced by the slow pace of technology transfer through the UNFCCC's various technology transfer mechanisms. The timeliness and importance of renewable energy issues, as well as the recent creation of IRENA in an area – climate change and energy policy – in which the international institutional architecture is in flux, make IRENA a good vehicle for exploring whether states do, in fact, consider issues of vertical integration and fragmentation when establishing epistemic institutions.

In what follows, I first discuss the basics of IRENA's work programme and how it seeks to use networks to disseminate usable knowledge about renewable energy technologies to a wide range of information consumers. I then turn to looking at how IRENA's creation illustrates the theory of epistemic cooperation set out above.

4.1. *IRENA*

IRENA was created in 2009 with the chief objective of 'promot[ing] the widespread and increased adoption and the sustainable use of all forms of renewable energy'.[98] The Agency's Statute charges it with fulfilling this mission by, among other things, analyzing member states' laws and policies regarding renewable energy and technology transfer; coordinating with other intergovernmental and non-governmental agencies; facilitating investment in renewable energy and technology transfer; and, most importantly for present purposes, encouraging research into renewable energy, its effects, and how it can be effectively deployed.[99] IRENA differs from a number of renewable energy initiatives born in the last 15 years in that it is a stand-alone intergovernmental organization.[100]

---

96 OECD, *Factbook 2011–2012: Economic, Environmental and Social Statistics*, available at: http://www.oecd.org/publications/factbook.

97 Ibid.

98 Statute of the International Renewable Energy Agency (IRENA Statute), Art. II, Bonn (Germany), 26 Jan. 2009, available at: http://www.irena.org/documents/uploadDocuments/Statute/IRENA_FC_Statute_signed_in_Bonn_26_01_2009_incl_declaration_on_further_authentic_versions.pdf.

99 Ibid., Art. IV.

100 Other renewable energy initiatives are either nestled within larger organizations, such as the IEA's renewable energy programmes, or are non-governmental organizations, such as the Renewable Energy & Energy Efficiency Partnership (REEEP).

Although an intergovernmental body, IRENA lacks the authority to impose legal obligations on its members; it is not designed as a body aimed at facilitating the negotiation of legal obligations, and does not seem inclined (at least yet) to venture into the realm of soft law instruments.[101]

IRENA's work programme to date has consisted of three initiatives: (i) Knowledge Management and Technology Cooperation (KMTC), (ii) Policy Advisory Services and Capacity Building (PACB), and (iii) the Innovation and Technology Centre (IITC). The KMTC and PACB programmes focus on providing governments with an analysis of their soft structures and recommendations on how to create a legal and regulatory environment conducive to attracting investment in renewable energy infrastructure. These programmes accomplish this task through individualized assessments of governments' renewable energy policies,[102] as well as through the compilation of a database (built in conjunction with the International Energy Agency (IEA)) of global renewable energy policies.[103]

The final component of IRENA's programme, and the one of most interest here, is the Innovation and Technology Centre (IITC). The IITC emphasizes most directly the availability of and research into technology itself. Not surprisingly, renewable energy technology is subject to intellectual property protection. Renewable energy patents are difficult to search for. While the European Patent Office (EPO) has a classification for patents with renewable energy applications, the classification is so broad as not to be terribly useful.[104] The IITC aims to tackle these high search costs by creating a single searchable database of renewable energy patents that integrates information from the EPO and the roughly 200,000 renewable energy patents known to the World Intellectual Property Organization (WIPO).[105] The IITC also hopes to put together use data on particular renewable energy patents, with the idea that use data will provide policy-makers and investors with an idea as to which patents perform well commercially.[106] This use data will thus be a cost-saving tool in identifying practically useful renewable energy technologies. Moreover, it could be a springboard for identifying groups of renewable energy patents that function well together within particular types of project. The IITC's pilot project in this area involves compiling information on renewable energy patents useful in desalinization plants, which are energy-intensive and are largely found in the developing world.[107] More concretely, the IITC programme

---

101 IRENA Statute, Arts. I and IV ('The Agency shall analyse, monitor and, without obligations on Members' policies, systematize current renewable energy practices').

102 See, e.g., IRENA, 'Renewable Readiness Assessment for Mozambique', 2012, available at: http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=35&CatID=109&SubcatID=164.

103 IEA/IRENA Global Renewable Energy Policies and Measures Database, available at: http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=35&CatID=110&SubcatID=158&RefID=158&SubID=170&MenuType=Q

104 Interview with M. Isaka, International Renewable Energy Agency (Mar. 2012) (on file with author).

105 IRENA, 'Proposed Work Programme and Budget for 2012', 30 Jan. 2012, at p. 38 (IRENA 2012 Work Programme), available at: http://www.irena.org/documents/uploadDocuments/2assembly2012%2F2012WPB_A_2_1.pdf.

106 Isaka, n. 104 above.

107 Ibid.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

is in the process of developing draft reports on the cost-effectiveness of renewable energy,[108] while also examining the feasibility of discrete technology transfers that IRENA might facilitate, such as biofuel technology transfer from Brazil to Africa.[109]

IRENA in this sense acts as a node for a network of national policy-makers and international legal institutions. IRENA does very little, if any, basic scientific or technological research itself. Instead, IRENA organizes, translates, and disseminates information about renewable energy technology in a form useful to a wide range of decision-makers.

4.2. *Institutional Architecture*

IRENA's ability to execute its mission is contingent to a large extent on its institutional architecture. From the time IRENA was first conceptualized, there has been a question as to whether IRENA should be a stand-alone institution, as it ultimately was established to be, or nested within some larger institution. Candidates for umbrella institutions included the UN (possibly under the UNFCCC) and the IEA.[110] The IEA, in particular, seemed a natural destination for the new agency. Germany spearheaded IRENA's creation, with the backing of Denmark and Spain.[111] All three nations are founding members of the IEA. Moreover, the IEA has been involved with renewables for close to three decades.[112] The UNFCCC also has a great interest in facilitating renewable energy technology transfer as part of its mission to reduce the emissions of greenhouse gases. The UNFCCC has for some years had an Expert Working Group on Technology Transfer. In 2010, the parties to the UNFCCC increased the emphasis on technology transfer, creating a Technology Mechanism that consists of an Executive Committee and a Climate Technology Centre and Network. Why, given the existence of these well-established institutions and their interest in technology transfer, did IRENA's sponsors nonetheless insist on establishing a free-standing organization?

The answer turns on a comparison of the costs resulting from IRENA's independence and the governance costs that would flow from integrating IRENA into a larger legal institution. The nature of the information IRENA produces means that the costs associated with IRENA's independence are quite low. Information about renewable energy technology – such as databases of patents with renewable energy applications, renewable energy policies adopted in different countries, renewable energy resources, and reports aimed at disseminating information about the economic viability of renewable energy technologies and the legal and policy environments that

108 International Institute for Sustainable Development, 'Summary of the IRENA Workshop on Renewables – Competitiveness and Innovation', 6 Oct. 2011, available at: http://www.iisd.ca/ymb/irena/iitco/html/ymbvol187num5e.html.

109 See IRENA 2012 Work Programme, n. 105 above, at p. 37.

110 'The Case for an International Renewable Energy Agency', German Government White Paper, 10–11 Apr. 2008 (The Case for IRENA), available at: http://www.wcre.de/en/images/stories/The_case_for_IRENA.pdf.

111 T. van de Graaf, 'How IRENA is Reshaping the Global Energy Architecture' (2012) *European Energy Review*, available at: http://www.europeanenergyreview.eu/site/pagina.php?id=3615.

112 Ibid.

promote investment in renewables – has value to a wide variety of actors. Moreover, collective action in the form of legal rules is not necessary to drive the spread of renewable energy technology or the adoption by governments of policies to encourage the use of renewable energy (although international legal rules might be an additional way to facilitate diffusion). High demand from different information consumers preserves the incentives for IRENA to invest in developing high quality usable scientific information. Nations can adopt renewable energy policies and businesses can invest in commercially viable forms of energy production without collective action at the international level. The credibility of IRENA's information can thus ultimately be field tested. Developing nations wary of epistemic institutions do not need to be able to directly observe the process by which usable scientific information is assembled before deciding in a collective setting whether to adopt legal rules. Instead, they can observe whether the information proves valuable when adopted by others. Indeed, part of IRENA's programme is to publicize exactly this kind of use information with regard to renewable energy patents and renewable energy policies.

While the costs arising from independence are relatively low, the governance costs associated with integrating IRENA into a larger legal institution are potentially quite high. The phasing in of renewable energy technologies and whether the diffusion of the necessary technology occurs on commercial terms are fraught with distributive tension. From the standpoint of developed countries, technology transfer on non-commercial terms under the auspices of the UNFCCC is redistributive. They have therefore opposed technology transfer. Indeed, fights over intellectual property rights within the UNFCCC led to the demise of the Expert Group on Technology Transfer and the creation of the Technology Mechanism (which notably dropped the 'transfer' aspect of 'technology transfers' from its name). Putting IRENA out from under the UNFCCC limits the risk of distributive fights in the UNFCCC to block action in IRENA or, relatedly, to use disagreements about technology transfer policies to block broader action on a range of other climate change initiatives. In short, separating IRENA greatly reduces governance costs by narrowing IRENA's mandate in a way that reduces institutional gridlock and animates governance within IRENA itself. Liberating epistemic cooperation from legal cooperation allows epistemic cooperation to occur outside the shadow of diplomatic wrangling about highly contested legal rules and the economic consequences of their adoption. IRENA thus shows every possibility of being considerably more successful than the epistemic institutions, such as the Technology Mechanism, that are subordinated to the UNFCCC and its political process.

Not coincidentally, these same considerations were included in a white paper circulated by the German government when it was rallying support for IRENA's creation. In arguing for an independent IRENA, the German government expressed concern that nesting IRENA in the IEA would be unwise because it would limit the ability of IRENA to disseminate information outside the OECD countries that are IEA members and that are already technology rich.[113] Moreover, the German government went on to argue that existing 'political structures often put renewable energy at

[113] The Case for IRENA, n. 110 above, at p. 9.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

a disadvantage compared to other energy sources'.[114] This statement reflected the German government's belief, shared by observers, that the IEA (and by extension its parent organization, the OECD) were in the pocket of the oil and nuclear industries and would thus be likely to subvert IRENA were it under their institutional control.[115] For similar reasons, the German government rejected the idea of putting IRENA within the UN, the German government not so delicately noting that:

> States that are skeptical about the rapid expansion of renewable energy would not support [putting IRENA within the UN], and the rule of consensus within the UN would therefore make it impossible.[116]

An independent IRENA was thus envisioned as a way to reduce the governance costs of providing a diverse set of decision-makers with access to information about renewable energy technologies. The German government expressed concern that subordinating IRENA to an institution such as the UN or the IEA would entail significant governance costs in the form of diversion of resources by the legal institution away from IRENA's epistemic mission. Alternatively, the German government feared that the distributive considerations at play in the dissemination of renewable energy technologies would result in blocking the epistemic institution's mission. Both of these governance costs could be eliminated by establishing a free-standing institution.

5. CONCLUSION

Many modern international regulatory problems require scientific information. Scientific information can support the emergence of consensus in bargaining. It can provide an ostensibly neutral basis for evaluating allegedly protectionist measures in trade and investment tribunals, and through diffusion can support economic development and the adoption of best practices by countries. At the same time, the production of scientific information for use in law and policy-making raises co-operative considerations for states. Much recent scholarship examines how scientific networks and institutions can be integrated into policy-making to facilitate the 'co-production' of scientific information that is useful to solve particular regulatory problems. This scholarship generally overlooks the institutional question of whether and under what conditions states should employ hierarchical relations between epistemic and legal institutions. Where usable scientific information is concerned, asset specificity – the extent to which information has value to multiple different regulators – drives the decision as to whether legal and epistemic institutions should be integrated. Hierarchy is appropriate when the information has especially high value to one legal institution, resulting in either underinvestment in the production of usable scientific information or credibility concerns in situations if collective action is required. In these

114 Ibid., at p. 7.

115 See Van de Graaf, n. 111 above, at p. 2.

116 The Case for IRENA, n. 110 above, at p. 10.

https://doi.org/10.1017/S2047102513000010 Published online by Cambridge University Press

cases, the asset specificity of knowledge pushes legal and epistemic institutions towards integration. Hierarchy introduces governance costs as well, however, and in the presence of high governance costs fragmented governance may be optimal.

More generally, much of the literature on fragmentation in international law treats fragmentation as a monolithic phenomenon in which international institutions frequently intrude into each other's policy space. Considering the relationship between epistemic and legal institutions offers an opportunity to distinguish among different kinds of fragmentation, and therefore to generate more granular analysis. International legal institutions can be fragmented vertically as well as horizontally along multiple points in the legal process – rule-making, monitoring, dispute resolution, and enforcement. Thinking through why states vertically fragment institutions and when such fragmentation might be desirable offers new insight into how international law works and its ability to discipline state behaviour to solve some of the 21st century's most intractable international problems.